DOCTOR OF PHILOSOPHY

The search for alternative factors to chronological age when examining fitness-to-drive in older drivers
Establishing the relevance of an accessible test OMEDA PLUS

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The search for alternative factors to chronological age when examining fitness-to-drive in older drivers: Establishing the relevance of an accessible test OMEDA PLUS

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Ethical approval certificates

Certificate of Ethical Approval

Applicant:

Lara Carballo

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Older drivers in a changing traffic environment

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

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Please note that the additional certificates of ethical approval and related full ethics documents can be found in Appendix A.

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***The afternoon of human life must also have a significance of its own and cannot be merely a pitiful appendage to life's morning*.**

Carl Jung

Abstract

Driver Licence renewal in the UK is currently reliant on age-based measurement. However, at a time when the older populations are expanding globally, there is potentially an element of implicit ageism present in the government's unchanged policy. Whilst age-related changes may certainly be seen to affect driving, with statistics showing that road junctions provide a particularly complex scenario for the older driver, these changes do not occur at a uniform rate. The markers of ageing are plentiful, and do not advance evenly either within a single individual, or within the older section of the population.

Driving has been reported as being important for independence and wellbeing, and replacing the concept of age with that of functional ability with regards to fitness-to-drive measurements may well provide the opportunity for older drivers, an arbitrarily defined group, to make the choice to retain their driving status safely for longer.

Computer-based driving assessment tool, OMEDA PLUS was built to augment the Object Estimation under Divided Attention test (OMEDA) (Read 2001), to provide an accessible tool capable of measuring fitness-to-drive across age groups by accessing the higher order cognitive function of judgement. The test provides an opportunity to test fitness-to-drive across ages by examining the ability to execute an important component of driving safely, time-to-contact (TTC).

The aims of this research were divided between testing the augmented version OMEDA PLUS to ensure that it was fit for purpose, and also to examine perceived relevance and likelihood of use of the test. In addition, the research sought to explore alternative factors to chronological age that might emerge as effective variables when measuring fitness-to-drive in older adults in the hope of encouraging the debate around questioning age-based policy. Now portable, OMEDA PLUS is easily manipulated by the end user and is able to reach a greater volume of people within the comfort of their communities.

The research employed mixed design methodologies across four studies. Performance on the new version OMEDA PLUS was compared to results generated by the original version, OMEDA, and by the Useful Field of View test (Ball and Owsley 1993), particularly subtest 2 (UFOV2), in order to establish its robustness and relevance to measuring fitness-to-drive. Interviews took place in order to establish the usability, relevance and likelihood of use for the tool. Analyses included in the main, Spearman's correlations, one-way ANOVA, and Thematic and Interpretative Phenomenological analysis.

Results showed that age continues to be an important indicator for fitness-to-drive across tests which are designed to be sensitive to age, but that on occasion age might be acting in conjunction with other factors. No alternative factor was found to emerge, but hopefully further research would enable more isolation of variables to occur. In terms of the tool itself, it was found to work well providing consistent results, and it benefitted from its new portability. Discussions with participants highlighted a perceived relevance for the existence of OMEDA PLUS, with a willingness to engage with it pending certain ethical and verification assurances.

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Abbreviations

ABT	Age-based testing
CD	Collision detection
DHQ	Driving Habits Questionnaire
DVLA	Driver and Vehicle Licensing Agency
DWP	Department for Work and Pensions
IADL	Instrumental Activity of Daily Living
IPA	Interpretative Phenomenological Analysis
NHS	National Health Service
OADR	Old Age Dependency Ratio
OMEDA	Object estimation under Divided Attention test
ODS	Older driver status
ONS	Office for National Statistics
PHE	Public Health England
RDAC	Regional Driving Assessment Centre
SA	Situational awareness
TTC	Time-to-contact
UFOV	Useful field of view test
UFOV2	Useful field of view test – subtest 2
UK	United Kingdom
WHO	World Health Organization

1. Introduction Chapter

1.1. Chapter Summary

This chapter serves to introduce the research that is planned in order to examine the potential for aspects other than chronological age that might have an effect on measurements of fitness-to-drive in older adults. It will show the augmentation of OMEDA in the form of OMEDA PLUS which increases the accessibility of the tool, and provides a portable test that is easy to be carried out by researchers, and ultimately by end users within the medical and driving assessment professions, and by members of the public. Finally it will outline the plan for gathering opinion regarding OMEDA PLUS by talking with older adults who have either ceased driving or who are beginning to display signs of self-regulation.

This chapter will provide an outline for the thesis overall, and will highlight the overarching questions that direct this research.

1.2. Introduction

The importance of driving may be seen to fluctuate as life events change, with an increased need developing around childbirth, and changes to working life (McCarthy et al., 2021). Dependence can also alter depending upon the alternative modes of transport available. However, driving is seen as a flexible (Musselwhite 2017), safe and often preferred mode of transport by older adults (Ball and Rebok 1994, Musselwhite 2017). However, scrutiny at the age of 70 occurs where drivers are required to renew driving licences via a Driver and Vehicle Licensing Agency (DVLA) tick box form. This is expected despite the requirement from the DVLA to report any changes to health which might affect driving at any age. This becomes important to consider when we acknowledge the fact that we are undergoing a time of population increase which includes a prevalence of adults over 65 years of whom an increasing percentage is continuing to drive. Indeed, the biggest increase in holders of driving licences over the last 40 years has appeared amongst older drivers (Evans et al. 2018). This ageing population is seen to be reflected in the development of the World Health Organization's (WHO) Age Friendly Cities which place an emphasis on the importance of both transport and social inclusion for older citizens (WHO 2007).

In addition, where the car exists as the favoured mode of transport, it is also often a necessity. The retirement age is slowly – yet continuously - increasing which leads to an ageing workforce (Centre for Ageing Better 2020a). It then becomes necessary to ensure that the means of transport required to facilitate lengthened working lives continues to exist (Government Office for Science 2016). This research considers the option for individuals to retain the choice of driving as they age. It also considers the increasing working age in light of the current digital divide (Hill, Betts, and Gardner 2015; Reisdorf and Rhinesmith 2020), whilst also taking into account the person's identity, independence and wellbeing that is supported by the freedom to drive and own a car (Al-Hassani and Alotaibi 2014; Hawley 2016).

Developments within car design are available which provide an opportunity to benefit drivers who may have developed physical problems as a result of either age - or accident. Lane departure warning systems and park assist cameras help to add to the angles of peripheral vision that might have decreased over time (Ball et al. 1988; Clay et al. 2005; Wolfe et al. 2017; Kotseruba and Tsotsos 2021), while cruise control can to be used to ensure that speed limits are maintained (Young and Bunce 2011). These developments extend the support offered by adaptions within cars, such as transfer plates (Motability Operations Limited 2020) aiding access to cars and steering aids that may counteract changes in physical ability that may be seen to occur naturally through ageing, or unexpectedly, through illness or accident.

This research seeks to question the need for the driving licence renewal to be based on age as opposed to an ability to drive; and aims to provide evidence to support the potential choice for older people to maintain, and possibly extend their driving lifetime by removing the hitherto reliance upon chronological age to determine fitness-to-drive. It intends to examine other variables that might emerge as a fairer and less restrictive method of evaluating safe driving in older adults.

The definition of the older driver appears to differ across academic literature and often ranges from 55 years (Chihuri et al. 2016; Ragland, Satariano, and MacLeod 2005; Sims et al. 2000) to 65 years (Wood et al. 2013; Klavora and Heslegrave 2002) to 70 years and above (Cicchino, J B and McCartt 2015; Staplin et al. 2013). The DVLA does not define the older driver, but instead places an emphasis on the age of 70 years as being the time at which the first driving licence renewal should occur. The Office for National Statistics (ONS) refers to the older age category as beginning at 65 years, although their recent release regarding population change questions this and suggests that, based on remaining life expectancy, older age within the United Kingdom (UK) may arguably now be seen to begin at the age of 70 years (ONS 2019). Whilst based on the skills required for driving, the "older person" and the "older driver" may not be interchangeable terms. As such, older people who may be experiencing the naturally occurring declines that age entails, may retain the skills, and may obtain required adaptions that lead to safe and continued driving access. , range of ages and potential compensatory actions, highlight a sense of limited objectivity when approaching policy from the basis of chronological age.

The nature of this research necessitates the acknowledgement of the varied definitions of "older". When referring to academic literature, it must recognise the broad range of ages from 55 years and above; when carrying out studies that partially replicate elements of previous research it will reflect the ages within. In addition, whilst examining the effects of the ageing population in general, this research will also acknowledge the information provided within the reports of the ONS which currently refer to the older person as being 65 years and over (ONS 2019).

By approaching the question of fitness-to-drive from a functional viewpoint, this research provides the opportunity to examine age as one of a group of factors that might be seen to affect driving, encouraging the apparent emphasis within policy to consider a shift away from that which might be seen to place age-based restrictions on adults. Instead, it explores other potential determining factors such as driving exposure, experience and confidence in order to provide balanced data from which to create a just policy that does not feed into a sense of implicit ageism (Levy and Banaji 2002) borne out of the unconscious acceptance of a stagnant and unchanged policy.

This current research acknowledges the fact that physical and cognitive changes occur with the increase of age, and that these changes for example in neck mobility, peripheral vision and the time taken to react may lead to incidents or accidents (Mishori 2020). It also accepts that a high proportion of incidents that occur amongst those perceived to be older drivers happen within the complex environment of the road junction (Ball and Rebok 1994; Hakamies-Blomqvist and Henriksson 1999; Davidse 2006). However, this research firstly argues that these age-related changes do not occur in a uniform manner across all individuals, and secondly seeks to determine whether factors other than chronological age might emerge as being significant when measuring fitness-to-drive.

The inquisitiveness of this introduction perhaps surpasses the remit and time availability for this single PhD. With this in mind, the focus will be placed upon the development of OMEDA PLUS together with the opinions towards it based on driving experience and crash experience of those referred to as older drivers. Their thoughts and discussions will act as a measure of importance and relevance for developing and promoting the use of a tool such as OMEDA PLUS which serves to provide a method by which individuals in private, or with trusted professionals, friends or family members, might take steps towards examining their level of safe driving, and as a result begin their own personal conversation regarding self-regulation and/or eventual cessation of driving.

1.3. Key tests

In order to understand the rationale for, and process of, the research, it is important to introduce the main tests being used throughout the research. Namely the OMEDA, OMEDA PLUS and the Useful Field of View test (Ball and Owsley 1993).

This research will employ mixed techniques comprising qualitative and quantitative methods. The examination of the functions required for driving will be carried out using the Object Estimation under Divided Attention test (OMEDA) (Read 2001), and the newer version, OMEDA PLUS (prototype). Qualitative methods will seek to collate opinions from members of the public of different ages via interview and survey. Importantly, the final study will explore the relevance, and likelihood of use, of a test such as OMEDA PLUS amongst the demographic of older drivers whose retained driving status it is designed to promote.

A tool such as this would also provide bodies such as the DVLA, general practitioners and the regional driving assessment centres (RDACs) (RDAC 2021) with an opportunity to measure peoples' ability to drive safely regardless of their ages.

OMEDA PLUS measures a specific skill required for driving; that of the ability to judge correctly the time-to-contact of an oncoming vehicle. This refers to the ability to avoid crashes by correctly estimating the time at which either a single vehicle travelling at a constant speed will reach a stationary vehicle at a junction; or the point at which two separate vehicles driving towards each other might collide at a junction if neither party was to alter their speed or come safely to a halt. As such, the concept of time-to-contact (TTC) will be central to the research.

This performance of TTC will be examined across varied ages, and across differing levels of experience as measured by driving exposure and number of years driving. Through interview and survey data the concept of the "older driver" will also be explored by asking participants to provide their views towards a definition.

1.3.1. OMEDA

Originally devised and used by Read (2001) to establish a recordable difference in driving safety between younger and older adults; and between older adults with and without signs of dementia. OMEDA was used to examine the differences in errors made by each of these groups in the judgement of TTC. OMEDA (Read 2001) no longer existed in physical form, and so it had to be re-created using details gathered from the original PhD thesis. The way in which it worked will be described below within the description of the augmented reconstruction OMEDA PLUS.

1.3.2. OMEDA PLUS

OMEDA PLUS, previously OMEDA, is a computer-based 2-dimensional test that represents the setting of the junction that has been proven to be the scenario in which the majority of accidents are experienced by older drivers (Paire-Ficout et al. 2016; Clarke et al. 2010). It comprises two subtests. The first subtest of OMEDA PLUS, measures the errors made in peoples' ability to judge the time at which an object will reach a certain point on the screen – Time-to-Contact (TTC). The second measures the errors made in judging when the two objects on the screen will collide – Collision Detection (CD). In each case, the participant is asked to depress a foot pedal at the precise time at which the event occurs.

In each case, the stimuli are presented in a manner which serves to increase the complexity of the environment. Firstly, the object's destination at the centre of the screen is sometimes obscured by a yellow circle which can vary in size between 0.53 mm to 66.2 mm (2 to 250 pixels on a 15.6 inch screen). This is further compounded by the addition of distractors in the form of geometric shapes that simultaneously appear in the centre, and around the edges of the screen. These distractors present the participant with a secondary task that asks them to acknowledge a match between the central shape and at least one of those around the edge. Where a match exists, they are asked to press a hand button upon its detection.

Figure 1.2: OMEDA PLUS CD subtest

To watch a video detailing the way in which OMEDA PLUS works, please press the "Ctrl" button and Click on the following link to access the recording:https://youtu.be/r9j-kq07nM0.

This is a copy of the video provided in Study 4 and it runs for 5”24, but the working example of OMEDA PLUS (referred to as OMEDA in the video) begins at 2”47.

1.3.3. Useful Field of View test (UFOV)

In order to begin to validate the OMEDA PLUS test, two main steps need to be taken. Firstly, the re-created version is to be tested with a similar set of variables to those used in the original OMEDA test (Read 2001) in order to establish whether or not it works as intended. Secondly, results and patterns will be compared with those gained by using an additional test, the Useful Field of View test (UFOV) which is an established predictor of safe driving. However, whilst the UFOV test concentrates on visual attention and distractions, OMEDA PLUS looks beyond this by measuring errors in the higher level cognitive domain of judgement.

The UFOV test (Ball and Owsley 1993) is a computer-based model that is currently distributed by Posit Science (2018; 2021) and has been used extensively within safe driving research since its emergence in 1993. It was created to investigate vision difficulties experienced by older adults which were found to affect their ability to carry out daily living activities such as driving. The concept of the Useful Field of View referred to the data that could be gathered from a situation from a single gaze whilst keeping eyes and head forward and static, and it was found to be an effective predictor of crash risk (Posit Science 2021b). The test, which has been referenced in more than 3000 articles since it was first developed in 1993 (Wolfe et al. 2017), examines the useful field of view of participants, and provides a predicted risk measurement based on results gained by undertaking the three subtests which comprise the following:

Subtest 1: Test of central vision and processing speed. This subtest presents an image of either a car or a van which is followed by a masking screen. The participant is then asked to recall which vehicle was seen. The accuracy of the responses is then measured.

Subtest 2: Test for divided attention. The test continues to ask the participant to recall the vehicle that was presented in the centre but adds complexity to the task by also asking them to note the position on the screen at which a second vehicle simultaneously appeared.

Subtest 3: The final subtest increases this level of complexity yet again by asking the participant to carry out required tasks for the previous subtests, but this time, presents the stimuli within an environment which is cluttered by the addition of triangles.

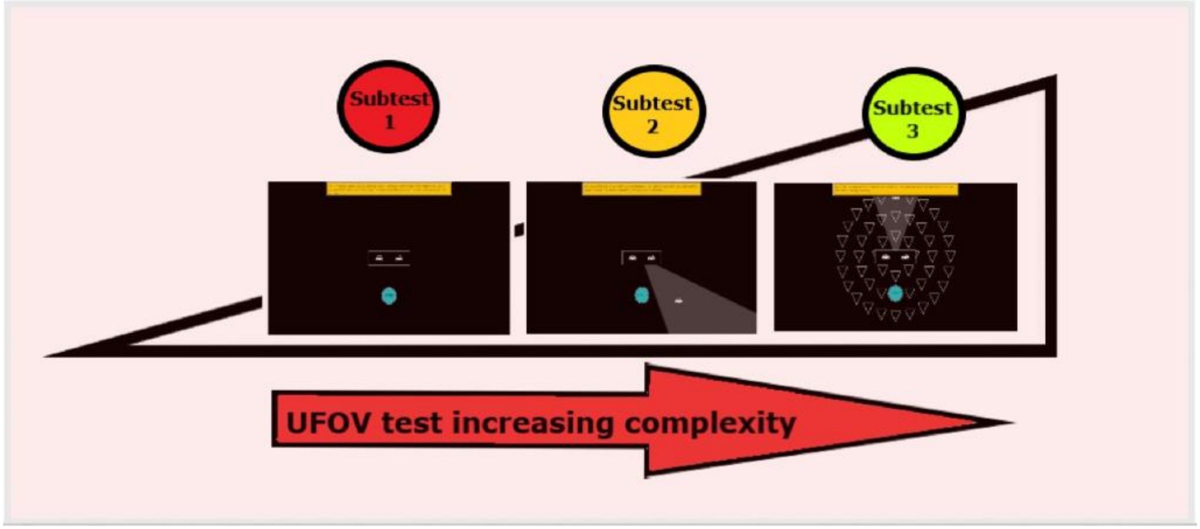

Figure 1.3: Increasing complexity of subtests within UFOV test - adapted from images taken from BrainHQ (Posit Science 2019)

The test takes approximately 15 minutes to complete, and largely works on the premise that the ability to attend to events around us changes as we age – especially as the environment becomes more complex. The conditions presented increase in complexity as it progresses through the subtests. In each of the studies within the research for this thesis, participants will undertake all three subtests.

1.4. Aims and objectives

This research seeks to defend the hypothesis that "Factors other than chronological age are at least as important when measuring fitness-to-drive", and aspires to introduce an accessible diagnostic test capable of guiding individual drivers to assess their own personal fitness-to-drive – either self-administered, or to be provided by health professionals or at established assessment centres. This is designed to become a catalyst in the increase of peoples' willingness to discuss changes that occur with age; and to support individuals to approach self-regulation and potentially cessation in as supported, and independent a manner as is possible if and when this becomes necessary. This research also seeks to provide bodies such as the DVLA, RDAC and general practitioners with a portable, accessible, risk-aversive and parsimonious tool with which to test safe driving ability.

1.4.1. AIMS

- Develop a prototype of a portable version of a tool capable of measuring errors in judgement of time-to-contact of oncoming objects. This portability will increase the flexibility of its use as a tool which will extend its use allowing it to be able to be taken to the homes and workplaces of potential users and thus enabling individuals to engage with it regardless of their level of mobility.

    - Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.

- Address the justification for retaining a UK licence renewal age of 70 which appears to be based on chronological age as opposed to an ability to carry out tasks related to safe driving.

    - Through examining licence renewal age, begin to address the concept of potential implicit ageism held within the retention of a long-term and unaltered policy despite a changing population and driving environment.

    - Gather opinion regarding the relevance, and likelihood of use of the proposed tool, OMEDA PLUS.

1.4.2. OBJECTIVES

- **Develop a prototype of a portable, and therefore more inclusively designed, version of a tool capable of measuring errors in judgement of time to contact of oncoming objects.**

This requires the examination of the theoretical design of OMEDA as laid out by NL Read (2001) in order to extract information required for a reconstruction that replicates usage and baseline results. In addition to the experimental testing of OMEDA PLUS, interviews will also be carried out at this point in order to examine the usability of the hardware, and software.

In order to ensure that this tool works accurately, OMEDA PLUS needs to be tested, with results being compared against those of the original studies reported (Read 2001). This will be carried out in Study 2. Testing will be supported by a comparison to the second subtest of the Useful Field of View test (UFOV2) (Ball and Owsley 1993), which also assesses accurate reactions to, and recall of, objects under divided attention. In addition, the overall crash risk measurement provided by UFOV will serve to provide extra triangulation between accident history / likelihood and TTC awareness measured in OMEDA PLUS. This comparison between theoretical OMEDA, OMEDA PLUS and UFOV will be continued in Study 3.

The software will need to be tested in different settings, using a laptop to establish its usability and portability. The desktop version will need to be able to be re-configured so that it can be transported on a laptop. This will enable further testing of the tool's reliability and will also serve to create a list of issues that will need to be considered for future testing.

- **Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.**

This will require the examination of results based on variables other than chronological age. In this case, elements that might be seen to be linked with driving exposure and experience level will be interrogated. Variables will include:

- Years driving licence has been held
- Driving exposure (miles per year, days per week)
- No of accidents / incidents (near misses)

Driving Habits Questionnaires (DHQ) will accompany the OMEDA PLUS test in order to gather the above details.

- **Address the justification for retaining a UK licence renewal age of 70 which appears to be based on chronological age as opposed to an ability to carry out tasks related to safe driving.**

Current UK license renewal policy requires individuals to update their licence for the first time at the age of 70 years (DVLA 2015). This research questions the apparent reliance on age in the creation of this legislation, and will examine other potential factors that might also be seen to have an effect upon measurements of fitness-to-drive.

A look at the value that individuals place upon driving, and the health and emotional effects of driving cessation, will be carried out. An online survey will be devised to ascertain levels of importance of driving, and considerations that people might have in light of impending cessation; in addition to examining the reasons that may lead to ending their driving careers.

This research examines the arguments put forward by the Older Driver Task Force (Parkes 2016) suggesting the increase of the licence renewal age from 70 years to 75 years, and it will examine results from OMEDA PLUS in order to ascertain a level of either agreement or opposition to this assertion.

- **Through examining licence renewal age, begin to address the concept of potential implicit ageism held within the retention of a long-term and unaltered policy despite a changing population and driving environment.**

This research concentrates on putting forward the need for an ageism-free approach to be used when creating policy that concerns older adults. This is considered in light of the changing population patterns which show the increase of individuals over 65 years within the UK, acknowledgement of the importance of driving that is reported, the acceptance that individuals do not experience the ageing process and any declines in a uniform manner, the fact that adaptions exist to support some of these changes; and lastly, a look at the change of the driving environment – especially within the car - brought about by technological advances.

- **Gather opinion regarding the relevance and likelihood of use of the proposed tool, OMEDA PLUS.**

The ability to improve the original OMEDA to include a level of portability and accessibility will provide a much-needed test of safe driving that supports people who may be on the cusp of considering changing their driving habits to face that decision in an informed manner.

The interviews planned in Study 4 will seek to discuss the perceived relevance and likelihood of use of OMEDA PLUS by individuals who may be approaching these decisions.

1.5. Research questions

The research questions are introduced below:

1.5.1. Driving and licence renewal

I. Can we measure fitness-to-drive in functional rather than chronological terms?

1.5.2. OMEDA and OMEDA PLUS

I. Does OMEDA PLUS show the same sensitivity to age, and to accident likelihood?
II. Does OMEDA PLUS show similar results to established fitness-to-drive measures – specifically the Useful Field of View (UFOV) test?
III. Can OMEDA's results show links to variables such as driving exposure, time the licence has been held, and self-reported accident history?
IV. Can time-to-contact be used to examine factors linked to the ability to drive safely when regarding fitness-to-drive?

1.5.3. Perceived relevance and likelihood of use of OMEDA PLUS

I. When on the cusp of driving self-regulation/cessation, is there a perceived relevance for the potential application of OMEDA PLUS?
II. How likely would this group be to engage with the test?
III. To what degree would this group trust the measured results and their usage?

1.6. Original contributions

The research seeks to provide the following original contributions to knowledge:

I. The reconstruction of a tool that had ceased to exist in physical form.

II. Improvement of this tool to increase accessibility by making it:

- portable
- able to be configured for different computers
- able to be emailed to users
- able to be easily transported by researchers / end users from one location to another
- easily programmable by users

III. Examination of perceived relevance and likelihood of use of OMEDA PLUS.

IV. Information for policy regarding UK licence renewal and the links to age and other factors.

1.7. A Note about Covid-19

The backdrop to the research also includes the global Coronavirus epidemic. This in itself has been seen to have an effect on the aforementioned digital divide in that there has been an increased need to remain connected through technology (Xie et al. 2020). The necessity to use technology in order to receive updated emergency information (Mikal, Wurtz & Grande 2021), to keep in touch with others, or for example to manage finances has led to an increased use of online functions by people who had not previously made use of such services. This has included a section of older people who had formerly represented part of this digital divide (Centre for Ageing Better 2020b). This increase was noticeable in Study 4 where people interviewed often expressed their recently formed familiarity with online platforms such as Skype or Microsoft Teams.

1.8. A note about Language: Crash / Accident / Incident

The pragmatic approach was extended to the use of language within the research. Specifically regarding words used when referring to crashes. Whilst crash is the preferred term within the current research, there was a decision made to use the less emotive word “accident” when discussing this topic with individuals. From an ethical point of view, the consideration was more around receiving information about incidents that had been experienced and less about potentially transporting them back to the event. This tempered use of language removed any element of blame and aimed to minimise any heightened emotion upon recall.

In order also to examine crashes and near misses in a combined way, the umbrella term chosen was “Incident”. The word “incident” is also used to refer to crashes where there was no physical harm caused to the participant involved, and where there was no need for the emergency services to attend.

2. Literature Review Chapter

The Introduction chapter discussed the rationale for the research while this chapter begins to examine the concept of the ageing population and the increase of older drivers within the UK. It begins with details of the original search strategy with the key search terms. From there, it highlights the physical, visual and cognitive changes that occur with ageing while describing the ways in which these decrements might be counterbalanced. Also discussed are the types of accidents which occur, specifically amongst the older demographic of drivers leading to the proposal of a test which might serve to highlight factors other than age which might also lead to these events. It concludes with a referral back to the points of **Error! Reference source not found.**provided by the research as mentioned in the previous chapter.

2.1. Search Strategy

The start of the research, and the greenness of the researcher, led to a more ad hoc search strategy with much of the literature searching being based on links between older drivers and Human Factors and Health Psychology knowledge. As specific questions became more advanced, searches began to take on a less organic shape. Using a mixture of sources provided by EBSCOhost, it was possible to search for topics that linked the human with the driving process. Where articles were difficult to locate, sources such as Google Scholar, and Researchgate were invaluable.

The earlier, and more organic, searches are included in the list below. The later and more detailed search strategy and key terms used can be seen in **Table 2.2**.

Table 2.3: Search terms used at start of research

Driving Cessation
Driving Cessation AND Health
Useful Field of View test AND Ball AND Owsley
Experience AND Driving AND crash or Accident
Tau AND Lee
Health Parity AND NHS
Interpretative Phenomenological Analysis

This improved somewhat leading to the first stage of an evolving literature review. , The searches were still broad but **Table 2.2** shows the number of articles retained for each search during the first iteration of the literature review. SCOPUS was seen to offer alternative articles to the EBSCOhost searches and was used throughout future literature searches.

Table 2.4: Early literature search strategy

Scopus Limiters: Peer reviewed journals / 2009-2018 / Adults		EBSCOhost – PsycINFO, CINAHL, PsycARTICLES, MEDLINE Limiters: 1982-2018 / Peer reviewed journals / Ages 40 and older	
Search terms	**Number retained**	**Number retained**	**Duplicates removed**
Visual Test AND Driving OR Driver	**24**	**25** (out of 379)	
Driving AND Dynamic OR Driver	**13** (out of 16)	**38** (out of 115)	
UFOV or Useful Field of View	**106** (out of 253)	**76**	**59**
Older drivers AND intersection AND crash OR Accident AND peripheral vision	-	**59** (out of 148)	
Static AND dynamic visual test AND driving	-	**12**	
Peripheral vision AND visual field AND driving	-	**19** (out of 56)	
Visual scan AND driving	-	**13** (out of 27)	
Gap acceptance AND driving AND intersection	-	**13** (out of 18)	
Hazard perception AND driving AND older	-	**29** (out of 37)	
Driving cessation AND age AND vision	-	**7** (out of 11)	
Organic – Searches taken from article suggestions / Researchgate suggestions / Mendeley suggestions	**24**		

The main body of searches occurred between 2017 and 2020. With an updated search being carried out in 2021 at the time of completing the original body of research. This has been further updated in 2022 in order to address issues requiring further information and consideration.

Table 2.3: List of search terms and sources used

	Searches	Sources	Total articles found	Total articles retained	Referenced in Thesis
2017-2020	Time-To-collision Visual Test and Driving or Driver Driving AND dynamic AND vision Older drivers AND intersection AND crash OR Accident AND peripheral vision Static and dynamic visual test AND driving Peripheral vision AND visual field AND driving Gap acceptance AND driving AND intersection Hazard perception AND driving AND older Driving cessation AND age AND vision UFOV or Useful Field of View Peripheral vision AND age Visual Test AND Driving OR Driver Driving AND Dynamic OR Driver UFOV or Useful Field of View Visual scan AND driving Focus group methodology AND older adults or elderly or seniors or geriatrics AND driving Situation* awareness AND driving Peripheral vision AND visual field AND driving Driving accident older Implicit ageism White-coat syndrome	Ebscohost Scopus IngentaConnect ProQuest Journals@Ovid Taylor & Francis ScienceDirect PubMed Academic Search complete Sage/Jisc SpringerLink Wiley	2979	1853	195
updated and added to 2020-2021	Implicit ageism White-coat syndrome	Other sources Recommended Bibliographies			

2.2. Chapter summary

The Introduction chapter discussed the rationale for the research while this chapter begins to examine the concept of the ageing population and the increase of older drivers within the UK. It highlights the physical, visual and cognitive changes that occur with ageing while describing the ways in which these decrements might be counterbalanced. Also discussed are the types of accidents which occur, specifically amongst the older demographic of drivers leading to the proposal of a test which might serve to highlight factors other than age which might also lead to these events. It concludes with a referral back to the points of **Error! Reference source not found.**provided by the research as mentioned in the previous chapter.

2.3. Introduction

Road traffic accidents occur within a multifaceted context and are potentially affected by the state and layout of the road, the dimensions and design of the car, and the state of cognitive, physical and visual health of the human. Crashes have implications for the driver and those other road users around them within that shared space, but also on the Public Health system (Michon 1978; Bédard et al. 2008).

Regarding Public Health, Public Health England (PHE) highlights its priorities to be achieved by 2025 within its 2020-2025 strategy (Public Health England 2019). The fourth point within this strategy refers to promoting and supporting better mental health. In addition it aims to use "…behavioural science and digital technologies to provide the public with a range of personalised preventative interventions" (Public Health England 2019). This works alongside the remit of the National Health Service (NHS) Parity Report which is designed to decrease the gaps between physical and mental health provision within the NHS (Panday 2016). This research also aims to support the mental health – and wellbeing – by providing an augmented computer-based test, but it aims mainly to examine this from the perspective of the older driver demographic within the UK. It also follows the approach of the NHS Parity Report (Panday 2016) and as such will continue to treat references to both physical and mental under the same headings. Previous research (Read 2001) will be augmented ensuring that opinion is sought regarding the perceived level of relevance and likelihood of use for OMEDA PLUS. This arguably has a renewed importance in light of the isolating effect of the ongoing global pandemic (Hannigan et al. 2021; Fancourt, Steptoe, and Bu 2021; Webb 2021).

Focusing on driving itself highlights a highly complex activity which holds a varying importance in the individual's life. Deemed to be an Instrumental Activity of Daily Living (IADL) (Sherman 2006), driving has been seen to be an important factor in a person's identity with cessation having a negative impact on health and wellbeing (Davey 2007; Oliver 2019).

Driving Licences are largely unquestioned unless a driver develops health conditions such as cataracts, epilepsy and dementia which might affect safe driving. However, scrutiny automatically increases as the individual reaches the age of 70 in the form of a requirement to renew a driving licence via a self-reported tick box form. It is questionable as to whether this renewal should be based on age at all as it implies a level of discrimination (Box, Gandolfi, and Mitchell 2010). The changing population, and an examination of accident figures, however provides evidence to suggest that any extra scrutiny is potentially unjustified until after the age of 75 years at which point evidence of an increased risk on the road begins to become identified (Box, Gandolfi, and Mitchell 2010; Mitchell 2013; Parkes 2016).

This research argues that the necessity to report illnesses that might affect driving exists for drivers at any age. Currently no extra tests are taken, and no medical proof is required when renewing the driving licence at the age of 70. At the same time, medical practitioners and opticians have the responsibility to report individuals to the DVLA if their fitness-to-drive is in question (General medical council n.d.; College of Optometrists 2021). As such, it questions the justification for licence renewal being linked to age, and attempts to provide alternative factors linked to the actual ability to drive which might be at least as effective in measuring fitness-to-drive.

In order to explore these alternative factors, the software now referred to as OMEDA PLUS has been reconstructed and augmented with the aim of providing individuals and practitioners with a potential tool that will offer the opportunity for informed choices to be made regarding the concept of retiring from driving.

The following section examines ageing and the attempts made towards its definition. It focuses also on the potential implicit ageism indicated by the UK driving renewal policy.

2.4. The ageing population

The ONS reported the population figures in the UK to have reached 65.6 million in 2016, with a predicted increase to 74 million by 2039 (ONS 2018). The figures for the year 2006 to 2016 showed a 2.1% increase in percentage of individuals aged 65 and over. These increases have been partially attributed to the fact that the last sixty years has shown birth rates to exceed death rates. The report also refers to the increase in births after the end of the WW2 leading to an increase in 69 year olds. Improvements in health care, and informed and healthier lifestyle choices are also seen to contribute to these extended lifetimes (ONS 2018; 2019) The latest ONS figures show that there continues to be an increase in the population for those aged 65 years and over, with this group being seen to grow at the greatest rate across all age groups. Figures show an increase of 2.3 million across the decade 2009-2019 (ONS 2020).

The World Health Organization (2007), acknowledges the global increase in those aged 60 years and above. As a result of this growth within the older population, it should arguably follow that a change is required within the infrastructure that would accommodate this demographic shift (Government Office for Science 2016). This would rely on the interaction between factors that encompass gender, culture, the physical environment, economical circumstance, and access to health and social services. This reflects the support of the WHO for the concept of "Active Ageing". The determinants of ageing as proposed by the World Health Organization can be seen in the figure below (WHO 2007):

Figure 2.1: Determinants of active ageing taken from the WHO 2007 report on Age Friendly Cities

The discussion regarding Age Friendly Cities worldwide included the feedback from focus groups across the world. The outcome comprised eight main topics inclusive of:

- Transportation
- Housing
- Social participation
- Outdoor spaces and buildings
- Community support and health services
- Communication and information
- Civic participation and employment
- Respect and social inclusion

This research concentrates on Transportation, but is unable to consider this in isolation from other topics such as respect and social inclusion, and social participation. The use of transportation becomes a necessity in order to gain access to services. Without a robust method of mobility, people risk missing out on elements of social participation and employment.

The WHO report stipulates that transport should be available, affordable, reliable and frequent (WHO 2007; WHO 2015; Parkes 2016). It stresses that driving continues to remain an important method of transport, as the above requirements are not always met by public transport. The access to efficient transportation, whether independently managed or received via other services, may have a bearing upon the ability to fulfil other determinants such as social and civic participation or employment, thereby resulting in an imbalanced access to services and having a negative effect on quality of life. In addition to the above, there is also a tendency for rural areas to be made up of older populations (ONS 2020). This automatically creates implications regarding the necessity of access to transport and mobility (WHO 2015).

In terms of attempting to define the older age category, The ONS regards 18-64 year olds to be of "traditional working age" with those in groups 65 years and above, and 85 years and above being placed in the "older" age group categories when indicating comparisons. The ONS also refers to the old age dependency ration (OADR) which provides a matrix whereby the balance of older and younger sectors of the population might be compared. This refers to the number of people aged in excess of 65 years for every thousand 16-64 year olds. The resultant figure is then used to examine changes in ageing and population over time. It could be argued that this chosen delineation of ages before and after 65 may also provide one of the definitions of the "older person".

Other such defining delineations are arguably inferred by the Pensions Act 2014 (DWP 2014) which currently has retirement age set at 66 years. It intends for there to be an increase for both men and women to the age of 67 which is set to occur between 2026 and 2028. Methods of attempting to measure and define age also include examining functional and chronological age.

2.4.1. Functional versus chronological ageing

Chronological age refers to the time that an individual has spent on the earth. It enables a measurement of time to be calculated, but does not categorically provide a division between older and younger age (Anderson and Gettings 2019). Functional ageing acknowledges the changes that occur to the person as a result of getting older, but retains the concept that these changes do not occur uniformly (Anderson and Gettings 2019). In addition, age per se fails to provide a metric by which functional changes might be measured (Fisk et al. 2009). Taking a structured approach to highlight points at which functional decline begins to occur, Mitnitski et al. (2002) made use of a Frailty Index to differentiate between chronological age and a more biological measurement. Providing a formula, they were able to indicate the times at which chronological age exceeded that of the biological age shown by the Index allowing functional abilities to be compared between participants of different ages. The separate biological factors that indicate ageing do not all develop at the same rate for each individual. Markers within the brain which identify ageing may not match those within for example, the visual system (Rabbitt 2020). If these markers do not align for an individual, it follows that it would be impossible for a generalisation to be made across a broader population.

The life-course approach to retaining maximum functional capacity interestingly defines the stereotypical changes to strength and cognitive health across the lifetime whilst acknowledging the individual pathways taken by different people within a population (Kalache and Gatti 2003; Kalache and Kickbusch 1997; Eldemire-Shearer 2008). The framework shows that functional capacity grows from below the disability threshold stereotypically to the highest level. As adult life is approached, the highest level of function is maintained for a while, and then begins to decline. This decline can be seen to happen at a different rate for different individuals. As age increases into older age, this decline continues; but here the variation is at its broadest point. While some remain at a level just slightly below that which they experienced within adult life, others continue to decline to a point below that of the disability threshold. This is highlighted by the diagram below:

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Figure 2.2: Maintaining functional capacity over the life-course (Kalache and Gatti 2003)
Source: Active aging: A Policy Framework

Functional impairment may lead to a tendency for individuals to drive fewer miles, but it may also increase the likelihood of an individual to crash when they do (Antin et al. 2012). Crash rates may be related to increased functional impairment as opposed to the chronological age of these drivers (Karthaus and Falkenstein 2016; Huisingh et al. 2018; Renge et al. 2020). Concepts such as the Safe Driving Criterion (Antin et al. 2012) compared the distributions of functional ability of drivers and their non-driving counterparts across an impressive and extensive suite of physical tests. They overlapped the two distributions providing an area of functional ability. The further right within this area the more fit to drive the individual was seen to be.

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Figure 2.3: Safe Driving Criterion taken from Antin et al. 2012

This criterion importantly shows the tendency for older drivers with experience of driving to retain functional abilities linked to body movement and strength more effectively than those who have never driven. Arguably then the “older driver” may belong to a group apart from the “older person”. Physical and cognitive skills practised during the driving lifetime may actually contribute to an increased range of functions as mentioned by Kalache and Gatti (2003).

This research seeks to explore alternative factors to chronological age that might be effective in measuring fitness-to-drive in a fairer and less restrictive manner. The OMEDA PLUS test requires an examination of a particular ability to judge time-to-contact (TTC).

2.4.2. Implicit ageism

It is against legislation to discriminate against anyone directly or indirectly due to any protected characteristic. The Equality Act 2010 lists age as one such characteristic (HM Government 2010). Ageism can manifest in inaccurate portrayal in the media, within the job market or in everyday encounters (Age UK 2021). Implicit ageism exists where unconscious stereotypical ideas about individuals on account of their age exist (Levy and Banaji 2002; 2018). This research considers the possibility that policy that remains unaltered potentially as an oversight, may also be considered a form of implicit ageism. This refers to the static age of 70 that endures within UK Licence Renewal law despite the changes in driving population, and safe driving statistics.

Ageism is present in advertising, film and media (Centre for Ageing Better 2021). One such daily reminder that drivers encounter is the "elderly people crossing" sign which presents two stooped individuals walking with the aid of each other and a cane.

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Figure 2.4 Image by Clker-Free-Vector-Images from Pixabay

Much work still needs to be done on changing the stereotypes attributed to older people. The attempt to create more age-positive road signs still arguably falls short of this remit.

The image below has been taken from the age-positive collection of resources published by the Centre for Ageing Better, and it arguably does little to change the stereotype.

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Figure 2.5 https://ageingbetter.resourcespace.com/?r=8579

The images below each remind the driver of their responsibilities whilst on the road. The first reminds the driver of the safe driving speed for the road whilst the second increases the level of prompting to remind the driver that the road often becomes a shared space.

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Figure 2. 3 Image by Markus Winkler from Pixabay

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Figure 2. 4 Image by Clker-Free-Vector-Images from Pixabay

Continued exposure to normalised ageism could lead to the delay in necessary changes being made in policy and society as a whole. This is of great concern from a human rights and protected statistics point of view. Equally importantly they fail to reflect the actuality of a healthier and ageing society.

With the above in mind, this research considers its use of language to ensure a non-ageist stance, aiming to highlight a non-arrogant approach. As such, the term “retirement from driving” is generally used when discussing driving cessation with participants. This term has been adopted relatively recently by presenters at conferences, and by related groups such as the Older Drivers Forum (Older Drivers Forum 2021) and Driving Mobility (Driving Mobility n.d.). This language assumes that the older driver retains a sense of agency regarding their choice related to changing their driving status.

2.4.3. Licensing and age

Barriers to activities and services based solely on age can arguably be considered to be ageist. One way to remove this potential ageism would be to erase references to age within policies such as the licence renewal being expected at an arbitrary 70 years (Mayhew 2005). With pensionable age in England increasing, it will be become necessary to accommodate these changes to the working population. This will require changes in age-based policy, and an attempt at providing alternative measurements of fitness-to-drive would support this adjustment.

Examining figures provided by the Department for Transport (2018) that covered the year 2016, it was seen that 57 per cent of older people in the UK held full driving licences. This report considered older drivers to be aged 70 years and over. The number of older drivers holding full licences increased by 14 per cent over the 3 year period 2013-2016 which reflected the increased ageing population.

2.5. Driving and the law

The UK currently allows people to apply for a provisional driving license aged 15 years and 9 months, and to start driving a car at the age of 17 years although there are special provisions made that allow an individual to drive at 16 years if they are in receipt of the enhanced rate mobility allowance (Road Traffic Act 1988 2014). People are then allowed to continue driving unhindered until the age of 70 at which point drivers are required to undergo the Licence Renewal process. This age however appears to have been arbitrarily set as far back as 1976 (Driver & Vehicle Standards Agency 2015).

The law also requires that the rules of the road be followed. These are outlined in the Highway Code which describes up-to-date road signs, required road behaviours, and expected conduct under conditions such as accidents or roadworks (Driving Standards Agency 2019). The DVLA outlines the legal obligations of the driver (DVLA n.d. a) by specifying ages at which individuals may start to learn to drive, and by stipulating the rules for expected levels of eyesight required for driving (DVLA n.d. b). In addition the DVLA requires drivers to continue to update information regarding addresses and illnesses which might affect driving (DVLA n.d. c).

The illnesses and conditions mentioned within the guidelines include those which affect eyesight such as cataracts and macular degeneration, and those which affect cognition such as Alzheimer's disease and Bipolar disorder. It also includes physical illnesses, and conditions which might affect physical movement such as post-operative hysterectomy. Medical practitioners follow guidance regarding confidentiality which outlines their role in the process of assessing fitness-to-drive of a patient, and ensuring that the DVLA is informed in the case of any decline in health that might affect safe driving (General medical council n.d.; DVLA 2020). The college of Optometrists provides similar guidance regarding sharing of confidential information (College of Optometrists 2021).

2.5.1. Licensing

The Driver and Vehicle Licensing Agency (DVLA) requires renewal of licenses to take place at the age of 70 (DVLA 2015). It is questionable as to how relevant it might be to carry out extra age-based testing for any drivers choosing to renew their licences (Ross et al. 2011), but there is arguably also an issue regarding the advisability regarding the current method of age-based licence renewal in the United Kingdom which solely relies on carrying out a tick-box action on either an online or postal form (DVLA 2015).

The questionable reliability of this licence renewal method is further compounded by both the lack of clarity over the level of scientific evidence that forms the basis of this policy and the requirement for individuals of any age to update the DVLA of any changes to health that might affect their ability to drive regardless of age. Arguably any measurement of fitness-to-drive should become part of a scientifically-backed process that enables individuals to maintain their mobility and independence regardless of age (Bohensky et al. 2008).

An attempt to devise an efficient and all-encompassing solution to licence renewal processes presents a problem which has been attempted to be managed in a variety of manners across the globe.

An Australian-based study that was linked to the Dynamic Analyses to Optimise Ageing project (DYNOPTA) sought to study the effect of age-based testing (ABT), inclusive of visual test and medical health check, when taken at the approach to licence renewal. This tested 5206 individuals aged between 65 and 103 using a mixture of methods comprising self-reported driving status, ABT, visual acuity and the mini mental state examination (MMSE). It was found that in terms of road accidents and fatalities, results showed no difference when compared with rates in Finland where the ABT method is used and Sweden where it is not (Ross et al. 2011).

This is admittedly only one test, but it employed a reliably large sample. Self-reports, however, may sometimes be seen to be unreliable due to a desire to provide a socially acceptable response (Lajunen & Summala 2003; Wåhlberg et al 2010). In addition, the use of visual acuity tests are also occasionally called into question (Wood 2002; Antin et al 2012).

However, the clear comparison using a suite of tests when comparing ABT between Finland and Sweden shows an undeniable and trusted measurement indicating little basis for employing age-based testing.

In 1986, according to Zaidel and Hocherman (1986), Israeli licence renewal was required at the age of 65 years and then every subsequent 2 years. Renewals were carried out by post, but were supported by medical examination, an eye test and the completion of a health questionnaire in the company of a medical practitioner. None of the private vehicle licence holders were refused renewal, but were required to start wearing glasses if they didn't already do so. The tendency for individuals to be found to wear corrective lenses as required created a question over the relevance of the costs and time required for this process.

An alternative method to relying on testing at the point of renewal, lies instead in the imposition of restrictions on when and where people are allowed to drive in the aim to support the delay for the need for cessation as a result of safe driving decrement (Satariano et al. 2012). This creates a formal structure which parallels a frequent tendency in drivers to decide to self-regulate as they begin to notice decrements in their driving abilities or confidence (Ball, K et al. 1998; Molnar and Eby 2008)

The current licence renewal process within the United Kingdom necessitates the self-assessment of individuals at the age of 70 in order to retain their licences (Box, Gandolfi and Mitchell 2010) This check is then repeated every 3 years thereafter. There is no formal requirement for proof of an eye examination, with the form to be completed being presented merely as a series of tick boxes via either form D46P or D1 (Box and Mitchell 2010; UK Rules 2021). The DVLA, however, requires drivers of all ages to alert them to any changes in their health, and so the question within this research arises as to why the particular age of 70 years is the age chosen at which to add an extra level of scrutiny. The 2016 report delivered by the Older Drivers Task Force (Parkes 2016) begins to examine the science behind recommended ages for renewal, and also examines the safety of older drivers on the roads.

In light of changing demographics, this research felt that there was a need for policy around licensing to reflect the increase in numbers of older drivers. It welcomed the evidence-based research from the Older Drivers Task Force that suggested that the risk to older drivers tended to increase after the age of 80, and that it would sensibly propose an increase in licence renewal age from 70 to 75. The report suggests that any original disagreement that existed with regards to any additional testing within the licence renewal process has been seen to dissipate with the report claiming an increased support for an extra tick box to be added to the D1 form indicating the completion of a recent eye test (Parkes 2016).

IAM RoadSmart reported in their survey of older drivers "Keeping Older Drivers Safe and mobile: a survey", surveyed 2619 drivers and ex-drivers, aged 55-101, mean 69.45 years (Hawley 2016). They asked about "Attitudes to potential methods to increase safety of older drivers". Amongst their considerations were the options to re-take the driving test at the age of 70, for all drivers to pass an eyesight every 10 years, or every 5 years if aged equal to or in excess of 70, to have a medical examination once the age of 70 is reached.

There was agreement by 50% of the respondents that the licensing process should be designed in such a way that restrictions could be suggested. These restrictions may well mirror a tendency to self-regulate any way, and included restricting the use to local roads, or day time driving. Interestingly for the purpose of this current research, IAM RoadSmart asked respondents if they would use a home kit for self-"diagnosing" fitness-to-drive. 72% said that they would.

The Older Driver Task Force (Parkes 2016) suggests a licence renewal age of 75 based on evidence of research into driving behaviour. It examines the actual safety of drivers at different ages in order to support this. In terms of the ageing process, the report acknowledges the tendency for adults' physical structures to become more fragile as they get older. Because of this, they decided to examine accident figures that included minor injuries as opposed to concentrating on the statistics that have led to death and serious injury. This prevents the statistics from being skewed in favour of younger drivers due to the increased likelihood that accidents involving an older person may be more likely to lead to serious injury or death as a result of increased frailty. Where figures for minor injuries were considered, this served to provide a level baseline from which to measure and compare data.

It has also been noted that individuals also choose to retain their driving licences for non-driving related purposes such as a reliable and accepted form of identification (Ross et al. 2011).

2.5.2. The qualified driver

The Motor Vehicles (Driving Licences) Regulations 1999 (Gov.UK 1999) clarify their definition of a qualified driver in terms of minimum age, licensure and driving experience. Provision 16.2.a states that an individual in possession of a provisional licence may only drive a car if accompanied by a "qualified driver". This status is clarified in Provision 17.1.a-d in the first instance. Here a "Qualified Driver" is an individual who is either 21 or over, and who holds a relevant licence for the class of vehicle concerned. They must hold relevant driving experience. There is no upper age attached to this definition but instead the emphasis is placed on experience of being behind the wheel.

2.6. The ageing driving population

The National Travel Survey (Department for Transport 2016) estimates that there were 32.4 million driving licence holders in England in 2016. This survey also states that the biggest increase in holders of driving licences over the last 40 years has appeared amongst older drivers (Department for Transport 2016). These figures are for England alone, as opposed to the United Kingdom, as the survey has only gathered data for England since 2013 (Mitchell 2018).

The DVLA (DVLA 2016) offers figures for Great Britain as a whole and shows that the figure for holders of full licences is in 2016 was nearer to 38.6 million. People over 65 were seen to form 20.1% of this overall figure. It was not possible to compare the change in licence holders over the same time period as for the aforementioned increases in population, but it was possible to examine figures for driving licence holders for 2018 (DVLA 2018). Over this 2 year period, the percentage of licence holders over 65 increased slightly to 20.6% of the whole driving population.

In this way, it can be seen that the population of people aged 65 and over has increased; and we can also see that individuals aged over 65 are continuing to obtain full driving licences. With this in mind, we can begin to surmise that there will continue to be an increase of older drivers on the road. This necessitates the adoption of a fair fitness-to-drive measurement which is not based on age.

The National Travel Survey 2018 (DFT 2019) states that 76% of households in the UK own at least 1 car, with 35% of the total holding multiple cars. This either reflects a necessity for a car, or at the very least a desire for the car as a chosen mode of transport. Figures also state that 75% of individuals over the age of 17 were in possession of a driving licence. Within this licence holding group, 81% of males were reported to hold a driving licence as compared to 70% of females. However this figure is higher than it would have been 40 years ago. Over the 40 year period of 1974/5 to 2018, the number of driving licence holders, both male and female between the ages of 17 and 20 has slowly increased by about 8%. For men in excess of 20 years, the increase has been fairly steady rising by 12% between the two target years. For women however, this increase has been more noticeable, increasing by 41% from 29% in 1975 to 70% in 2018. Another similarly noticeable increase is for that of older drivers. Here the older driver is defined as being of the age of 70 or above. This increase exceeds the other growing areas, by an increase of 52% from 15% in 1974/5 to 67% in 2018.

In 2018, there were 32 million cars amongst the licensed vehicles. This represented 82% of the licenced vehicles indicating an increase of 1.3% from the previous year (DFT 2019).

2.6.1. Importance of driving and effects of cessation

The driving licence serves as a formal means of identification, but also as a badge of identity that represents a sense of independence, choice and mobility. Cessation of driving is an emotive topic, and its occurrence has been seen to have an effect on physical and mental health. Groups such as the Older Drivers Forum (https://olderdriversforum.com/) provide invaluable support to those considered to be older drivers to remain informed about continuing to drive safely. One such project that they support is the Project Edward (https://projectedward.org/) which strives to encourage driver safety (Every day without a road death) by providing information about safe driving.

Ackerman et al. (2008) examined the reasons for cessation in terms of cognitive and functional performance whilst also considering the effect of aspects such as health, visual health and vision, and demographic differences. The researchers used data across 3 years from the ACTIVE project (Advanced cognitive training for independent and vital elderly) and individuals were screened to ensure an absence of dementia. The project ran from 1998 to 2002 (Jobe et al. 2001) and was funded by multiple bodies. The significant determining factors for cessation were seen to be older age, poor balance, diminished functional performance and slower cognitive processing speed as measured by the UFOV test. The UFOV test was used in order to ascertain cognitive speed of processing.

Dellinger et al. (2001) worked with 1950 participants aged 55 years and over. Of these, 141 participants with a mean age of 85.5 years were found to have ended their driving career within the previous 5 years. Reasons included medical conditions 41%, and age 19.4%. It transpired that 25% of their participants ceased driving as a result of visual problems that included macular degeneration, cataracts, glaucoma and blindness. The relationship between health and self-regulation was examined by Donorfio. et al. (2008). They made the point that age in itself is not a reliable predictor of self-regulation, but that this provides a stronger positive relationship when the interaction between health and age are considered.

They also make the point that as age increases, the levels of enjoyment and confidence tend to decline with the movement accelerating after the age of 70 years. This highlights the concept that perhaps the retention of driving status may be linked to necessity.

The IAM RoadSmart (Hawley 2016) survey highlighted a desire for drivers to retain their licences for as long as possible. Those who currently drove had not considered finishing their driving career, and they also tended to not feel the need to self-regulate according to weather or road conditions. Those who currently drove valued the independence and mobility that driving offered them. They claimed that driving enabled them to retain their chosen lifestyle, and indeed their quality of life. They suggested that they would give up driving if it was recommended by a medical professional.

When questioning those who had ceased driving, the top 3 reasons for them having made the decision to stop driving included poor health, cost of running a car, and a decline in their level of confidence. In addition, those that had ceased to drive, continued to hold their driving licence for purposes such as identification.

Within the IAM RoadSmart survey (Hawley 2016), the patterns of cessation were such that the mean age of driving cessation was 61.7 years with a standard deviation of 13.66. This ranged from those who had ceased shortly after gaining their licence to others who maintained their driving status until the age of 92. Of these ex-drivers, 20.7% (45 people), claimed to have previously considered giving up driving at least once.

This report also showed that 25% of men and 30% of women allow their licences to lapse by the age of 85. However, it was also noted within the literature that some individuals choose to retain their licences if only to use it as a means of formal identification (Hawley 2016).

Driving cessation can potentially have a detrimental effect of female drivers in particular due to a tendency for them to surrender their licence appears to be higher than that of their male counterparts (Mitchell 2013). By the age of 90 years, it has been seen that of those who retained their licences upon reaching 70 years, 38% of female drivers and 25% of male drivers tended to allow their licences to lapse (Mitchell 2013).

Al-Hassani and Alotaibi (2014) recognised driving as being an activity that has an impact on the identity of an individual, and that provides a means by which an independent lifestyle can be retained. They stressed the importance of this access to mobility particularly in light of the potentially increased need to attend medical appointments with increased ageing. Their study compared ex-drivers with older current drivers, and found that cessation tended to lead to a decreased feeling of independence, and contributed to changes in identities to a point where individuals began to consider themselves to have become an encumbrance on their families.

There is a reported correlation between life satisfaction and driving and car ownership (Chihuri et al. 2016). Retiring from driving has been seen to have a diminishing effect on quality of life (Musselwhite and Shergold 2013), and has been found to play a part in the onset of depression (Fonda, Wallace & Herzog 2001; Ragland et al. 2005). Ragland, Satariano and MacLeod (2005) carried out a longitudinal study across a period of 3 years. The study invited individuals of 55 and above within the city of Sonoma, California in order to examine physical health, cognitive function and depression status and its link to driving. The first stage of the study comprised a population of 1953 participants of which 1772 were drivers, 135 were former drivers, and 46 had never driven. At the 3 year stage, the sample of 1772 drivers had declined to 1419 as a result of fall out. 3% of the drivers had now ceased drivers and become “former drivers”. Depression status was measured using the Centre for Epidemiological Studies Depression Scale which serves to measure levels of depression by presenting the individual with 20 questions around their feelings and behaviours. Figures for the depression status indicated a higher rate in former and newer drivers than in those who had retained their driving status. This pattern was retained at the 3 year point.

Satariano et al. (2012) also suggested that being less mobile, and becoming more sedentary can contribute to the development of health issues such as obesity, breast cancer and depression. They propose the development of a public health system which supports a maintained mobility through walking and driving, which serves to optimise mental, physical and social wellbeing. This would allow access to services and lifestyles to be maintained.

Waterworth and Dakin (2022) refer to different categories of travel – “Essential” for example activities such as food shopping, and “Discretionary” – travel that would lead to social interaction or that is unplanned. The researchers refer to the importance of driving for well-being, and the negative effects that cessation can place on an individual. They helpfully discuss the need for a period of supported adjustment that can be provided by nurses who cross the divide between community and policy. Whilst applauding the planned existence of age-friendly cities, they sensibly suggest that short-term strategies need to be developed while these cities are often in their relative state of infancy.

Importantly Waterworth and Dakin carry out their research in the form of a 6-month case study using semi-structured interviews with Mike (Dakin). Across the time of the study, four interviews captured the transition from driver to retired driver in a way that showed the true experiences from the co-author’s point of view.

This New Zealand study discusses the potential for nurses to be involved as information providers, and support givers during the choices and testing undergone whilst on the cusp of driving cessation. Further research is required into the UK National Health System to establish the potential for nursing support within the UK. However, the system that is in place within the UK is that of the Occupational Therapist network who support individuals to manage daily living activities, and provide information about options.

This is where OMEDA PLUS would fit. As a test that could take place either in private or with the support of a trusted individual. In this way, a user would be able to examine their own safety to drive based on their ability to judge time to contact of oncoming vehicles. It would be a tool to be used as part of a cessation conversation that ensured the retiring driver retained their agency within their decision.

2.6.2. Self-regulation

There are measures that have been put into place in order to support individuals to remain safe when a driver might be considered to present a risk on the road. Police are able to insist upon an assessment being carried out if a driver looks unsafe, and opticians are required to alert the DVLA if a driver is seen to be experiencing sight which jeopardise safe driving (Parker et al. 2003). However there is also the option for a driver to retain agency over their circumstances and consider self-regulating their driving.

Okonkwo, Crowe, Wadley and Ball (2008) studied 1543 older drivers aged 75 and over in Alabama. They used the Driving Habits Questionnaire as devised by Owsley et al. (1999) in order to establish situations under which they began to self-regulate their driving behaviour. It was found that older drivers tended to avoid driving in bad weather more readily than other situations that included night driving, high traffic volumes, unfamiliar areas and turning against traffic. It was suggested that this self-regulation might come about based on an awareness of a decline in visual attention abilities. When tested using UFOV software, it did support this in that those exhibiting lower visual attention measurements did tend to avoid situations more readily than their healthy counterparts. However, this was not always the case, and some with deficits failed to show signs of self-regulation. This group warrant further study by way of attempting to establish as to whether this was down to limited awareness or lack of desire to relinquish levels of independence.

Broberg and Willstrand (2014) found a difference between genders in attitudes towards cessation. They found that men tended to be less willing to consider the idea, seeing it as a restriction to their chosen lifestyle and activities. On the other hand, Molnar et al. (2013) found that limitations to driving did not always occur as part of a conscious decision to self-regulate, but they sometimes occurred due to the consequences of a changing lifestyle.

Mitchell in the National Transport Survey analysis (DFT 2019) approaches the concept of one self-regulatory measure of driving at night. He states that there is generally a reduction in the amount that people tend to do this as they get older. He highlights the requirement for research to be carried out specifically into driving in the dark as carried out by people from different points across the demographic spectrum. He examines the differences between men and women, and also the differences that occur as people get older.

However, there is a tendency for the number of trips made by men and women to begin to decrease as they age. For women this occurs around the age of 55, and for men it begins to decline at the age of 60. Trips continue to decrease in number in accordance with increasing age, with women of 70 tending to travel less than their male counterparts under these conditions. Mitchell (DFT 2019) makes the point that it might not simply be that older people may not be actively choosing to make less trips at night, but there may in general be less relevant activity occurring at night with the need for travel at that time becoming less.

Ball et al. (1998) examined the likelihood of drivers to avoid particular driving situations based on the existence of cognitive and visual impairment. They highlighted the fact that older drivers were seen to have more accidents per mile driven but argued that this figure was increased as a result of the inclusion of the group of individuals that had cognitive or visual impairments of some sort. Their study found that this group of drivers with impairments reported more avoidance of driving situations than their unimpaired counterparts. Those with increased visual or attentional deficits tended to avoid driving in situations that were considered more complex such as driving in the rain or at night, and driving during heavy traffic situations such as rush hour. The data also showed that those who had been found to be at fault in crash situations within the previous 5 years also tended to avoid more situations than their counterparts who had not had experienced crashes. They considered that self-regulation might be one way to enable older drivers to avoid high risk circumstances and to perhaps extend their driving lifetime. However, they felt that at the time this required further investigation.

2.7. Driving requirements

In order to be able to measure decrement of a skill, it is advantageous to understand what that skill entails. Driving is a complex activity that enlists the use of physical, cognitive and visual abilities (Groeger 2000; Sherman 2006; Karthaus and Falkenstein 2016). Many of these functions are seen to diminish with age, but do not do so in a uniform way across all members of a population (Mifsud, Attard, and Ison 2017). In addition, the action of driving, together with the environment in which it is carried out is supported by constructed representations, or schema, of previously encountered versions of the scenario (Platten et al. 2014). Because of the dynamic nature of driving, it is necessary to continually maintain a level of attention and working memory that enables the constant updating of these representations. Cognitive decrement leads to a limited awareness, and slower processing speeds which may increase the likelihood of accidents (Caserta and Abrams 2007).

Eyesight is also important for driving, with 90 per cent of all information required for driving being taken in via the eye (Transportation Research Board 1988). Measured on the Snellen scale (DVLA n.d.b), people intending to drive within Group 1 which allows for the driving of cars and light vehicles, are required to have a visual acuity of 6/12, and should be able to read a car number plate from either 20 or 20.5 metres depending on the width of the characters (DVLA n.d.b). Where the number plate was manufactured after September 2001, the letters and numbers are slightly smaller and measure 79mm high and 50mm wide, and as such the shorter distance of 20 metres is used for the test (Kotecha, Spratt, and Viswanathan 2008).

Individuals are allowed to wear their corrective lenses to carry out this check. Where issues arise that affect the sight in both eyes, or in one eye if monocular, the person is legally obliged to inform the DVLA. This relies on a person being aware of any decline, and also upon the individual willingly reporting the changes. In circumstances where this does not happen, it falls to the GP or optician to inform the DVLA of the risk to driving.

Situation Awareness (SA) has also been found to decrease with ageing. This concept of SA was originally designed to support decision-making within critical aviation environments (Endsley 2000). The concept itself is used colloquially (Vaitkunas-Kalita, Landry, and Yoo 2011), but in scientific terms, SA refers to the concept of an individual's ability to experience their surroundings in a safe manner under conditions where confusion is limited and cognitive load is managed (van Dijk, van de Merwe, and Zon 2011). Successful SA relies on being able to perceive and comprehend events that are occurring within the environment to such a level as to facilitate an informed concept of what is likely to occur next within the environment (Endsley 1995; 2000). The data received from the dynamic environment helps to support the decision-making process (Artman and Garbis 1998).

Similar to the aviation environment, driving also presents a dynamic scenario, and requires an understanding of the situation in order to make safe decisions. As the cognitive load is increased by complicating the scenario, SA declines in older groups. Kaber et al., (2012) examined the difference in performances between younger and older drivers across two simulated environments representing different levels of complexity and hazard exposure. Each group comprised 10 participants, with the younger group having ages of between 18 and 25 years, and the older group being aged 65 to 81 years. Each participant was presented with 4 scenarios which they drove twice. Complexity was varied by increasing numbers of buildings, junctions and pedestrians, and by adding to the traffic density. Dynamic and static hazards were included, with the former being represented by a multi-car incident, and the static hazard being presented as a construction zone. Questions were asked in real time by a person posing as a passenger. Overall, older drivers were found to have lower levels of SA than their younger counterparts when performing complex driving tasks. Within a more complex city-based simulation, older drivers continued to exhibit lower levels of SA as measured by real-time probes and assessment of driving performance.

Examining SA is useful in order to gain an understanding of the complexity of some of the functions that are required within the driving situation. Successful attainment of SA requires a combination of factors inclusive of visual ability, memory and the capacity to attend to information (Bolstad 2001). However, working memory has been seen to deteriorate with age (Fairfield, Mammarella, and Di Domenico 2015; Borella et al. 2007; Cornoldi et al. 2007) and complexity can lead to difficulty in efficiently perceiving situations (Cornoldi et al. 2007; Zhang et al. 2009). Older individuals have also been found to process intrusive and less relevant information hindering the management of relevant information within an environment (Cornoldi et al. 2007; Fairfield, Mammarella, and Di Domenico 2015; De Fockert and Bremner 2011).

Ageing has a reported effect on field dependence, defined as the "Reliance on the visual frame of reference for spatial orientation", this increases with age. Our ability to efficiently orientate spatially is affected by our proficiency in manipulating our frame (egocentric frame) within the environment. This requires the ability to visually fixate set points, and contend with cluttered visual scenes (Agathos et al. 2015). Agathos and colleagues hypothesised firstly that the increase in visual field dependence linked to age would show reduced egocentric dependence leading to a decreased level of visual fixation stability; and secondly that the decrease in UFOV brought about by age would lead to an increase in eye movements that would correlate to a decreased visual fixation stability and visual field dependence. This study supports two concepts. Firstly that visual changes can be seen to occur with age, but also that compensatory actions are taken in the form of increased eye movements. Older drivers have been found to scan scenes in a more disjointed manner than their younger counterparts, and have been reported to make additional glances in order to fully perceive and comprehend the scenario (Maltz and Shinar 1999).

Inattentional blindness has been defined as the failure to notice unexpected objects or events that arise when undertaking tasks which demand high levels of attention (Graham and Burke 2011; Beanland and Chan 2016; Beanland and Pammer 2010). An increased working memory arguably provides a greater attentional workspace that aids the support of processing unexpected information (Beanland and Chan 2016).

Two theories of cognitive ageing include the Attentional Capacity Model (AC) and the Inhibitory Deficit Model (ID) (Graham and Burke 2011). The first (AC) assumes that there are limited attentional resources available, and as such an additional secondary task would suffer in terms of resources required. This capacity declines with cognitive ageing, leading to the potential for an increased level of inattentional blindness existing among older people. The ID model works on examining the ability of the working memory to ignore information that is irrelevant to the task in question. There is an increased tendency to attend to irrelevant information as a person ages, and this is compounded by the tendency for the ageing person to find it harder to manage the extra workload leading to an increase of clutter.

Working memory is important for acquiring SA (Endsley 1988; Endsley et al. 1998; Endsley 2000; Orique and Despins 2018) as it stores information temporarily so that it can be retrieved to support the ability to understand scenarios, and to make decisions. It is also important for the retention of visual images (Baddeley 1992), and provides available workspace to enable the effective processing of data amongst potential distractors and plays an important role in supporting the selective attention of required information (De Fockert and Bremner 2011). It is a tripartite system comprising the central executive which controls two other systems – the visuospatial sketchpad that supports the retention of imagery, and the phonological loop which facilitates the uptake of language (Baddeley 1992). Working memory has been seen to deteriorate as age increases (Fairfield, Mammarella, and Di Domenico 2015).

Older individuals tend to exhibit difficulties when attending to visual tasks that are presented with a second simultaneous task that indicate a hindrance caused by overloaded attentional processes. When examining age-related differences in the performance of searching scenes of differing complexity with and without divided attention, McPhee et al., (2004) found that older adults performed less accurately under the main task, and were also seen to have an increased number of eye movements with longer fixation periods. The reported increase in eye movements may reflect the cognitive decline in the visuospatial sketchpad within working memory resulting in a decreased ability to retain imagery.

In addition to the potential declines mentioned above, increased age brings with it an increased likelihood of conditions such as arthritis which affects joints and movement. This is not, however confined to those of increased age. However, in one particular study when compared with a group of younger drivers, drivers aged over 65 years were seen to report increased discomfort around the hips, thighs, buttocks and knees when driving, in addition to more head and neck stiffness when carrying out parallel parking. There was no significant difference found in the use of in-vehicle controls, but it was reported that older drivers had a tendency not to press the horn immediately in emergency situations (Karali, Mansfield, and Gyi 2017).

2.8. Factors affecting driving

Although there is evidence of age-related physical and cognitive decline, there are multiple factors which affect driving that might be experienced by drivers of all ages. Fatigue (Zhang et al. 2016), alcohol (Jongen et al. 2014), medication (Alvarez & Fierro, 2008; Hetl et al. 2014), and a tendency to take risks (Ivers et al. 2009) also affect the ability to drive safely. It may therefore be argued that chronological age is an unreliable metric by which to calculate the complicated phenomenon of fitness-to-drive (Dugan 2006). In fact chronological age provides limited information about the individual, and is highly subjective in terms of who might consider themselves to populate the older person category (Dixon 2020). There are certainly physical and cognitive changes that occur as people age, but these do not manifest at a uniform rate across individuals. It is important to maintain a healthy level of functional ability to drive safely, but factors other than age affect these levels, for example medical conditions affecting the eye or body strength and comfort of movement (Dugan 2006).

The changes that occur within the eye highlight the variability of biological markers within the context of an individual (Rabbitt 2020) whilst also emphasising the alternative factors such as illness and medication that may begin to affect them. For example, changes in the shape of the cornea and thickness of the lens within the eye lead to conditions which may or may not be able to be corrected with prescription glasses. As the shape of the cornea changes, the way in which light is focused also alters which may lead to astigmatism. This potentially begins to happen in a person's forties (Cassel, Billig, and Randall 1998). As the lens begins to thicken there is an increased risk of cataracts. This tends to happen at around the age of 65 but there are other factors which might also which might increase the chance of cataracts forming. These include medications taken, family history, race and the existence of diabetes (Cassel, Billig, and Randall 1998).

Age-related Macular Degeneration, occurs as the retinal pigment epithelium begins to age, and is by definition a condition that occurs as individuals approach their sixties. However vision affecting conditions such as Diabetic Retinopathy occurs as a result of retinal blood vessels within the basement membrane beginning to thicken and lose access to oxygen. This is not age-specific, but will lead to visual decrement (Cassel, Billig, and Randall 1998).

From the point of view of body strength, illnesses such as arthritis may affect the ability to grip, and move the joints. This condition may not be limited to older individuals, and adaptions exist in order to support people choosing to drive. Similarly fitness-to-drive might be affected by dementia or depression (Dugan 2006).

Situational awareness is said to decline, and movement is reported to become less fluid. Research has linked cognitive decline to less safe driving (Aksan et al. 2017). In addition older individuals have been seen to make extra eye movements in order to compensate for diminished peripheral vision (Beurskens and Bock 2012) with common causes for decrease in field loss being ascribed to cataracts, glaucoma and retinal disorders that have a tendency to increase with age. This visual field loss particularly increases after the age of 65 years.

However just as drivers are able to adjust their driving behaviour to allow for changes in, for example, their visual field, by driving slower or avoiding crowded driving conditions (Edwards et al. 2006), adaptions are also available to increase the comfort within a car, and the technologies are available to supplement declining movement. It is important to ensure that design and technology takes into account the requirements of older drivers as the population increases. This way, individuals may well be more likely to accept and find relevance in these advances (Gish et al. 2016). These adaptions from both the point of view of the driver and the design of new technology go some way towards reflecting the importance of driving to individuals.

2.9. Accidents

Antin et al. (2012) referred to the debatable concept of the low mileage bias leading to the supposition that older drivers who drive the least amount of miles tend to be involved in the greater number crashes for that demographic. An examination of Japan-based motor vehicle crashes (MVCs) across age groups, found that the teenage and oldest groups of drivers were most likely to be at fault in MVCs. Older drivers were less likely to cause harm to other drivers, but were at greater risk of being injured themselves (Ichikawa, Nakahara, and Inada 2015).

This research refers to incidents causing slight injury as near misses, with those that require emergency services to be referred to as accidents. Mitchell (2018) in the National Travel Survey defines slight injury as "…an injury of a minor character such as a sprain (including neck whiplash injury), bruise or cut which are not judged to be severe, or slight shock requiring roadside attention."

During a study of the National Highway Traffic Safety Administration's (NHTSA) National Motor vehicle Crash Causation Survey, it was found that during the period 2005-2007, there were 620 crashes involving 647 adults aged 70 and over that required the attendance of emergency services. The critical errors made by these drivers were examined and also compared to a younger group of drivers aged between 35 and 54 years. Driver error was cited as the main reason for the crashes in 97% of these accidents in the older group. Amongst them, inadequate surveillance accounted for 33 % and gap misjudgement for 6%. These were less numerous in the younger group, accounting for 22% and 3% respectively. The inadequate surveillance type error was further split into different sections. 71% of these incidents in the older group were due to "look but failed to see" events with the equivalent in middle aged drivers being 40%. The majority of these events took place when turning left (US driving scenario with right-side driving) at junctions (66% of inadequate surveillance and 77% of gap and speed misjudgement) (Cicchino and McCartt 2015).

More recent figures (DFT 2018) reported 468 per billion miles travelled aged 71 to 75 years to have been involved in road traffic collisions. The number for those aged 66 to 70 years was 367 per billion miles travelled. The highest accident rate however existed for drivers aged 86 years and over which equated to 2167 car drivers per billion miles travelled. With an overall 48 per cent decrease in road traffic accidents occurring over the period 1990-2016, there has been an increase of 5 per cent of accidents which included at least one driver over the age of 70. The report suggests scenarios and contributory factors that increase the likelihood of an accident:

- Relatively low traffic periods
- Time of day (e.g. between 8pm and 4am during the week, and between 2 and 4am at the weekends)
- The driver failing to look properly
- The driver misjudging the speed and path of another driver
- Dazzling sun
- Slippery road (bad weather conditions)

According to STAT19 data, of the 107535 accidents reported in England for 2019, the breakdown of accident locations were as follows:

Table 2.4: Taken from STAT19 – Accident locations England, 2019

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This shows a total of 62192 accidents which occurred at junctions compared to 43947 which were definitely not at junctions. The remaining 1396 accidents occurred at unspecified locations types. These junctions represent a complex driving scenario.

(Bolstad 2001) hypothesized that SA of older adults would decrease as the complexity of the environment increased. Junctions present as complex driving situations. Indeed accidents and Junction volume have been found to be significantly correlated (Cooper 1973).

Wood (2002) made the point that older drivers have been found to be at higher risk of being involved in a crash at a junction. She suggested that age per se tended not to be the cause of such incidents but that age-related eyesight declines, for example the ability to recover from glare or the increased likelihood to develop cataracts, should also be taken into account. She examined the concept of dynamic visual acuity testing methods which she found to be a better predictor of crashes than static visual acuity.

Braitman et al., (2007) compared two groups of older drivers with ages 70 to 79 (n=78) years and 80 years (n=76) and over. Groups were evenly matched in number, and were compared to a similarly sized group of 35 to 54 year olds (n=73). It was found that the crashes where individuals failed to acknowledge the right of way rules tended to increase in line with age. The 70 to 79 year olds tended to miscalculate the speed of oncoming vehicles and so began to cross the junction at an unsafe time. The older group were often unaware of the oncoming vehicle whilst the youngest group tended to become distracted by the radio or mobile phones.

Bowers et al., (2005) assessed the visual field within an on-road setting. They found that there was no significant link between visual field and the ability to stop safely at a junction. They tentatively suggested that there might be some use for crash avoidance systems in order to support drivers to improve their management of driving across junctions.

This research uses a test that is representational of the junction environment in order to examine factors which might provide an alternative to chronological age when measuring fitness-to-drive. This test measures time-to-contact of a moving object arriving at the centre of the screen. This is indicative of the on-road scenario of a car reaching a junction.

2.10. Fitness-to-drive: Search for a new measurement tool

As discussed throughout this literature review, driving cessation can have a negative effect on physical (Satariano et al. 2012) and mental health (Fonda, Wallace & Herzog 2001). It also affects the identity of the individual (Al-Hassani and Alotaibi 2014) and has a negative impact on quality of life (Musselwhite and Shergold 2013).

Individuals often prefer to retain their licences (Hawley 2016) with driving and life satisfaction being correlated (Chihuri et al. 2016). Specific groups such as female drivers can be particularly affected due to their relatively high tendency to surrender licences when compared to men (Mitchell 2013).

With increasing numbers of older people holding driving licences (DVLA 2018) and the understanding that drivers tend to self-regulate by avoiding particular driving situations as natural changes occur (Ball et al. 1998), it could perhaps be argued that there is room for another way of thinking.

Providing a less ageist method of managing the expected, though not always actual, changes that occur in individuals as they age, perhaps more safe drivers in general might retain their licences without scrutiny on account of their age.

This reflects the evidence-based recommendations of the Older Drivers Task Force (Parkes 2016) regarding the potential increase of licence renewal age from 70 to 75 years.

With the above in mind, this research strongly suggests that elements other than age should be examined when discussing safe driving in those perceived to be older drivers. It proposes the use of a tool that will examine the ability of people to carry out specific activities of driving (by measuring errors in judging TTC). For this reason, OMEDA PLUS will be developed and tested throughout this research.

This tool aims to show that factors other than age are of importance when examining fitness-to-drive. The tool itself will be developed in such a way as to maximise portability and accessibility. The aim is to develop a tool that can either be used within assessments of safe driving ability, or within a more private decision-making setting.

The section below discusses some of the tools that currently exist with a view to justifying the development of OMEDA PLUS.

2.11. Fitness-to-drive: Testing

Antin et al., (2012) developed a conceptual model, the Safe Driving Criterion, which aimed to identify drivers who were either fit or unfit to drive. They carried out 60 different physical, psychomotor, and perceptual tests across 49 drivers and non-drivers aged between 65 and 93 years. The matrix aimed to identify individuals who might benefit from interventions which would support them to continue to drive safely. Drivers were seen to perform better in 7 out of the 8 perceptual tests with the exception of the glare contrast sensitivity test. The researchers found that the correlation between dynamic and static visual acuity was weak, indicating a limited usefulness of the Snellen test in terms of predicting fitness-to-drive.

Using logistic regression, the researchers originally condensed their model to include 5 variables which could be used to accurately predict the membership of either the driver or non-driver group. Eventually this was further decreased to just three and comprised tests of physical strength, vision and visual cognition.

This study has provided a plausible matrix based on detailed and impressive research. The Safe Driving Criterion offers valid data that supports the model by Kalache and Gatti (2003) by highlighting the differences in functional ability across different groups of people. These studies are significant for this current research due to the emphasis they place on functional ability and its variability across individuals. This in itself highlights the tenuous link that exists between driving and age per se when examining fitness-to-drive.

An alternative study also sought to create a suite of tests that might predict safe driving by examining methods that would avoid risky and expensive on-road testing (Myers et al. 2000). Testing 98 participants aged between 61 and 91 years who were recruited from the Bryn Mawr Rehad Adapted Driving Program in Pennsylvania, it was found that a 7-variable model proved effective. Multiple logistic regression comprising these 7 variables was found to return a significant result with p=.0001. Further chi–squared analyses found that the predictive ability of the 7-variable model did not significantly exceed that of the UFOV test on its own. Their effective tests included:

- Visual tracking
- Visual acuity measured using the Snellen eye chart
- Reaction time using the AAA Reaction time tester
- Pegs missed measured using the Peg and board test
- Pegs time measured using the Peg and board test
- Hooper visual organisation test
- UFOV – use of 3 subtests

This study could arguably be criticised as a result of its small sample, but the methodical manner in which it provides a suite of tested tools is of great value to this research. It highlights the need to compare the efficiency of different tests, and supports the aim of this current research to use multiple tests to triangulate the results in order to increase validity.

The aim of this research was to ascertain the usefulness and relevance of the augmented OMEDA test, OMEDA PLUS. In order to do this, the effectiveness of other tests needed to be examined. Following are the descriptions of some of the tests mentioned in the two studies above which bear some relevance for the current research. In addition, the intentions as to whether or not the tests relate to what is required for the research will also be briefly discussed here.

2.11.1. Static Visual Acuity – Snellen test

As mentioned above, The DVLA expects a minimum level of acuity of 6/12 as measured on the Snellen scale (DVLA n.d. b). This scale is presented as a chart on which rows of letters of decreasing sizes are printed. The further down the list that can be read, the better the level of acuity. A measurement of 6/12 suggests that an individual can see from a distance of 6 metres what a person with normal visual acuity can see from 12 metres away.

As mentioned above, Antin et al. (2012) found that the correlation between dynamic and static visual acuity was weak, indicating a limited usefulness of the Snellen test in terms of predicting fitness-to-drive. Interestingly, unlike the results of Antin et al. (2012), Myers et al., (2000) found the Snellen visual acuity test to have some predictability for safe driving.

2.11.2. Dynamic Visual Acuity

Landolt C rings (Long and Garvey 1988) were used to examine dynamic visual acuity in Antin et al., (2012). They asked participants to follow Landolt rings as they moved horizontally across their visual field at varying speeds. They were then asked to indicate the position of the gap in the ring which was in one of 4 positions of up, down, left or right. These rings decreased in size as the trials progressed. The measurement was taken at the point where the gaps could not be acknowledged. The sizes of gap ranged from the largest which represented 20/200 acuity to the smallest which represented 20/20 acuity (Antin et al. 2012). There is a higher level of validity to be placed on the dynamic quality of the Landolt C test than the static nature of the Snellen test. In a sense the dynamism of the Landolt C rings are replaced by elements of OMEDA PLUS, specifically the use of changing speeds of the red moving objects and the changing size of obscuring yellow occluders. Because of this overlap, and in interest of streamlining the study so that participant time investment is minimised, the Landolt C test will not be explored.

2.11.3. AAA Reaction Time Tester

Participants were presented with a box that showed a green and a red light. They were asked to move their foot from accelerator to brake pedal as promptly as possible upon the green light turning to red. This was measured by calculating the average reaction time taken over 10 separate trials (Myers et al. 2000).

The movement of foot to the brake pedal is a valuable detail regarding the current research. It retains the physical function required for driving, and is also beneficial in that it serves to cross the digital divide by making it easier to use for some individuals than a computer mouse.

Because of the similarities between the AAA reaction time test and the main task within OMEDA PLUS – the requirement to depress the brake pedal when the red object either reaches the centre of the screen or collides - this additional test of reaction time was considered to be unnecessary. As above this also supported the desire to streamline the time investment required by the participants.

2.11.4. Trail making test A and B

The trail-making test is a 2-part paper-based neuropsychological test. Part A comprises a sheet of paper with numbers on it. The participant is asked to join the numbers together rising from 1 upwards. Part B comprises a sheet with numbers and letters. The participant is asked to connect the letters and numbers as they increase for example 1 to A, 2 to B etc. (Bowers et al. 2013). In an aim to continue the movement away from pen and paper tests initiated by the original OMEDA study (Read 2001), the trail-making test has also been rendered superfluous to this research.

2.11.5. Useful Field of View Test

As described in more detail within the Introduction Chapter the **Error! Reference source not found.** (Ball & Owsley 1993) is a computer-based model that is currently distributed by Brain HQ (Posit Science 2018). It comprises 3 sub-tests that serve to measure visual attention, central vision, processing speed, divided attention and selective attention and has been used extensively since its emergence in 1993. According to Woolfe et al., (2017), The UFOV test had been referenced in more than 3000 articles since it was first developed in 1993. The overall measurement of the test is calculated by combining the score across all of the subtests. Each subtest has a score range from 0 to 30, and so the highest score with the most efficient useful field of view would be 90 (Myers et al. 2000).

Aust and Edwards (2016) explored the link between IADLs and the UFOV subtests. They found that UFOV subtests 2 (divided attention) and 3 (selective attention) had some effect on processing speed, and cognitive and visual functions. UFOV has been seen to be correlated to age-related driving ability, and has also been reported to be an effective training tool that could support older people to increase their skills (Gentzler and Smither 2012).

The UFOV test has been seen to be a reliable predictive measure of safe driving (Clay et al. 2005; Edwards, Jerri D et al. 2006) and also provides a relationship between age and visual function with no significant difference being found in participants using either the mouse or touchscreen version of the test (Edwards et al. 2006). Clay et al. (2005) examined the relationship between the UFOV test and older driver's performance. Their meta-analysis highlighted the relevance of using on-road as opposed to simulated tests by way of measuring driving performance. They found that a poor UFOV test result was directly related to a diminished driving ability within the older driver demographic. It was seen that those with 40% decline in UFOV test result were 2.2% more likely to experience a motor vehicle collision. They found that sub-test 2 was a particularly strong predictor.

The UFOV test was considered to be a strong and reliable test to use as to comparative test. In particular, the second subtest had been found to be a particularly strong predictor of driving risk.

Despite its position as a strong predictor of crash risk, and an effective test of peripheral vision and divided attention, the experience is potentially limited due to the static nature of the test. OMEDA PLUS improves upon this by providing a dynamic setting more representative of the driving environment of the junction.

However its effectiveness manages to exceed that of the current state of development for OMEDA PLUS due to its reliable algorithm that enables a tangible result to be provided to the user. Currently the result gained via the OMEDA PLUS tool is required to be provided by the researcher.

For this reason, the UFOV test has been chosen to triangulate the results of Studies 2 and 3. Further testing would enable parallels to be drawn between the 3 levels of driving ability (UFOV) and errors made in TTC (OMEDA PLUS).

2.11.6. Object Movement Estimation under Divided Attention (OMEDA)

The original OMEDA tool was originally conceived by Dr Lily Read (2001) as part of her post graduate research. The aim was to develop a tool to measure any changes in time to contact (TTC) errors in drivers as a result of increased age, and also as a result of early onset dementia.

This research favoured the use of the OMEDA test which provided an opportunity to extract a single element of driving to be examined for affecting factors amongst drivers of different ages and levels of experience. The specific unit in particular was the number of errors made in the judgement of TTC.

Because of its hitherto limited development, little literature existed about the original tool itself. However the original justification for its use is made clear (Read, 2001). The programme was created for the purpose of Dr Read's specific research but was not developed beyond this. As such when it was selected as the tool to use within the current research, there was neither a working tool nor the source code to re-create it.

This therefore necessitated the development of OMEDA PLUS – a working and usable product that would include improvement and enhancements over the original. The lack of literature about the tool led to the need for measurements and details to be extracted from Read's research (2001), and eventually from email discussions with her and the Serious Games Institute / Cue Interactive at Coventry University who were subsequently chosen as a partner to develop the tool.

This version of OMEDA, OMEDA PLUS, would harness the useful attributes of the original but that would also build on new elements such as portability and accessibility. This would serve to create a product that might be used by individuals in order to support their own decisions to decrease or cease driving. Rather than older individuals needing to necessarily undergo assessments in public, OMEDA PLUS would provide an individual decision-making tool enabling questioning drivers to retain their sense of agency and power over changes to such an emotive decision.

Coronavirus restrictions also led to an acknowledgement of increased reliance on technology in order to remain connected to others (Xie et al. 2020). The necessity to use technology in order to keep in touch with others, or for example to manage finances has led to an increased use of online functions by people who had not previously made use of such services. This has included a section of older people who had formerly represented part of this digital divide (Centre for Ageing Better 2020b). This increase was noticeable in Study 4 where people interviewed often expressed their recently formed familiarity with online platforms such as Skype or Microsoft Teams.

This portability therefore also aims to address the digital divide (Matthews et al., 2019) between generations where the uptake of technology for adults over 55 appears to occur at a slower rate than their younger counterparts (Age UK 2010, Centre for Ageing Better 2020b). With the assessments being carried out on an individual basis, the 1:1 visit of the researcher also aims to provide a documented need for support and reassurance in the use of technology that some individuals desire (Age UK 2010, Centre for Ageing Better 2020b). This approach would also hopefully serve to provide a situation where any potential power balance between researcher and participant might be equalised. While the researcher is providing the test, the participant remains in complete control of their environment. The ethical promise that the participant may halt proceedings at any time is indisputable, potentially rendering the process fairer all round.

In addition, the intention to distribute this tool via local libraries and medical centres or within the realm of Occupational Therapy assessments would also support firstly, the limited access to computers as a result of economic status and secondly any potential exclusion due to diminished knowledge or understanding of computers as other professionals would ideally be on hand to support the process.

OMEDA PLUS would need to be tested and validated as part of this research. It would be compared to the long-standing Useful Field of View test in order to establish its ability to judge crash likelihood and would be compared to results provided by Read (2001) regarding sensitivity to age decrement.

Read (2001) makes the important point that driving is by its very nature a dynamic activity which may not be sufficiently served by static tests when attempting to measure fitness-to-drive. OMEDA (Object Motivation under Divided Attention) was created with this in mind. It is a computer-based test that examines the events that occur when drivers approach a junction. The driver approaching a junction would need to be able to calculate the time that it would take for an oncoming car to reach the junction known as the time-to-contact estimation (TTC). This is an action found to be problematic for older drivers (Rusch et al. 2016). They need to be able to ascertain as to whether a collision would occur if neither of the drivers altered speed referred to as the collision detection estimation (CD). They then also need to repeatedly search the road for other road events.

Read (2001) designed a computerised test that made use of a hand button and brake pedal as response keys instead of relying on the use of the keyboard. It was her belief that many older users at the time may have had limited experience of computers, and she felt that this method of recording responses would make OMEDA more accessible to that demographic. Despite the consideration that older individuals may have become more conversant with computers during the period between 2001 and 2021 with an increasing use of technology within the workplace (Rizzuto, 2011), this augmented version of OMEDA, OMEDA PLUS, has retained the foot pedal and hand button in order to retain the more accessible feel of the design.

Read's (2001) study comprised 46 participants who were drivers. They were split into groups of young (aged 25 or less, n=19), old (aged 60 or above, n=18), people with dementia (n=3). After analysis by ANOVA, older drivers were found to perform worse on all conditions, with the effect being significant in all cases apart from collision detection. A detailed description of the test is provided in the Introduction chapter. There is no additional literature with which to review the effectiveness of the original OMEDA as a tool. However it remains necessary to evaluate it as shown in the following section.

OMEDA Original was used mainly to study the difference in ability to judge time-to-contact between older drivers with and without symptoms of dementia. It was presented on a static computer, and did not have access to transferability over the internet that exists today.

OMEDA PLUS presents a portable test that uses software that can be configured and emailed to different computers. It aims to use the tool for a different purpose to that of Read (2001), and seeks to explore the effect of different factors upon TTC with the aim of identifying factors which might prove to be an alternative to chronological age when examining this particular skill (judgement of TTC) required for a healthy measurement of fitness-to-drive. In this way it hopes to tackle implicit ageism which can arguably be seen to occur in age-based policies that remain unchanged despite the ageing shift in global populations.

As an additional by-product of this research, there will also be an attempt to provide definitions for the "older driver" whilst also exploring the perceived relevance and likelihood of use of OMEDA PLUS.

Future development of OMEDA PLUS would serve to increase its efficiency by employing methods to provide accessible results with clear meaning to the user. This would require input from additional experts who would be able to successfully develop and test an algorithm that would supply these results.

In addition it is acknowledged that OMEDA PLUS is still a computer-based tool and would benefit from being tested against an on-road driving activity in order to increase its validity.

2.12. Conclusion

It is accepted that the population is increasing, and that the proportion of adults over 65 is becoming particularly prevalent. The following research comments on this demographic change and serves to examine the importance of mobility to this group while also questioning the fairness of current UK licence renewal policy. It seeks to shift the emphasis of measuring fitness-to-drive to the ability to carry out the function of driving as opposed to continuing to base it on chronological age.

Specifically, it examines the concept of time-to-contact or the time that it takes for a moving vehicle to reach a specific point. It will do this by augmenting the original OMEDA by creating OMEDA PLUS, a portable, and live version of the test which was previously only available to this research in theoretical form as any working version of the original had ceased to exist. The research will examine the measurement of errors made in the judgement of TTC according to age, but will also examine other factors that may be more closely linked to the concept of experience (Time driving licence held, Driving exposure, Accident history). This particular approach to measuring fitness-to-drive will provide a contribution to new knowledge. In addition to this novel attempt to measure fitness-to-drive using experience as opposed to age, the research will also aim to examine the perceived relevance and likelihood of use of OMEDA PLUS which represents an important but missing element of the original study by Read (2001). In addition this research also addresses the lack of a cohesive definition of the "older driver", and begins to move towards a definition through interview and survey responses.

3. The Development of OMEDA PLUS

3.1. Chapter summary

The following chapter serves to discuss the reasons for choosing to build OMEDA PLUS with the aim of using it for this research. It describes the process of its development, testing and use within the studies that were carried out. It provides a description of the elements within the tool itself and suggests further research whilst offering recommendations for future iterations of the product.

3.2. Background

The original OMEDA tool was originally conceived by Dr Lily Read (2001) as part of her post graduate research. The aim was to develop a tool to measure any changes in time to contact (TTC) errors in drivers as a result of increased age, and also as a result of early onset dementia.

The work was introduced to the author by one of Read's co-authors of the study, and curiosity, coupled with its potential to provide the singular unit of measurement required, largely led to its selection for this research. It would however require improvements before becoming the intended tool.

This research favoured the use of the OMEDA test which provided an opportunity to extract a single element of driving to be examined for affecting factors amongst drivers of different ages and levels of experience. The specific unit in particular was the number of errors made in the judgement of TTC.

Because of its hitherto limited development, little literature existed about the original tool itself. However the original justification for its use is made clear (Read, 2001). The programme was created for the purpose of Dr Read's specific research but was not developed beyond this. As such when it was selected as the tool to use within the current research, there was neither a working tool nor the source code to re-create it.

This therefore necessitated the development of OMEDA PLUS – a working and usable product that would include improvement and enhancements over the original. The lack of literature about the tool led to the need for measurements and details to be extracted from Read's research (2001), and eventually from email discussions with her and the Serious Games Institute / Cue Interactive at Coventry University who were subsequently chosen as a partner to develop the tool.

This version of OMEDA, OMEDA PLUS, would harness the useful attributes of the original but that would also build on new elements such as portability and accessibility. This would serve to create a product that might be used by individuals in order to support their own decisions to decrease or cease driving. Rather than older individuals needing to necessarily undergo assessments in public, OMEDA PLUS would provide an individual decision-making tool enabling questioning drivers to retain their sense of agency and power over changes to such an emotive decision.

This research was carried out against the backdrop of the Coronavirus epidemic which in turn played a role in further exposing the digital divide that exists among adults over 55 years of age (Age UK 2010, Centre for Ageing Better 2020b). . This in a sense increased the necessity for a tool designed to eventually be distributed to individuals via download or pen drive. The epidemic also played a role in highlighting the digital divide that existed between the generations despite factors such as the increasing working age (Hill, Betts, and Gardner 2015; Reisdorf and Rhinesmith 2020).

Coronavirus restrictions also led to an acknowledgement of increased reliance on technology in order to remain connected to others (Xie et al. 2020). The necessity to use technology in order to keep in touch with others, or for example to manage finances has led to an increased use of online functions by people who had not previously made use of such services. This has included a section of older people who had formerly represented part of this digital divide (Centre for Ageing Better 2020b). This increase was noticeable in Study 4 where people interviewed often expressed their recently formed familiarity with online platforms such as Skype or Microsoft Teams.

This portability therefore also aims to address the digital divide (Matthews et al., 2019) between generations where the uptake of technology for adults over 55 appears to occur at a slower rate than their younger counterparts (Age UK 2010, Centre for Ageing Better 2020b). With the assessments being carried out on an individual basis, the 1:1 visit of the researcher also aims to provide a documented need for support and reassurance in the use of technology that some individuals desire (Age UK 2010, Centre for Ageing Better 2020b). This approach would also hopefully serve to provide a situation where any potential power balance between researcher and participant might be equalised. While the researcher is providing the test, the participant remains in complete control of their environment. The ethical promise that the participant may halt proceedings at any time is indisputable, potentially rendering the process fairer all round.

In addition, the intention to distribute this tool via local libraries and medical centres or within the realm of Occupational Therapy assessments would also support firstly, the limited access to computers as a result of economic status and secondly any potential exclusion due to diminished knowledge or understanding of computers as other professionals would ideally be on hand to support the process.

OMEDA PLUS would need to be tested and validated as part of this research. It would be compared to the long-standing Useful Field of View test in order to establish its ability to judge crash likelihood and would be compared to results provided by Read (2001) regarding sensitivity to age decrement.

This creation and testing of the product itself eventually became a large element of the current thesis. Testing has so far shown it to be effective, and begin to support the overarching argument that factors other than chronological age might be seen to have an effect on the errors made in TTC across individuals.

3.3. Introduction

The original OMEDA tool served as a good starting point for the current research as it was found to be sensitive to effects caused by ageing including cognitive decline. It was able to show a difference in performance between healthy older adults and those who had begun to develop early onset dementia. In addition, it was found to reflect driving behaviour on a simulator and also to reflect the accident experience of the participants in that performance was worse in those who had had recent crashes (Read, Ward, and Parkes 2001).

The issue though was that this no longer existed in a tangible and usable form and needed to be built. There was however much room for improvement this time round. It needed to be made more portable and accessible. So that individuals could become less of a “subject” undergoing a test and more of an “agent” taking steps within their own decisions to either alter their driving behaviour or cease driving altogether.

In addition, an important part of the current research would include determining the position and likelihood of use of the product as perceived by the group whose voices and choices it aimed to amplify.

Work might need to be carried out to manage the cost and the format in which it is eventually delivered in order to hopefully bridge any digital divide as a result of differing access to WIFI and levels of computer experience and confidence.

It might be that the format itself would be able to undergo further development in order to create a product similar to that of the FibriCheck app that supports the measurement of cardiac arrhythmias. This can be downloaded onto a portable device. (https://www.fibricheck.com/ ©2021 Fibricheck). This is currently available from €6.99 / month.

Another product that is also currently available is the Kardia Mobile (https://www.alivecor.eu/ - ©2022 AliveCor, Inc). This is of particular interest because of the combination of downloadable app and pocket-sized hand button device. This button device can be seen in the photo below. If something similar were to be used with OMEDA PLUS, it would be the equivalent to the option (as yet untested) that allows the Z and M buttons to provide the feedback for each of the tests.

This item has been removed due to third party copyright. The unabridged version of the thesis can be viewed at the Lanchester library, Coventry University

Figure 3.1: Kardia Mobile – image from https://www.alivecor.eu/produits/

This is currently available via AliveCor inc for €130. Research into OMEDA PLUS has not yet reached the point of costings, but the aim would be to provide this for the cheapest sustainable price, so making it usable and accessible as a screening tool

3.4. Reason for the selection of OMEDA PLUS for this research

OMEDA PLUS was selected for this research based partially on the results shown by the original tool (OMEDA) (Read, 2001) but also with the increased portability and accessibility that would be possible by an updated and improved version. The original tool had been seen to be sensitive to the effects of ageing, and was also seen to show a positive relationship between the simulated environment and that of self-reported recent crashes (Read, Ward and Parkes 2001)

This tool provided the opportunity to examine a single distilled element of driving that would be able to be tested in line with changes in driving behaviour existing either because of age, or perhaps due to a variable linked more closely with levels of experience. It moves forward from Read's (2001) research by focusing the lens in such a way as to examine the factors which might have an effect upon the age variable that she measures with a somewhat unrefined ruler. Whilst OMEDA in its original form indicated a sensitivity to age, it fails to view age as a multi-faceted phenomenon which is part of a time- and experience-based continuum.

Crashes at busy junctions have been shown to be significantly correlated to traffic volume (Cooper 1973), and STAT19 data show a total of 62192 crashes occurring at junctions compared to 43947 which occurred elsewhere. The complexity of the junction scenario and the ability to calculate TTC was found to be problematic for older drivers (Rusch et al. 2016). The importance of understanding crashes experienced by older drivers is increased by the fact that although older drivers are less likely to cause harm to other drivers, they are at greater risk of being injured themselves (Ichikawa, Nakahara, and Inada 2015).

OMEDA PLUS provided the opportunity to test TTC within a dynamic environment more akin to an on-road test. On-road testing would be planned for future development and validating, however the remit of this study ensured that the testing remained safe by not placing individuals in a risky driving environment, and the budget was able to be kept relatively low.

The tool is able to be configured so that it can be transported to peoples' work places or homes so that testing might be carried out in the most convenient way for them. OMEDA PLUS is also able to be emailed but its current phase of development would require a level of understanding to download and make the system workable. This might not be possible for people at the moment, but future development into App form would add to its portability. In study 4, one participant – referred to as Christine - indicated a confidence in using the tool, but questioned her confidence in loading it onto her computer.

> ***I don't know about fitting it on my computer and all that stuff. That might stump me a bit…***

This portability of software theoretically enables a tool that can be accessible with regards to price, and it would be the intention of this research to provide this at a low cost and possibly even distribute the test to local libraries or health centres. This would enable the cost of the hand held device to remain lower by being spread across multiple users.

The tool, as in the case of the original, moves away from the paper and pen tests (Read, 2001), and also provides a safe off-road test that acknowledges the dynamic nature of driving.

Throughout the research, results provided by participants are also gathered from their interaction with the Useful Field of View Test (UFOV) (Ball and Owsley 1993; Posit Science 2018; 2021). This test has been seen to be a reliable predictive measure of safe driving (Clay et al. 2005; Edwards, Jerri D et al. 2006) and also to be correlated to age-related driving ability and being reported to be an effective training tool that could support older people to increase their skills where necessary (Gentzler and Smither 2012). Despite the reliability and understandable status of this tool, it arguably fails to reflect the dynamic environment experienced while driving. Instead it focuses on a fixed visual situation and provides a test which to some extent relies on memory rather than active interaction with a driving scenario.

UFOV test also assumes access to WIFI which prevents inclusivity on the part of individuals who are either unable or disinclined to obtain it. On two occasions, it was impossible to administer the UFOV test as a result of a poor WIFI connection. This did not occur with OMEDA PLUS.

The use of the hand button and foot pedal with OMEDA PLUS also proved to be an advantage over the use of the mouse in the version of the UFOV test being used. In one situation the test had to be brought gently to a halt due to the lack of familiarity of mouse use. This participant was however able to carry out the OMEDA PLUS element of the test.

The desire to create this product stems from the perceived need for a sense of agency for individuals within the cessation conversation, and also the potential desire for some of this decision-making to be carried out in private without scrutiny.

3.5. Funding

Originally, due to limited funding, the build of OMEDA PLUS involved examining options within the research centres at the university. Ultimately, funding was received from the National Transport Design Centre (NTDC) research centre to employ the Serious Games Institute / Cue Interactive to realise the product under the author’s guidance.

3.6. Development of the product – The Process

The process from paper to working software took a year. The timeline below shows the overall process.

Table 3.1 Time line to show development of OMEDA PLUS

Month	Activity
March 2018	Decision made to build OMEDA PLUS. This would require research into best developer support / strengthening basic programming skills / securing funding / Clarifying objectives for the tool to be created
	Lack of previous literature surrounding original OMEDA – contact attempts made with NL Read (creator of original version) in order to ensure measurements were accurate
	Developed objectives and design plan to approach potential developers
April 2018	learn C++ (strengthen basic skills)
May 2018	Learn Unity (strengthen basic skills)
July 2018	Final C++ and Unity learning
Sept 2018	Contact made with NL Read to clarify measurements and input devices used in the original
Sept 2018 to April 2019	Software objectives devised by researcher and shared with developers (Now SGI / Cue Interactive)
	Continuous liaison with SGI developers to guide the development of the tool Reliability testing of prototypes undertaken by researcher using Iterative testing of tool and providing feedback regarding necessary changes to developers. Included working collaboratively with programmers to develop software to ensure full reliability.
	Researcher liaised with Colleagues (user-centred human factors professionals at NTDC) to extend depth of feedback and usability testing of the tool
February 2019	Learn XML to programme OMEDA PLUS
	Trials devised using Excel
March 26 2019	Final version of OMEDA ready
April 2019	Programming of presentations using XML
29 April 2019	First of the studies using OMEDA PLUS started

The development of OMEDA PLUS took 13 months from the decision to create this improved working version. Once the funding had been secured from the National Transport Design Centre at Coventry University, steps were taken to secure a developer.

The first stage of development had included clarifying the objectives of the intended tool. Due to limited literature specifically surrounding the original OMEDA tool, measurements and details of OMEDA PLUS were combined using Read (2001), meetings with Read's co-author, and email discussions with NL Read. NL Read was unavailable until September 2018, but was extremely helpful in confirming measurements and details of input devices – hand button and foot pedal.

A list of these measurements from NL Read (2001) **(Table 3.3)** together with an animation **(Figure 3.3)** of how OMEDA PLUS was devised in order to be presented to potential developers. The recording of this can be seen by pressing the ctrl button whilst clicking on the following link: OMEDA+1mp4.mp4. After discussions with sections within the university, Serious Games Institute (SGI) / Cue Interactive was chosen to support the build. Details of measurements and decisions made for OMEDA PLUS also follows in a later section.

In order to increase efficiency of working with the developers, time was also taken to learn C++ and Unity software. This proved useful as it supported the discussion about language choice for OMEDA PLUS. Due to the fact that XML was more recent and had an increased level of user-friendliness, the decision was made to use this as the language for OMEDA PLUS. This would differ from C++ but the software would work in the same way. This proved to be useful when changing the format of the messaging within the instructions at a later date. It was necessary to add an extra line of text in order to clarify the instructions. This was easily done with the help of an online search which provided the specific text/code required to add a new line. Having tried to carry this out previously with C++, the advantage of using XML began to become apparent.

The 7-month period between September 2018 and April 2019 was spent providing guidance for the developers SGI / Cue Interactive sharing software objectives in order to develop the tool. This involved meetings, email conversations and online testing of each iteration in order to discuss and feedback any problems, bugs and required changes. There were 12 iterations in total.

The final version of OMEDA PLUS was completed on 26 March 2019, and XML notepad was learnt and used in order to design and set up the trials for the eventual start of the first study using the new tool on April 26 2019.

3.7. Reliability

Iterative testing for the reliability of the prototypes was part of the ongoing development process. As SGI/Cue Interactive produced each version, this was tested by the author for bugs, usability, visual display and robustness of the design. With each set of testing, feedback and suggestions for changes were returned to the developers.

The input devices (foot pedal and hand button) were also tested with the latter iterations of OMEDA PLUS. At this time, colleagues (User-Centred Human Factors specialists) at the National Transport Design Centre were also asked to test the tool and provide feedback. The results appear later in the chapter under the section for Colleague usability test.

OMEDA PLUS underwent a triangulated testing within Study 2 that enabled 3 bodies of data to be examined with a view to testing the validity and reliability of the product. That is to say that it was tested to ensure that the tool measured what was required and also that the results were consistent **(Figure 3.2)**.

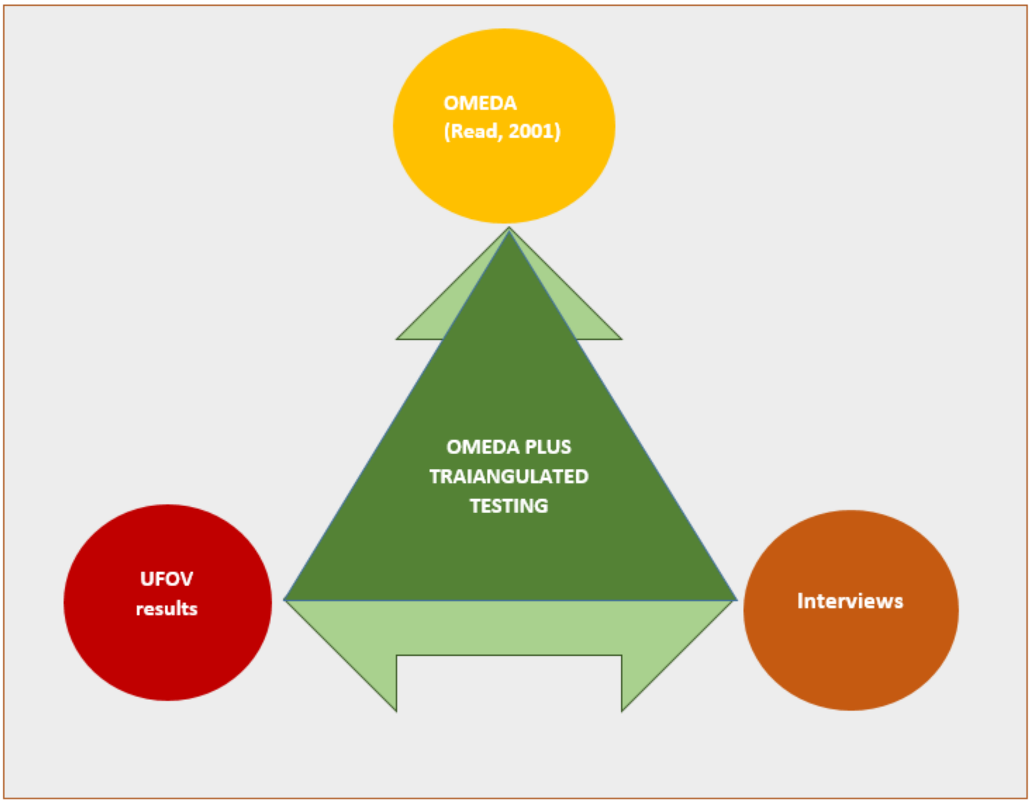

Figure 3.2: Diagram indicating triangulated testing

In order to increase the efficiency of testing during the time allowances of the research, the tool was tested against:

- Results of original study (Read, 2001)
- Results of UFOV tool (especially subtest 2)
- Qualitative information regarding driving habits via semi-structured interviews in Study 2 (these results are reported in Study Chapter, however a brief outline of relevant results for studies 2 and 3 can be seen below)

Studies 2 and 3 showed OMEDA PLUS to work in the same way as OMEDA with regards to the sensitivity to age decrement. However, there was a difference in TTC errors and reported crashes. For OMEDA PLUS these two factors were inversely related according to the Spearman's correlations for each study. This was constant for each of the studies regardless of sample.

The Spearman/s correlations for each study also consistently showed a strong relationship between the diverted attention task in the UFOV test and the measurement of TTC errors in OMEDA PLUS.

3.8. Validity

OMEDA PLUS was developed to primarily do two things. Firstly to measure the errors made by individuals when judging TTC. This tool has been seen to do this effectively, matching the pattern of OMEDA consistently across studies 2 and 3. Following this theory, in the knowledge that results from the original OMEDA were found to reflect simulated driving behaviour, we can arguably tentatively surmise that this would be the same for OMEDA PLUS.

Secondly OMEDA PLUS was to be a screening tool used to measure safe driving by examining factors other than chronological age. If we choose to reflect the measurements used in OMEDA, it can be seen that the ability to judge TTC declines as age increases. However, if we examine this result closer, and compare reported crashes to the tendency to make TTC errors, we find a negative relationship. It could therefore be argued that although age appears to be the factor governing the decline in safe driving, that in fact, age may well be masking another factor.

In this way it can be argued that there is an acceptable level of validity at this point in the research. OMEDA PLUS measures what we require it to measure. However, further validation is required to move the tool beyond its prototype stage. It would be advisable to carry out on-road testing. This was mentioned by the participant referred to as Clive in Study 4:

> ***I think if the test was valid, and had been validated, by lots of people doing it and seeing whether they act when you actually went down with them to …Basically, if you validate it, and it correlates with all other types of information that you get about peoples' driving. Yeah. I'm confident with it.***

An additional sample allowing a comparison between older drivers who have driven since a young age and older drivers who are new to driving would enable the concept of experience as a variable to be examined in greater detail. This further testing would provide the opportunity to examine the factors potentially being masked by the variable of chronological age.

3.9. General product overview

OMEDA PLUS is devised to represent the road junction in 2-dimensional form. The situation is made more complex by the addition of visual distractors in each of the 4 corners of the screen. The aim of the product is to measure errors made in the judgement of Time to Contact by recording responses from participants made on a foot pedal and hand button.

3.9.1. Locating the measurements and details

The main measurements needed to be extracted from Read's research (2001), and from discussions with the researcher and the development team.

3.9.2. The size of the objects on the screen

The size of the screen and elements within it had originally been measured in pixels. This posed a problem as this measurement had been replaced by the centimetre. Using the conversion 1 pixel = 0.0264583333 cm it was possible to provide the sizes of the objects on the screen **(Table 3.2)**.

Table 3.2: pixels converted to mm

Pixels	MM
2	0.53
150	39.7
200	53
250	66.2

3.9.3. Measurements extracted from Read (2001)

In order to ensure that the elements worked in the same way as the original, Read (2001) was examined. This provided the following details regarding speed and size of all elements.

Table 3.3: list of measurements collated from Read, 2001

With these elements in mind, a simple animation was created so that SGI/CUE could see OMEDA PLUS in “action”. This did not reflect the final tests exactly, and changes were made as the design emerged, but it does clearly show the main elements of the tool. A more complete example of the workings of OMEDA PLUS can be seen in the video found in **section 3.16**. The storyboard from this animation can be seen below:

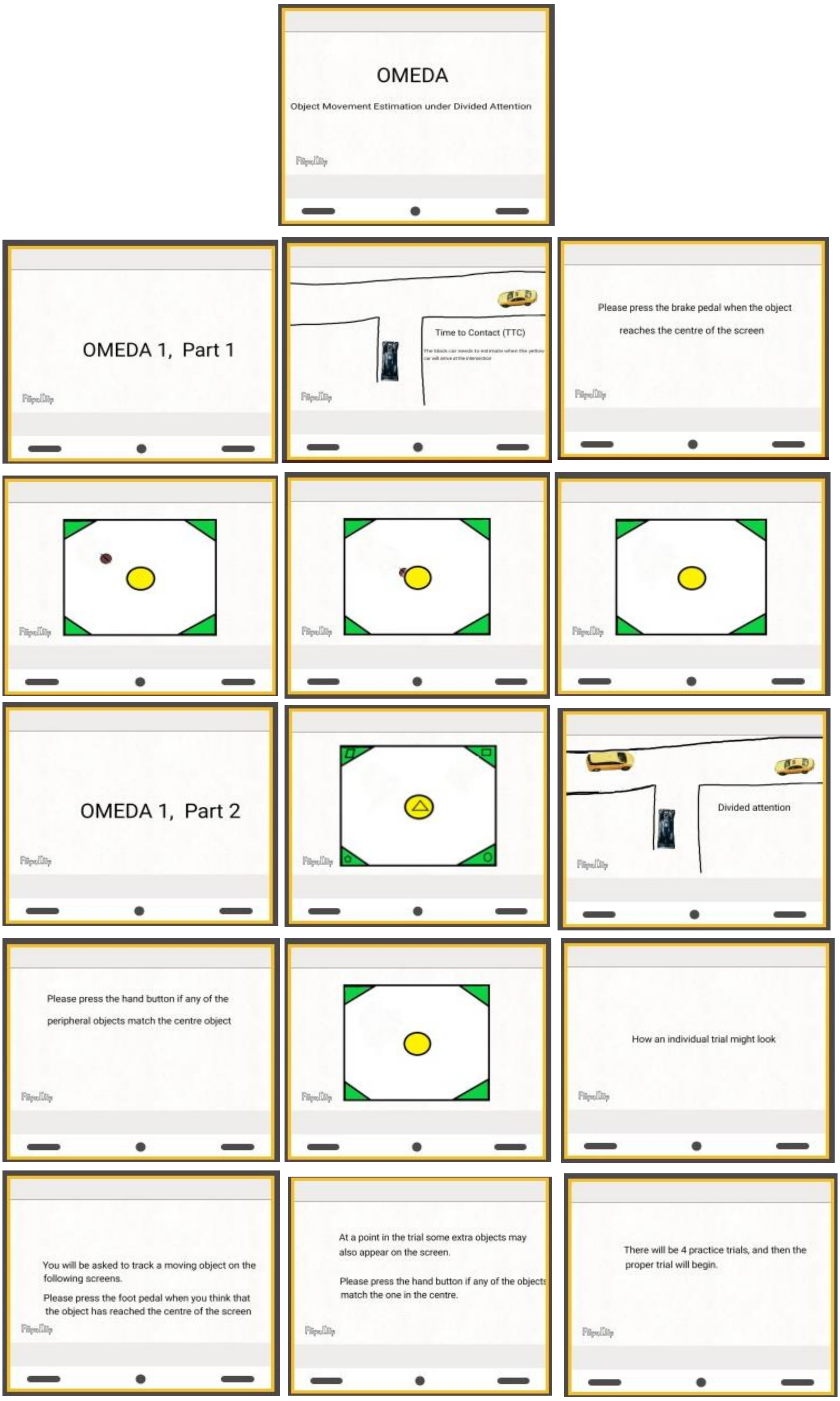

Figure 3.3: Story board for explanatory animation

Some further details were still required in order to ensure that OMEDA PLUS matched the working of OMEDA, but it was also important to create a more accessible product. Meetings with SGI/CUE led to working details to be decided upon.

3.9.4. The screen

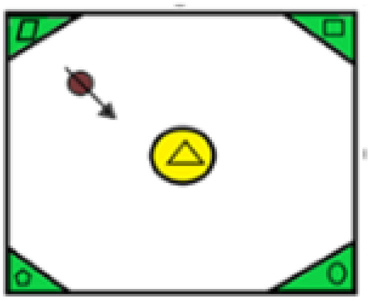

Figure 3.4: Image of the screen with its components (arrow to show direction of red object)

The screen **(Figure 3.4)** comprises varied elements within each individual trial. It is white with green corners as can be seen above. Each of the green corners contains a randomly selected geometric shape which act as visual distractors. These geometric shapes also need to be able to appear in the centre of the screen.

The TTC measurements are created by measuring the time response to stopping the red circle as it reaches the centre of the screen, or in some cases another red circle. These represent the vehicle at the crossroads and need to be able to be changed in size and speed.

The original OMEDA did not specify a screen size and so every attempt was made to retain the ratios within the working area as implied by the drawings provided.

Further discussion with Dr Read highlighted the fact that the screen was square as opposed to rectangular, and so measurements were adjusted accordingly. When transferred to a laptop monitor of 15.6 inches, the working area of OMEDA PLUS was to be 7.6 x 7.6 inches **(Figure 3.5)**.

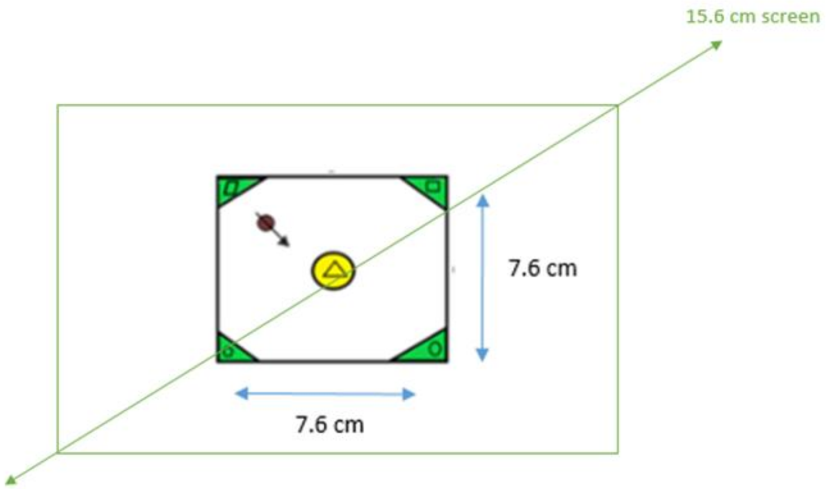

Figure 3.5: Computer Screen Working screen dimensions (not to scale)

The advantage of OMEDA PLUS would also lie in its proposed ability to be configurable to different computer monitor sizes.

3.9.5. Flexibility of display elements

OMEDA PLUS required the following flexibility to enable research to take place.

- Number and size of occlusion circles
- Speed of moving objects
- Size and timing of geometrical shapes
- Display colours
- Order of presentation
- Number of trials presented

3.9.6. The language

This was originally devised in C++ but XML was later chosen due to its user-friendliness. It was decided that the language would need to be easy for researcher to programme, and the main concern was that the product worked in the correct way and looked identical to the original.

3.9.7. Required screen elements

In order to ensure a level of finesse within the new tool, the following screen elements needed to be added.

3.9.7.1. Personal identifier

A personal identifier (PI) was set to be created randomly for each participant as they began the test. As the test conditions followed one after the other within the study, i.e. OMEDA PLUS 1, OMEDA PLUS 2, the identifier remained constant for the OMEDA PLUS test. This was then matched to the correct results from the other parts of the study.

3.9.7.2. Age field

Participants were required to also enter their age when starting the OMEDA PLUS test. This served as another method of cross checking the data in case of failure to record the PI at the time each study took place. This was extracted into the results excel spreadsheet.

3.9.7.3. Ability to alter instructions for each section of the test.

The page at the start of the OMEDA PLUS test provides the instructions for each test. These were designed so that they could be updated for further studies.

3.9.7.4. Start when ready button (press space bar)

When participants were comfortable and confident that they understood the procedure, they were asked to press the space bar to start. This ensured that individuals were ready when the test started.

3.10. Outputs

The results were designed to be extracted into an excel file as the test progressed. This made it simpler to move required data into SPSS for analysis. The fields agreed upon can be seen in the figure that follows.

Table 3.4: list of measurements recorded by OMEDA PLUS

ID	TIME AT WHICH MOVER STARTS MOVING (MOVER 1 AND 2)
AGE	TIME AT WHICH GEOMETRIC SHAPES APPEAR
CONDITION– OMEDA PLUS 1 OR OMEDA PLUS 2	DIFFERENCE IN TIMES OF EVENTS 1 AND 2
TRIAL NUMBER	COLOUR CORNER TRIANGLE
SIZE OF RED MOVING OBJECT (MOVER)	COLOJUR GEOMETRIC SHAPE
SPEED OF RED MOVING OBJECT	SIZE TRIANGLE
START POINT MOVER	SIZE GEOMETRIC SHAPES
MOVER COLOUR	GEOMETRIC SHAPE MATCHES SHAPE
SIZE OF OCCLUDER	GEOMETRIC SHAPE DOES NOT MATCH CENTRE SHAPE
COLOUR OCCLUDER	REACTION TIME OF HAND BUTTON PRESS
LENGTH OF OCCLUDER ON SCREEN	MATCH CORRECT
REACTION TIME FOOT PEDAL PRESS	MATCH INCORRECT
CORRECT FOOT PEDAL PRESS (Y/N)	FOOT PEDAL AND HAND PEDAL BOTH CORRECT
INCORRECT FOOT PEDAL PRESS (Y/N)	

3.11. The hardware / Control buttons

The control buttons **Z** and **M** were configured to correspond to the hand button and foot PEDAL. The foot pedal was designed to act as a stop switch and did not have a “braking” model where it slowed the object down gradually as it came to a halt.

The foot pedal and hand button were retained here in order to allow for a more direct comparison between the now theoretical version of OMEDA and the version in development OMEDA PLUS.

These were sourced after discussion with the Dr Read as details had not previously been available in the literature.

3.11.1. The Foot Pedal

Figure 3.6: Image of foot pedal used

The TechAffect Foot Switch for Windows PC Computer was sourced from Amazon.com

3.11.2. The Hand Button

Figure 3.7: Image of hand button used

The USB Switch (75 mm diameter) was sourced from Dad in a shed http://www.dadinashed.com/?product==usb-switch

3.12. The configuration

The theoretical design did not appear to provide an ability to re-configure the test to different sized computers, and was designed at a time before laptops were commonplace. The addition of the MonitorInfoView application (https://www.nirsoft.net/utils/monitor_info_view.html) to the programme enables the user to access the size and resolution of the screen that they are using.

This item has been removed due to third party copyright. The unabridged version of the thesis can be viewed at the Lanchester library, Coventry University

Figure 3.8: image taken from screen showing MonitorInfoView

This also provided the option to download the details of specific computers **(Figure 3.9)**. In this case, it can be seen that screen size allowed for the maximum image size to be 34.4 cm x 19.3 cm. Maximum resolution was 1920 x 1080.

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Figure 3.9: Details downloaded from MonitorInfoView screen

This was then reflected in the XML set up of the test as configured for this specific screen **(Figure 3.10)**:

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Figure 3.10: Taken from XML set up page showing configuration

3.13. The Working screen

3.13.1. Triangular corners

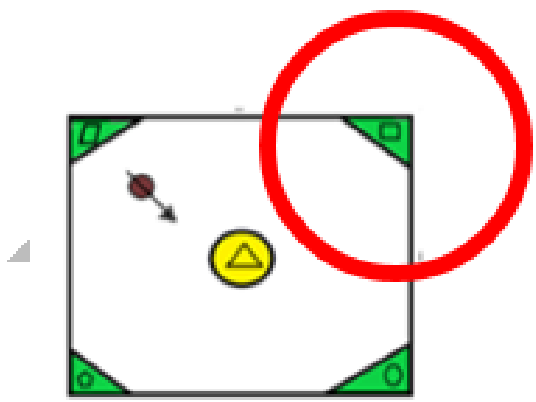


Figure 3.11: Image showing green corners to screen

These were designed so that they could be removed or altered in size to allow for varied future research. The colours are also able to be altered.

3.13.2. Geometric shapes / Distractors

These were set to appear as distractors and appear randomly during each presentation. One appears in the centre with another appearing in each of the 4 triangular corners. The one in the centre should match at least one around the edges.

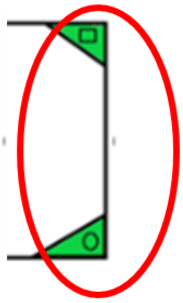


Figure 3.12: Image showing geometric "distractor" shapes

3.13.3. Red movers (Movers / targets)

The aim is for the participant to estimate the time at which the target (mover) meets the centre of the screen when it is either visible or not. These targets remain at a constant size. Once the target hits the edge of the central circle it disappears as if disappearing under the occlusion. In the second subtest, OMEDA PLUS 2, the participant needs to note the point at which two separate movers collide if they happen to do so. Sometimes this event will be occluded.

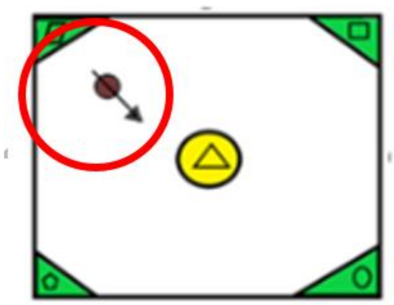


Figure 3.13: Image showing red mover (arrow to demonstrate direction of movement - this does not appear on true screen

In subtest 2, the movers travel at different speeds to each other, but this speed remains constant. The different speeds and occlusion sizes can be seen below:

	Object speeds (path lengths / second)	Occlusion sizes (mm)
OMEDA PLUS TTC Subtest	0.07	0.53
	0.12	39.7
	0.17	53
		66.2
OMEDA PLUS CD Subtest	0.07	0.53
	0.17	39.7
		53

Table 3.5: speeds of red object and occlusion sizes in OMEDA PLUS 1 & 2

3.13.4. Occluders

These appear as a yellow circle of varying size (See above for measurements).

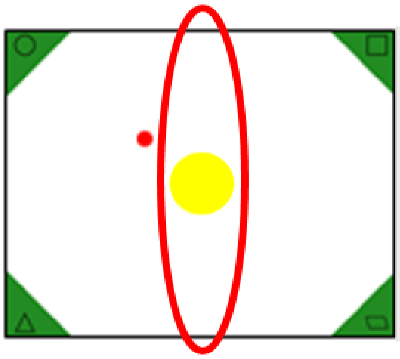


Figure 3.14: Example of occluder position on screen

3.14. Programming and designing the trials for OMEDA PLUS

Programming was carried out within XML and XML notepad.

3.14.1. OMEDA PLUS 1

The aim is for the participant to estimate the time at which the target (mover) meets the centre of the screen whether or not it is visible. The secondary task requires them to acknowledge a match between distractors in the centre and around the edge where this occurred. There are 24 presentations which are designed to appear random. For the purpose of standardising the test however, the random setting was not used but instead a random design ensuring that each condition was realised was carried out.

The 24 planned presentations needed to cover each speed of object approaching each of the occlusion sizes. These were planned within Excel and randomised using randomising software **(Table 3.6)**.

Once the presentations were plotted, they were converted to XML to be uploaded via the OMEDA PLUS software **(Appendix B3.1**).

Table 3.6: OMEDA PLUS presentations

OMEDA PLUS 1 – before randomisation							
	mover speed	**occlusion size**	**start corner**	**match shape**	**centre shape**	**match corner**	**distractor timing**
1	slow	tiny	TR	yes	circle	BL	0
2	slow	small	BL	no	triangle	BR	2
3	slow	medium	BR	yes	rhombus	TL	0
4	slow	large	TL	no	square	TR	2
5	medium	tiny	TR	yes	triangle	BL	0
6	medium	small	BL	no	circle	BR	2
7	medium	medium	BR	yes	square	TL	0
8	medium	large	TL	no	rhombus	TR	2
9	fast	tiny	TR	yes	circle	BL	0
10	fast	small	BL	no	triangle	BR	2
11	fast	medium	BR	yes	rhombus	TL	0
12	fast	large	TL	no	square	TR	2
13	slow	tiny	TR	yes	circle	BL	0
14	slow	small	BL	no	triangle	BR	2
15	slow	medium	BR	yes	rhombus	TL	0
16	slow	large	TL	no	square	TR	2
17	medium	tiny	TR	yes	triangle	BL	0
18	medium	small	BL	no	circle	BR	2
19	medium	medium	BR	yes	square	TL	0
20	medium	large	TL	no	rhombus	TR	2
21	fast	tiny	TR	yes	circle	BL	0
22	fast	small	BL	no	triangle	BR	2
23	fast	medium	BR	yes	rhombus	TL	0
24	fast	large	TL	no	square	TR	2

3.14.2. OMEDA PLUS 2

The participant is asked to press the foot pedal when they suspect that a Hit between two moving objects has occurred. Once again this is obscured by a yellow circular occlusion. The secondary task of acknowledging matching distractors remains the same as for OMEDA PLUS 1.

The three collision conditions are defined as follows:

Hit: Where targets reach the centre of the screen at the same time
Near miss: Where they reach the centre of the screen at nearly the same time
Miss: Where they reach the centre of the screen at significantly different times

Table 3.7: Presentation details for OMEDA PLUS subtest 2

	Number of presentations	Object speeds (path lengths / second)	Occlusion sizes (mm)	Collision conditions
OMEDA PLUS CD Subtest	36	0.07 0.17	0.53 39.7 53	Miss Hit Near miss

The 36 planned presentations needed to cover each speed of object approaching each of the occlusion sizes. In OMEDA PLUS 2, the presentations also had to allow for the collision conditions Miss, Hit and Near Miss. These were planned within Excel and randomised using randomising software **(Table 3.8).**

Once the presentations were plotted, they were converted to XML to be uploaded via the OMEDA PLUS software (**Appendix B3.1**).

Table 3.8: OMEDA PLUS presentations for subtest 2

OMEDA PLUS 2 after randomisation											
	trial	occlusion	speed	speed	**original corner**		collision status	match	position of match	shape	shape appears
Random. org			mover 1	mover 2	**mover 1**	mover 2					
6	6	2	0.17	0.7	TR	BL	near miss	n	**NM**	triangle	0.02
12	12	150	0.17	0.7	BR	TL	near miss	y	**BL**	square	0.00
36	36	200	0.17	0.7	TR	BL	near miss	n	**NM**	triangle	0.02
7	7	150	0.7	0.17	BL	BR	hit	n	**TL**	rhombus	0.02
9	9	150	0.7	0.17	TL	TR	near miss	n	**NM**	circle	0.02
16	16	200	0.17	0.7	BR	TL	hit	n	**NM**	square	0.02
34	34	200	0.17	0.7	BR	TL	hit	n	**NM**	square	0.02
11	11	150	0.17	0.7	BL	BR	miss	n	**NM**	rhombus	0.02
17	17	200	0.17	0.7	TL	TR	miss	y	**BR**	circle	0.00
24	24	2	0.17	0.7	TR	BL	near miss	n	**NM**	triangle	0.02
29	29	150	0.17	0.7	BL	BR	miss	n	**NM**	rhombus	0.02
4	4	2	0.17	0.7	BR	TL	hit	n	**NM**	**square**	0.02
20	20	2	0.7	0.17	TR	BL	miss	n	**NM**	**triangle**	0.02
28	28	150	0.17	0.7	TR	BL	hit	y	**TL**	triangle	0.00
22	22	2	0.17	0.7	BR	TL	hit	n	**NM**	**square**	0.02
5	5	2	0.17	0.7	TL	TR	miss	y	**BR**	circle	0.00
2	2	2	0.7	0.17	TR	BL	miss	n	**NM**	**triangle**	0.02
18	18	200	0.17	0.7	TR	BL	near miss	n	**NM**	triangle	0.02
10	10	150	0.17	0.7	TR	BL	hit	y	**TL**	triangle	0.00
14	14	200	0.7	0.17	TR	BL	miss	n	**NM**	triangle	0.02
1	1	2	0.7	0.17	TL	TR	hit	y	**BR**	**circle**	0.00
25	25	150	0.7	0.17	BL	BR	hit	n	**NM**	rhombus	0.02

33	33	200	0.7	0.17	BL	BR	near miss	y	**TR**	rhombus	0.00
21	21	2	0.7	0.17	BL	BR	near miss	y	**TR**	**rhombus**	0.00
3	3	2	0.7	0.17	BL	BR	near miss	y	**TR**	**rhombus**	0.00
31	31	200	0.7	0.17	TL	TR	hit	y	**BR**	circle	0.00
15	15	200	0.7	0.17	BL	BR	near miss	y	**TR**	rhombus	0.00
35	35	200	0.17	0.7	TL	TR	miss	y	**BR**	circle	0.00
27	27	150	0.7	0.17	TL	TR	near miss	n	**NM**	circle	0.02
32	32	200	0.7	0.17	TR	BL	miss	n	**NM**	triangle	0.02
19	19	2	0.7	0.17	TL	TR	hit	y	**BR**	**circle**	0.00
23	23	2	0.17	0.7	TL	TR	miss	y	**BR**	circle	0.00
8	8	150	0.7	0.17	BR	TL	miss	y	**BL**	square	0.00
13	13	200	0.7	0.17	TL	TR	hit	y	**BR**	circle	0.00
30	30	150	0.17	0.7	BR	TL	near miss	y	**BL**	square	0.00
26	26	150	0.7	0.17	BR	TL	miss	y	**BL**	square	0.00

3.15. Usability Reviews

OMEDA PLUS was first tested from a usability point of view with colleagues (user-centred / human factors professionals). Studies 2 and 3 served to test the reliability of the tool, with study 2 providing qualitative data regarding the perceived usability of the tool by participants. Study 4 presented participants with a video demonstrating the use of OMEDA PLUS which preceded an interview about perceived relevance and likelihood of use. Results from the usability colleague test and Study 2 are reported below, with the results from Study 4 being reported separately within the Study Chapter. Section 3.19 concludes with a table showing the main responses / suggestions.

3.15.1 Colleague / Expert usability test

In terms of the colleague / expert usability test, the eventual interview content was borne out of the research questions but also general discussion carried out at this testing of the new OMEDA PLUS.

The following issues arose from this original test.

3.15.1.1. Problems with instructions

In some places the instructions were seen to be too long and so it was suggested that they be broken into more sections. Also there were times where the wording of instructions in was unclear. For example, OMEDA PLUS 2 "when and if they collide" was clarified and replaced with "when you think the 2 red objects will collide".

3.15.1.2. Number of practice runs

Practice – 6 practices not enough. Would be better if increased to 9. Would be better if first foot pedal and hand button practice are carried out and then both are used together in the final 3 practices.

3.15.1.3. Foot pedal

Foot Pedal was problematic as it was not in brake position and kept slipping. This was found to be distracting. This was improved by using Velcro / tape to keep the pedal in place on the floor. The need to wear comfortable / flat shoes was also highlighted by the testers.

3.15.1.4. Fatigue

Originally the OMEDA PLUS 2 test was to hold 72 presentations. Individuals mentioned they felt fatigued, and visible signs of boredom set in. The decision was made to halve the number of presentations with the final test holding only 36 presentations.

Each reported study within the Study Chapter reports the results related to the working of OMEDA PLUS. However, the results related to usability from the semi-structured interviews from Study 2 have been separated and reported below. These results served to develop the design of the 3rd study which would be seen to introduce the portable version of the tool.

The relevant results from Study 2 are reported below.

3.15.2. Usability data from Study 2

Both tests elicited responses that related them to the on-road driving experience. OMEDA PLUS was likened to driving because of its use of the foot and hand controls:

> ***The second test was actually like, somewhat replication of what actual driving was interesting.*** [Aged 24]

The UFOV test was deemed to require a different type of concentration from driving on the road:

> ***I was aware I was concentrating very hard because it's sort of the test - concentrating harder than I do and I drive you know.*** [Aged 60]

This difference between computer-based activity and on-road driving had previously provided one 21-year-old participant with a problem when they attempted to transfer their driving to the road:

> ***I played like American video games. So they drive on the left side, whereas like in Malaysia, we drive on the right side. So when I was actually driving on the road, I accidentally went to the - almost went into the right lane when you're supposed to turn into the left lane. Cars are supposed to come but it was a traffic lights. I almost went there. And I was yelled at by my mom.***

3.15.2.1. The pedal

The interviews attempted to discuss the usability of OMEDA PLUS based on the participants' experience during the study. Comments from the participants included responses regarding the design. The use of the foot pedal was discussed, and found to have a few issues that would require addressing in a non-prototype version. One participant found the pedal to be too low, and suggested that a stand could be manufactured which would make it more comfortable to be used:

> ***Something that might be a beneficial, looking at it from engineering, you could just create a stand? That it just sits on? You'd still use the same pedal sensor, you'd just have…where it just changes the angle, so you can bring it closer or further away depending on the person.*** [Aged 25]

Another older participant felt that it responded differently to a driving pedal, whilst another member of the same group expressed concern that the pedal might break. They also wondered if it was registering a response successfully within the results:

> ***…found the foot pedal A bit - I didn't know whether when I was pressing the foot pedal whether it was actually registering or not. It's possibly coz I'm not used to it, perhaps it because the shoes I don't know. But I didn't get the feeling. I didn't know because I found myself in the end sort of stamping on it. To make sure. And I thought well if everyone does that, it's gonna be you know...it's gonna break before very long... I think a foot pedal with a simple click of something, you know, an audible click. Would be would be more beneficial I think. But apart from that, yeah. No trouble.*** [Aged 70]

Most of the participants found the pedal to be comfortable, but one member from each group mentioned a level of discomfort. The younger participant said that they were ok but their ankle had hurt a bit from repeatedly pressing the pedal, whilst a member from the older group said that they had positioned the pedal carefully to prevent the pedal from causing any discomfort with a knee which was arthritic:

> ***I've got arthritis in my knee so it does play up sometimes but, no it was fine because I positioned it so I didn't have to do as much.*** [Aged 73].

3.15.2.2. The instructions

Two participants referred to a query over the instructions with one feeling that the purpose was unclear, the second feeling that they had misunderstood the task. This participant actually explained what they had done which proved to be completely correct:

> ***But with the circle, you know when they came to crash? I just assumed that it they were gone behind, you would sort of...about what time they***

were going to crash. Then I realised afterwards, it's not when you could actually see them connecting. And I got a lot wrong. Coz I did it when I thought "ok, they've both gone behind the yellow dot, and about now they'd be crashing". [Aged 73]

This had not been the case when carrying out the UFOV test:

It was easy to follow. Obviously I found with the peripheral vision [UFOV] as it go faster, it became more difficult to do. It was ok to start with um yes so it was easy to see what I had to do. [Same participant as above, aged 73].

3.15.2.3. Practice sessions

One participant suggested that the practice session be lengthened so that there was more preparation before embarking on the proper test:

Okay, yeah. It's always going to time to take me a little time for me to get used to it. I'd like a little bit more practice.

3.15.2.4. Colour contrast

One advantage of OMEDA PLUS that was mentioned in a comparison to the UFOV test was its use of darker colours on a light background as one of the members of the older group pointed out:

I think the kind of grey against the black and not it not be or not appearing to be crystal clear. But no, it's fine **[**Aged 61]

3.15.2.5. Distractors

When discussing the UFOV test, one participant mentioned that they thought the distractors made the tasks easier to carry out:

I thought the final one the peripheral vision I thought it was easier to than when they have the distractors in than not - [Aged 60]

The mean performance in milliseconds for the older group carrying out UFOV2 for divided attention was 104.86ms, with this participant performing it at a rate of 57ms.

3.15.2.6. Wrongful clicking

Both younger and older participants expressed difficulty with managing the dual tasks presented by OMEDA PLUS, finding that their confusion often resulted in clicking the wrong pedal. They found themselves pressing the hand button when they intended to depress the foot pedal and vice versa:

> ***I guess I think I realised that later on after that, but it's still like, I think there were a few that made some errors...like when I press it, like the hand one when I realised the match the end up stepping on at the same time. Even though I didn't intend to.*** [Aged 21]

And:

> ***I got them the wrong way round and I was pressing my hand when they collided, and my foot when the shapes matched. Then I twigged that I was doing it the wrong way round.*** [Aged 60]

3.15.2.7. Strategies and learning

In order to manage the difficulties presented by the dual task, one of the members of the older group mentioned that they had developed a strategy that with the aim of improving their performance:

> ***I thought by the time the end of the test came, the, strategy Well, the strategy I adopted was to click the foot pedal then press the button or not. Rather than trying to do them simultaneously. [Aged 67]***

The speed and accuracy for pedal presses by this particular participant were examined and are shown in the figure below. The green circles (1) represent the time at which the foot pedal was pressed measured in seconds. The purple circles represent the point at which the test becomes more complex with the second object being introduced on the OMEDA screen. All circles that are filled with a red inner circle represent erroneous presses (**Figure 3.15 below**).

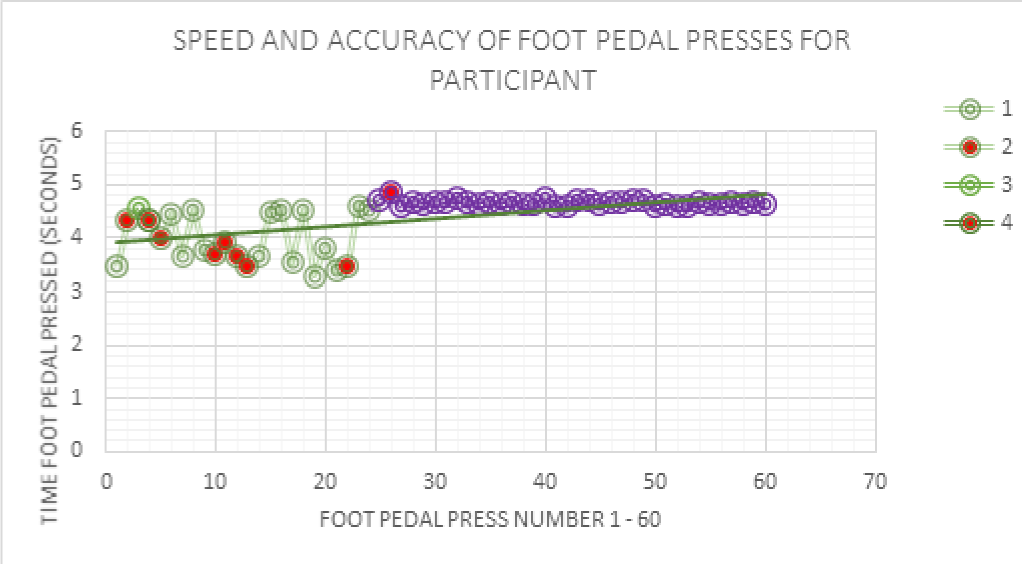


Figure 3.15: Demonstration of button pressing technique used by participant to increase accuracy

Examining this diagram suggests that the strategy undertaken by the participant included slowing down the speed at which they were pressing. This led to less inaccuracy.

3.16. Video showing use of OMEDA PLUS

To watch a video detailing the way in which OMEDA PLUS works, please press the "Ctrl" button and Click on the following link to access the recording: https://youtu.be/r9j-kq07nM0. This is a copy of the video provided in Study 4 and it runs for 5"24, but the working example of OMEDA PLUS (referred to as OMEDA in the video) begins at 2"47.

3.17. Discussion

OMEDA PLUS presents as a portable screening tool for examining safe driving in older adults. However, it serves to move away from the age-based emphasis and instead investigates factors linked to advanced years such as experience and / or confidence gained throughout the driving career. It also retains an awareness of its computer-based nature and proposes to provide an accessible method for individuals to make informed choices about potential changes in their driving behaviour by offering a simple portable tool.

It is the aim that this will be provided at a low cost and eventually in a simple and accessible application capable of being run on a mobile phone, tablet or laptop. The simplicity of the tool would make OMEDA PLUS able also to be provided in local libraries or medical establishments for free at the point of the user. This flexibility of provision is made possible by the ability of OMEDA PLUS to be configured to devices of different sizes. The current prototype is able to be delivered by email which improves upon the original as it is not tied to a specific research centre as was the case of the original. In this case, were there to be an absence of the input buttons – foot pedal and hand button – then button presses would need to be carried out by depressing keys Z and M on the keyboard. Further testing is required in order to examine and measure any significant differences in outputs obtained across differing input devices, such as between pressing keys on the keyboard and using hand button and foot pedal.

The use of XML as a language offers the researcher a user-friendly and flexible product that is adaptable to further study.

The input devices are also theoretically interchangeable. The current use of hand button and foot pedal provides a specific set up, but the outputs can also be registered using the keys on the keyboard. This also opens the tool up to further flexibility allowing for the test to be adapted to personal requirements as measurements can be registered using hands or feet.

OMEDA PLUS was successful in reflecting the sensitivity to age that had been highlighted in the original OMEDA. However, the new prototype was able to provide additional information when examining the factors through a more focussed lens. As such, it was discovered that TTC errors were found to decrease with increased crash experience. This separation of TTC errors from age per se will be examined at greater length in the Discussion Chapter.

This new tool undoubtedly requires more research, and some of the issues will be briefly examined below after an examination of the advantages provided by OMEDA PLUS. A more detailed exploration of these topics will once again be carried out in the Discussion Chapter.

3.17.1. Advantages

OMEDA PLUS provided a unique opportunity to examine factors affecting safe driving by extracting a single specific aspect of driving – that of judging time to contact. This enabled the researcher to examine results through varied lenses in terms of focus. On the one hand, when examined through the broader lens of the original OMEDA, age was seen to affect safe driving. However, when focussing the lens on each of the alternative factors in turn, it became apparent that there were other variables that affected safe driving which were potentially being masked by the assumption that age. Having a tool that was able to work in this way, was crucial to this research.

The tool, unlike the Useful Field of View test (UFOV), did not rely on WI-FI. This augmented its accessibility and affordability as it would not rely on access to the internet in order to be used. In practical terms during the research, it also ensured that OMEDA PLUS never failed to perform, unlike the occasions when the UFOV test was unable to be carried out due to weak WI-FI connections.

The tool itself could potentially be provided at a low cost, and also in settings such as libraries and medical settings. This again, would increase fair accessibility.

OMEDA PLUS was also highly advantageous at the point of research. It was transportable as it could be carried on a laptop, or emailed to computers in different locations. Because of this it was able to be transported to individuals who may have had mobility or transport issues. This ensured that research could be carried out in a more inclusive way.

Despite the reliance on confidence in using technology, the hand button and foot pedal of the original version were retained to ensure an inclusive design. These buttons also supported the perceived difference in levels of computer knowledge, and the potential age- or health-related differences experienced in the ability to perform finely–tuned movements, and to produce the force required to create a response measurement from the devices (Walker et al. 1997; Charness et al. 2004).

The study sessions were designed in such a way that enabled people to acclimatise to the room and / or situation. The aim was to manage any perceived pressure that the participant might have felt as a result of a potential "test" experience. The participants were assured that they were not under individual scrutiny, and the researcher asked them to work through a paper-based Driving Habits Questionnaire while the researcher re-set the tests after the previous participant. This enabled a rapport to build between researcher and participant.

In addition, individuals were able to choose where the study was conducted. People often chose their homes or workplaces. This enabled them to remain in places where they felt comfortable which provided the opportunity to ensure that any perceived power imbalance could be managed. It also enabled people to take part in the research where their limited time may have previously prevented them from becoming involved.

Test anxiety was another consideration. This is likely to occur when undergoing an assessment such as this (Whitbourne 1976), and portability might be seen to assuage this by enabling the test to be taken in a familiar and less confrontational environment (Lang, Parkes and Fernandez Medina 2013). This option to undertake the test at home or within their familiar work environment, may serve to overcome elements of White Coat Syndrome, leading to a more reliable and real measurement (Pickering et al. 2002; de la Sierra, A, 2013; Westin et al. 2010).

This flexibility provided by the portable version of OMEDA PLUS proved to be a highly advantageous augmentation of the tool.

The section below highlights some of the issues that arose during the development of the tool and its use in the research. These are issues that will be repeated in a more comprehensive list of further research to be found in a later chapter. For the purpose of creating a standalone chapter describing the development of OMEDA PLUS, these considerations are briefly discussed below.

3.17.2. Potential drawbacks

Whilst the portability was highly advantageous, it was occasionally difficult to create a workable testing area at peoples' homes and work places and an element of ingenuity had to be employed. On one occasion, a participant and I needed to create seating that would be comfortable and at the right height to carry out the test. In another, it was necessary to be aware of glare coming through large windows and I had to ask the participant to move to the other side of the table at which they were sitting.

The tool also relies to some extent on the individual's experience with computers. Although due to the similarity of the foot pedal to the brake of a car, and to the use of the hand button as opposed to the mouse, this proved to be easier for some people to participate than the UFOV test version used that relied on a more precise movement with a computer mouse. On one occasion, with one older participant who had had less experience of computers, the study had to be gently brought to a halt due to difficulties in using the mouse for the UFOV test. They were however able to carry out the less precise hand button pressing which eliminated the need to perform finely-tuned movements to respond to the test (Walker et al. 1997; Charness et al. 2004).

As a computer-based tool, there was occasionally a discrepancy between reported driving behaviour and response to OMEDA PLUS. For example, one individual in Study 4 mentioned that they were not currently driving because their distance vision was blurry, but that looking at a computer was not problematic highlighting the gap between the true act of driving and the computer-based testing.

In addition to the issues mentioned above, many important points arose as a result of the participant / usability feedback. These can be seen below:

3.17.3. Responses to feedback

Changes were made to instructions, practice runs and the foot pedal as recommended by the human factors testers and participants in Study 2. This input was important to the process of adding to the robustness and usability of the test.

Gaming experience arose in Study 4, where participants suggested that younger drivers might be more confident with the tool because of experience with computer gaming. However one younger participant in Study 2 had preciously claimed that this very experience had proven to be a disadvantage when engaging in on-road driving. This individual’s first driving experience had been carried out in a country that drove on the opposite side of the road to the American driving games that they had been accustomed to playing. This resulted in them nearly starting off on the wrong side of the road when driving as a new driver. This also highlighted the potential gap between the computer-based tool and real-world driving. This will need to be examined in future research.

Other points of interest to be discussed in more detail in the Discussion chapter include the consideration that wrongful clicking when using the tool was mentioned by both younger and older groups. There was also a tendency to create strategies with one 67-year-old participant slowing down for part 2 of OMEDA PLUS in order to make less errors. Whilst this is a computer-based tool, this example arguably highlights a tendency for more experienced drivers to manage the circumstances on the road and to adapt their behaviour so that they can make safe judgements whilst driving.

An additional advantage suggested by one participant regarding the colours used on the screen of the tool, was that the low contrast of what was perceived as grey on black in the UFOV test led to less clarity than the more primary colours set against the white background of OMEDA PLUS.

Thus whilst the tool has been seen to be effective, there is further work to be done regarding its validity. It is also still necessary to continue the research to increase the finesse of the tool, and to bring it to the attention of potential stakeholders. These suggestions will be discussed in the following section.

3.18. Recommendations for the product and further research

The tool has been found to provide reliable and valid results, but there is further testing that needs to be carried out to add to its current robustness, and to ensure that it is able to be used easily and equally by all individuals. It is also necessary to examine potential stakeholders that will enable parsimonious and inclusive access to OMEDA PLUS.

3.18.1. Platforms / hardware

Further research would ideally include testing across different devices in order to support OMEDA PLUS to work on App platforms similar to that used for the aforementioned Kardia Mobile. Enabling use also on tablets would increase its portability and accessibility.

3.18.2. Input devices

To increase the portability of the tool, and the options available to users, further investigation needs to be carried out to ascertain if there is any significant difference between using the current input devices and using the keyboard. This would allow for the tool to be rolled out more widely without the addition of further cost for input buttons. Research into the UFOV test showed that there was no significant difference being found in participants using either the mouse or touchscreen version of the test (Edwards et al. 2006).

3.18.3. Results system

The Results are currently extracted via an excel file which are then examined and analysed by the researcher. This could be improved by developing an algorithm that would enable the provision of a score which could be easily and independently understood by the user. This is currently only able to be provided after analysis by the researcher.

Of importance would be the decision to devise further studies to compare the likelihood to make errors in judging TTC and CD with measures aligned with experience such as length of time driving licence is held and miles driven per annum. Here it would be important to compare the results of older drivers who had driven for longer with those who were relatively newer to driving.

Further research is required to test the limits of OMEDA PLUS. This is considered to be valuable because of its unique attempt to examine the higher order cognition process of judgement making. In order to continue to develop a test that continues in its intentions to reflect the real-world action of driving, it would be beneficial for future research to explore the link between results from the test and on-road driving. This was one requirement that was specified by the participants in Study 4. There was a general trust of the tool, but a tendency to prefer for it not to currently be used in isolation until it was validated against on-road driving.

Importantly, further research had been planned but was unable to be carried out within the time specifications of this research. There was an intention to discuss the tool and its relevance with other stakeholders in addition to those in Study 4.

Beneficial and necessary discussions regarding the relevance and likelihood of use of OMEDA PLUS with stakeholders such as GPs, Occupational Therapists and Driver assessment centres would serve to locate a secure position for this tool. Discussions with libraries and these other professionals would potentially provide a network of support for those approaching their own personal cusp of driving cessation.

3.19. Conclusion

Further validation is required regarding the link of the results to on-road driving, while further research would be beneficial to testing the true limits of the tool. Improvement can be made by testing of its effectiveness across platforms.

That being said, this research has successfully led to a portable tool OMEDA PLUS being developed and validated, enabling real world testing to be undertaken in the field to better determine fitness-to-drive. This new driver screening tool is easily manipulated by the researcher, and is able to reach a greater volume of people within the comfort of their communities.

4 Methodology chapter

4.1 Chapter summary

This chapter aims to present the research in terms of the research paradigms and methods chosen to answer the research questions. According to the questions that needed to be answered and due to the stance of the researcher, a pragmatic stance was utilized. This was further supported by using a mixed methods approach that will be discussed and evaluated below.

4.2 Introduction

This research serves to answer 2 sets of questions. Firstly, it measures the effectiveness of a new tool created to measure errors in the judgement of time to contact (TTC), and secondly it explores the perceived relevance and likelihood of use for this tool OMEDA PLUS. This automatically creates the necessity to make use of a variety of approaches, both qualitative and quantitative.

The research aims to show that age per se may not be the strongest determinant of crash likelihood, and that factors related to the ability to drive may also influence the decline in safe driving. In this way it argues that those defined as the older driver may be facing extra scrutiny simply because of age, and that regulations such as licence renewal at 70 may well be unfair. Kalache and Kickbusch (1997) remind us that physical and cognitive decline do not happen at a specific age, and there is certainly no sense of uniformity in these changes. As such the research argues that basing licence renewal on age is a version of implicit ageism.

A more extensive account of the Aims and Objectives together with the research questions were mentioned in the introduction chapter Sections 1.4 to 1.5.3 but the overarching 3 major aims are repeated here to aid flow of the chapter for the reader. These are accompanied by the related research questions. The Introduction Chapter includes aims to examine the justification of licence renewal at 70 and to explore the implicit ageism within. These topics certainly form part of the narrative overall. However regarding the methodological choices and study designs, the main 3 can be seen below.

4.3 Aims

- Develop a prototype of a portable version of a tool capable of measuring errors in judgement of time-to-contact of oncoming objects. This portability will increase the flexibility of its use as a tool which will extend its use allowing it to be able to be taken to the homes and workplaces of potential users and thus enabling individuals to engage with it regardless of their level of mobility.

- Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.

- Gather opinion regarding the relevance, and likelihood of use of the proposed tool, OMEDA PLUS.

4.4 Objectives

- **Develop a prototype of a portable, and therefore more inclusively designed, version of a tool capable of measuring errors in judgement of time to contact of oncoming objects.**

This requires the examination of the theoretical design of OMEDA as laid out by NL Read (2001) in order to extract information required for a reconstruction that replicates usage and baseline results. In addition to the experimental testing of OMEDA PLUS, interviews will also be carried out at this point in order to examine the usability of the hardware, and software.

In order to ensure that this tool works accurately, OMEDA PLUS needs to be tested, with results being compared against those of the original studies reported (Read 2001). This will be carried out in Study 2. Testing will be supported by a comparison to the second subtest of the Useful Field of View test (UFOV2) (Ball and Owsley 1993), which also assesses accurate reactions to, and recall of, objects under divided attention. In addition, the overall crash risk measurement provided by UFOV will serve to provide extra triangulation between accident history / likelihood and TTC awareness measured in OMEDA PLUS. This comparison between theoretical OMEDA, OMEDA PLUS and UFOV will be continued in Study 3.

The software will need to be tested in different settings, using a laptop to establish its usability and portability. The desktop version will need to be able to be re-configured so that it can be transported on a laptop. This will enable further testing of the tool's reliability and will also serve to create a list of issues that will need to be considered for future testing.

- **Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.**

This will require the examination of results based on variables other than chronological age. In this case, elements that might be seen to be linked with driving exposure and experience level will be interrogated. Variables will include:

  - Years driving licence has been held
  - Driving exposure (miles per year, days per week)
  - No of accidents / incidents (near misses)

Driving Habits Questionnaires (DHQ) will accompany the OMEDA PLUS test in order to gather the above details.

- **Gather opinion regarding the relevance and likelihood of use of the proposed tool, OMEDA PLUS.**

The ability to improve the original OMEDA to include a level of portability and accessibility will provide a much-needed test of safe driving that supports people who may be on the cusp of considering changing their driving habits to face that decision in an informed manner.

The interviews planned in Study 4 will seek to discuss the perceived relevance and likelihood of use of OMEDA PLUS by individuals who may be approaching these decisions.

4.5 Research questions

The main research questions are listed below:

- Can we measure fitness-to-drive in functional rather than chronological terms
- Does OMEDA PLUS show the same sensitivity to age, and to accident likelihood?
- Does OMEDA PLUS show similar results to established fitness-to-drive measures – specifically the Useful Field of View (UFOV) test?
- Can OMEDA's results show links to variables such as driving exposure, time the licence has been held, and self-reported accident history?
- Can time-to-contact be used to examine factors linked to the ability to drive safely when regarding fitness-to-drive?
- When on the cusp of driving self-regulation/cessation, is there a perceived relevance for the potential application of OMEDA PLUS?
- How likely would this group be to engage with the test?

This research then naturally fell into an interdisciplinary position. It aimed to support those labelled as older drivers to retain their driving status for as long as they safely choose to do so. It considered existing UK driving licence policy, and also worked within the field of cognitive psychology and on the periphery of engineering.

This then created the need for a varied selection of research questions. Not only was it required to examine the response of individuals to the OMEDA test, but it was also necessary to ensure that the test worked in line with the original.

Having examined the aims and objectives for this research, the methods to achieve these aims were carefully considered. A pragmatic approach with mixed methods would be necessary in order to both test the software and harness public opinion. This led to a combination of qualitative and quantitative methods to be used. This will be discussed in the following sections.

4.6 Pragmatism

Pragmatism provides a paradigm in which researchers are able to employ methods and methodologies according to the suitability and ability to …"[Carry] us from the world of practice to the world of theory and vice-versa" (Kelemen and Rumens, 2012).

It has therefore been seen to forge a link between academic research and the bid to improve practice and inform research (Kelly and Cordeiro 2020). Interestingly, the use of mixed methods from a pragmatic stance in a sense complicated the discussion around ontology and epistemology due to the overarching emphasis on action and experience of the participants. (Morgan 2014).

Pragmatism is important from a point of view of searching for truths. It provides the opportunity to evaluate data by ensuring that there is complete access to information via different methods and perspectives. This reflects the level of responsibility that the researcher holds. Whilst funding, peoples' time and opportunity is provided to the researcher, there is an importance to provide something back to society and to those who may not be afforded such opportunity. It reflects the importance of furthering research (Kelemens and Rumens, 2012).

Whilst the development of OMEDA PLUS requires careful analysis of very specific quantitative data. There is also a necessity for including a more qualitative and interpretative approach. This is specifically valid when examining the attitudes surrounding the relevance of the tool to the real world in terms of potential acceptance and likelihood of use. In practical terms also this approach adds a layer of robustness to the quantitative data. An example of this is in the decision to include interviews in study 2. This invited on the one hand, discussion around the practical attributes of the test (Pedal / instructions), and on the other hand it provided additional details about driving behaviour and crash experience which would serve to lend support to the pattern of results from the OMEDA test when required. For example were a participant to be found to create a high number of errors on the OMEDA PLUS test, but mention a lack of accidents at the interview this disparity might prompt further research into the tool itself.

Each of the studies required this pragmatic approach in order to maximize the data and also to continue to show a sense of respect for the time invested in the research by the participants. Logistically, this approach was executed using a mixed methods approach.

4.7 Mixed methods approach

This research starts from the point of view that qualitative and quantitative methods have equal relevance when searching for a true answer to a practical situation. This also by its very nature also expands the view of research methods to incorporate those which fall under each paradigm (Johnson & Onwuegbuzie 2004). This research not only follows a mixed method approach in terms of using both qualitative and quantitative methods, but philosophically it also incorporates elements of both deduction and induction (Johnson & Onwuegbuzie 2004). Such mixed methods approaches have been used in Social Justice research within counselling and psychology (Ponterotto et al 2004) and Health Psychology (Dures et al 2010).

As mentioned above the need to answer questions based on two separate yet related elements of research, it was necessary to use a mixed methods approach. From a positivist stance the research was able to approach the development of OMEDA PLUS which required scientific measurement that would indicate the effectiveness of the tool, and to ensure that the new augmented version of OMEDA worked similarly to the original. This provided a need for qualitative methods to be carried out using OMEDA PLUS and the UFOV test.

However, on the other hand, an important and novel element of this research included the gathering of data from participants with regard to their perceived relevance of OMEDA PLUS, and to their willingness to use the tool were it to appear on the market. This required more of an interpretivist approach. Semi-structured interviews were carried out to discuss opinions with stakeholders.

Some methods used encompassed both qualitative and quantitative data. The Driving Habits Questionnaires asked for figures regarding crashes or length of driving history, whilst at the same time asking for a description of crashes experienced.

The Survey in Study 1 similarly sought numerical and measurable data whilst also asking for perceived definitions of the older driver and reasons for the use of specific types of transport.

Where some might consider the place where quantitative and qualitative research meet to be a “battleground” (Kelemen & Rumens 2012), this research acknowledges the usefulness of and indeed necessity for the data to be gained via each paradigm. This research argues that there is an equal place in furthering scientific psychological knowledge for both quantitative and qualitative measures.

4.7.1 Advantages of a mixed method approach

The use of a mixed methods approach enables the researcher to answer more complex questions (Arcidiacono and De Gregorio 2008) that may be less possible with a single method. While quantitative methods would provide measurable data regarding the working of OMEDA PLUS, it would not effective in providing data regarding the relevance of the tool within the real world.

The use of multiple methods to examine the same phenomenon also provides the opportunity to triangulate results. Separate data can be compared resulting in an increased validity. (Bryman 1988 in Todd et al 2004). This approach also enables the researcher to examine different aspects of the same question (Brannen 1992 in Todd et al 2004). Within this research the use of interviews and experimental studies when examining OMEDA PLUS led to a richer body of data being provided. The research was able to establish not only the effectiveness of the tool but was also able to investigate the perceived relevance of the tool itself.

In this way mixed methods provide the opportunity to expand the reach of research beyond the development of the tool to incorporate stakeholders leading to an introduction of the product to those who may consider making use of it (Stringer 1996 in Todd et al 2004).

4.7.2 Disadvantages of a mixed method approach

The employment of mixed methods by its very nature can become time-consuming (Gunbayi 2020; Lopez-Fernandez & Molina-Azorin 2011). The need to transcribe and analyse qualitative data lengthens the time span of a study considerably. There is also the potential for the answers to the research questions to expand beyond what is specifically required with a tendency to decrease objectivity (Gunbayi 2020).

In order to carry out the mixed methods involved with a study, there also needs to exist an understanding of what is required to ensure that they are executed properly and this may require training to ensure that research is balanced (Ponterotto et al 2013; Todd & Nerlich in Todd et al 2004:226)

There needs to be an honest balance of reported results that utilise both methods to reach a truth as opposed to shifting between multiple methods in order to obtain desired answers. This flexibility could arguably lead to a decrease in objectivity which may be partially managed by reflexive accounts. In addition, further disadvantage lies in the potential for results from mixed methods to create contradicting results which fail to successfully answer the research question(s) (Dures et al 2010).

Relevant points will be revisited in the Discussion chapter that occurs post-research. The next section describes the mixed methods used.

4.8 The Studies: Data collection

The table below shows the methods used in each study. A discussion of each of the methods is discussed in the paragraphs below which has been divided into sections to cover qualitative and quantitative research requirements. However, it will also be acknowledged that some of the methods gathered data that was both qualitative and quantitative.

Table 4.1: Data collection methods across studies

Methods	**Used in Study yes ☒**			
	1	2	3	4
Online Survey	☒			
Driving habits Questionnaire A		☒		
Driving habits Questionnaire B			☒	
Driving habits Questionnaire C “initial questionnaire”				☒
Number plate test for visual acuity		☒	☒	
UFOV test – 3 subtests		☒	☒	
OMEDA test – 2 subtests		☒	☒	
Semi-structured Interview A & B		☒		
Semi-structured Interview C				☒

4.9 The Studies: Research methods

4.9.1 Quantitative methods

- OMEDA PLUS
- UFOV
- Driving Habits Questionnaire (DHQ)
- Number Plate Recognition test

4.9.1.1 OMEDA PLUS

The quantitative methods were derived from the use of OMEDA PLUS and UFOV, described below. OMEDA PLUS sought to measure the errors in TTC judgement under divided attention conditions.

The main OMEDA PLUS trials followed those of the original study. In order to create trials that would appear random to the participant, a table of all possible presentations was created within Excel, and trials were then randomised using online software offered by Random.org (Random.org 1998-2019). The presentations for this test were the same for both of the studies in which it was used, and were programmed in XML Notepad. The code for the tests can be found at **Appendix B3.1**.

Each of the 2 subtests carried out by the participants was preceded by a practice session. The main tests then measured the errors made when tracking and responding to the objects (red dots) as they moved to the centre of the computer screen at varied speeds where they were each obscured to a lesser or greater extent by an occlusion (yellow circle) of varying size. In the second subset where the participant witnessed 2 objects (red dots) moving towards each other, conditions were set so that the objects either hit, missed or nearly missed one another. These speed, size and collision condition options can be seen in **Table 4.2** below:

Table 4.2: Measurements for OMEDA PLUS subtests

	Number of presentations	Object speeds (path lengths / second)	Occlusion sizes (mm)	Collision conditions
OMEDA PLUS TTC Subtest	24	0.07 0.12 0.17	0.53 39.7 53 66.2	
OMEDA PLUS CD Subtest	36	0.07 0.17	0.53 39.7 53	Miss Hit Near miss

Presentations were created by ensuring that each of the conditions interacted with the others twice. For example, in OMEDA PLUS (TTC subtest), the object moving at 0.07 path lengths / second interacted with occlusions at each of the 4 sizes shown in **Table 4.3** below.

	Number of presentations	Object speeds (path lengths / second)	Occlusion sizes (mm)
OMEDA PLUS TTC Subtest	24	0.07 0.12 0.17	0.53 39.7 53 66.2
OMEDA PLUS CD Subtest	36	0.07 0.17	0.53 39.7 53

Table 4.3: Example of order of presentations in TTC subtest

This was repeated for the objects travelling at 0.12 and 0.17 path lengths per second meaning that 12 individual presentations occurred. This cycle occurred twice leading to 24 presentations being produced within subtest 1.

The secondary distraction task which accompanied each presentation was also organised to ensure that the geometric shape that appeared in the centre of the screen matched at least one of the shapes around the edge of the screen for exactly half of the presentations. The corner in which the matching shape appeared was balanced to ensure that the match occurred in each of the four corners equally. Again this was organised within Excel.

4.9.1.2 The useful field of view (UFOV) test

The UFOV test measured fitness-to-drive based on measurements of central and peripheral vision under increasingly complex divided attention conditions. It was able to produce a score for 1-5 that indicated safety to drive, with 1 being the safest and 5 being the least safe.

A description of the UFOV test was provided in the Introduction chapter. Displayed on a computer monitor at a viewing distance of 2.1 times the viewing height of the screen, trials were delivered in all 3 subtests, with each subtest being preceded by a trial session. Participants responded using a computer mouse.

4.9.1.3 Driving Habits Questionnaire (DHQ)

The DHQ included questions that were designed to obtain numerical data based on driving exposure and the length of time that the individual had possessed their driving licence (these will be described within the qualitative section as they cross both methodologies).

4.9.1.4 Number Plate test for visual acuity

This test was adapted so that it would be able to be carried out in varied settings. Participants were presented with an image of a number plate on the computer screen to test visual acuity. This was designed in line with measurements used on the Vutest website (Eyelab Ltd 2001) which enabled an image of 6.4 cm in width to be presented at a distance of 2.7 metres. This eliminated the need for the usual testing distance of either 20 or 20.5 metres enabling it to take place in a variety of different settings. Number Plate recognition test measured visual acuity in terms of pass and fail.

4.9.2 Qualitative methods

- Surveys
- Driving Habits Questionnaires (DHQ)
- Semi-structured interviews

4.9.2.1 Surveys and Questionnaires

Surveys and questionnaires were both used in addition to interviews. Questionnaires served to extract specific demographic data from the participants. These were self-administered at the beginning of the studies. The online survey (Study 1) enabled the study to reach a larger audience (Gail Neely et al. 2011).

4.9.2.2 Surveys

The first study consisted of a survey that was conducted online. There had originally also been a paper version of the survey which was placed in libraries and coffee shops, but there was no take up via this method, and so the research remained solely online. Surveys have been considered to be a cost effective method of collecting data with postage being less expensive than the potential costs sustained by carrying out interviews (Blair, Czaja and Blair 2013:53). This survey required time to be designed, uploaded and managed but it was able to be placed online as soon as the design was completed and approved via Coventry University ethics. The questions were grouped together in topics in order to provide a logical route through it, and apart from a few open-answer questions it was devised in such a way that required simple answers to be provided. The survey was designed to take no longer than 15 minutes, to prevent fatigue (Fanning 2005). This method has been recognised as an effective method for interdisciplinary research (Blair, Czaja and Blair 2013: 6)

This data gathered in the survey used in Study 1 informed the questions to be devised in the Driving Habits Questionnaires and Interview schedules that followed in later studies. It also served to create a list of individuals who indicated their willingness to participate in later parts of the research. A survey map can be seen in **Appendix B3.2**, and the survey itself appears in **Appendix B3.3**.

4.9.2.3 Driving Habits Questionnaires

Questionnaires can be a useful way of collating simple demographic data (Codó 2008). Using a combination of questionnaires and on-road driving tests, Baldock *et al.*, (2006) attempted to examine the link between the tendency for increased self-regulation amongst older drivers and actual fitness-to-drive. They questioned adults aged between 60 and 92 about their confidence in driving under certain circumstances, for example in the rain, at night and on motorways or busy roads in an attempt to ascertain self-regulatory behaviours. The interviews within Study 2 of the current research asks participants to talk about their favourite and least favourite journeys in an attempt to invite them to discuss situations and scenarios that they prefer to either drive in or avoid.

The use of questionnaires in this research served to collect simple demographic or qualitative data that was required of each participant. In each case, the questionnaire was designed in 16-point font in order to be of an inclusive design, and it was planned in such a way that it would take less than 5 minutes to complete. This was achieved in each case with each questionnaire having 10 or less questions.

The Driving Habits Questionnaires for studies 2 and 3 were similar, but for study 3 there was an inclusion of 2 questions regarding illness and medication. They were designed to obtain information about driving exposure and accident history. The Driving Habits Questionnaire devised by Owsley et al., (1999) asked participants about accident history, driving status, and driving exposure. Their questionnaire also asked about average weekly mileage, whereas the questionnaire for this study chose to ask about average annual mileage in order to gather information that was more likely to be known or remembered by the participant as a result of carrying out other activities such as updating annual car insurance.

Questions considering length of driving, length of holding driving licence and miles travelled per year were added in an attempt to create a way of measuring experience and endeavouring to provide a valid comparison to age as a variable.

In order to ascertain a level of driving ability, participants were asked to describe accidents and near misses that they had experienced. The American Automobile Association (2000) suggests that near misses and collisions may be a sign of a decline in the ability to perform the functions required for driving:

> ***Rear-enders, parking lot fender-benders and side collisions while turning across traffic rank as the most common mishaps for drivers with diminishing skills, depth perception, or reaction time.***

This research asked participants to state the number of near misses they had experienced over the 2 years prior to completing the DHQ. This 2-year timescale reflected the time periods examined within other bodies of research (Read 2001; American Automobile Association 1994; 2000).

The questionnaire in Study 4 continued to ask about driving exposure, but it became more in depth asking about types of roads that were travelled on, and about perceived levels of confidence and driving skill. The DHQs for each of the studies appear in **Appendix B3.4**, **Appendix B3.5** and **Appendix B3.6** respectively.

4.9.2.4 Semi-structured interviews

The use of the semi-structured interview enabled the participants to develop conversations in ways in which they felt comfortable to do. They were able to provide the important parts of their stories by sharing what was of importance to themselves (Longhurst 2003). This helped to build rapport as the interview was allowed to develop naturally as a conversation. In study 2, the addition of the interview served as a method for triangulating the information between questionnaire, quantitative methods and the interview itself (Longhurst 2003).

The interviews proved a valuable method of collecting data, as people not only offered their own stories, but also the stories of their friends, families and acquaintances. This enriched the data, as extra layers of information were added.

Two of the studies made use of the semi-structured interview. The first, study 2 used it as part of a mixed methods approach so that it might strengthen the quantitative data gathered via OMEDA and UFOV. It comprised semi-structured interviews that discussed confidence, car use, driving difficulties and experiences of different driving scenarios. These were worded slightly differently for drivers and non-drivers, but only differed in topic on one question that asks non-drivers when they stopped driving. The version presented to the drivers can be seen in **Appendix B3.7**.

Donorfio et al., (2008) found that it was not chronological age per se that led to an increase in reported self-regulatory behaviours, but rather the interaction of age with health status. As heath declined, whilst age increased, self-regulation was seen to increase. They also found that confidence in driving tended to decrease with age, also leading to a tendency to self-regulate. The interviews within this study asked drivers to rate their confidence as a driver, in an attempt to examine this relationship thereby seeking to identify reasons for eventual cessation that may not be solely related to chronological age. This was carried out by presenting the participant with a visual prompt on an A4 sheet showing a 5-point scale. Levels of confidence ranged from 1-5 with 1 representing the lowest level and 5 the highest. This study also sought to examine changes in driving activity that tended to arise as a result of the onset of illness. The interview was recorded with the consent of the participant.

The semi-structured interview used in the fourth study examined the perceived relevance of OMEDA PLUS amongst individuals who had either ceased driving or were beginning to show signs of self-regulation. It also explored their constructed definitions of the term “older driver”. Due to Covid-19 restrictions preventing face-to-face meetings, the interviews were carried out on online MS Teams, Skype and WhatsApp platforms or over the telephone dependent on the preference of the participant.

The schedule (**Appendix B3.8**) was sent to participants ahead of time so that they could prepare if they chose to. It also then offered them the opportunity to ask questions ahead of the interview if details were unclear. The questionnaire showed the questions for a semi-structured interview that asked about the participants’ experience of driving, and their perception of themselves as drivers. It then asked for feedback to the video regarding their perceived relevance of the test.

4.9.3 Other tools

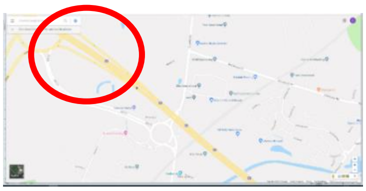
- Map representations
- Fact sheet
- Video

4.9.3.1 Map representations

The map representations were used in Study 2 as visual aids when carrying out the semi-structured interviews. These were drawn to reflect the design style of the OMEDA PLUS tests, and were based on real road maps of Coventry taken from Google maps (Google 2019). See **Table 4.4** below:

Firstly a junction demonstrating the desired layout of the road was found in street view:

This was then changed to the map view:



This was then converted into a representative image:

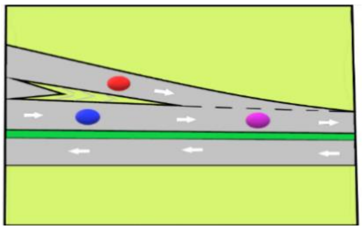


Table 4.4: Development of illustrations Study 2

These representations proved to aid the participant to recall situations that they had not remembered whilst completing the DHQ. Where accidents had been previously mentioned, these images appeared to prompt a richer discussion with people often assuming the position of a particular vehicle indicated on the representation.

4.9.3.2 Factsheet

This factsheet was designed for Study 4 and described the OMEDA PLUS test and offered background information. It was sent to participants ahead of interviews so that they were informed about the interview ahead of time (**Appendix B3.9**).

4.9.3.3 Video

The video (also used in Study 4) described OMEDA PLUS and showed a working example of the way in which it might be used. It then called upon individuals to discuss ways in which they might alter the test, whether it had any relevance and whether they would engage with it. A link to the video can be found in the Introduction chapter.

A description of the development process regarding the video establishes the reasoning behind each design choice.

1. A storyboard was created within PowerPoint. This moved through several iterations until the final format was chosen.
2. OMEDA PLUS practice presentations had to be programmed using XML. This was designed to present an example of all of the situations that occur when carrying out the test.
3. Images were sought to clearly illustrate the points made within the storyboard. Images free of copyright were sourced from Pexels.com. A search of online images for older drivers for the video proved unsuccessful, with most of the mature drivers facing the photographer with their thumbs up. The video required a photo of a mature driver in driving pose facing forward. The video required a photo that simply showed a driver of a mature age in driving pose at the wheel. This was taken by the researcher with permission from the subject.
4. Images and storyboard were then transferred to Animation Desk software, with the frames per second being adjusted in order to allow reading time for the on-screen captions. The slides showing the working example of OMEDA PLUS were also arranged to ensure that the timings and movement of the objects on the screen reflected that of the actual test.
5. The script (**Appendix B3.10**) was then completed and laid down over the animation. This went through two iterations as video edits occurred. The second iteration suffered when the audio track disappeared, and Audacity software was employed to isolate the vocal line so that it could be re-laid. A second track with corrections was then spliced into the original audio track.

Upon completion, the video was uploaded to a private (link required to view) channel on YouTube. This link could then be copied and sent to participants. **Appendix B3.11** shows screenshots to exemplify content of the video.

Having introduced the studies and the methods used, the section below completes the details of each of the studies in turn.

4.10 The Studies: Analyses to be used

Analyses will be carried out making use of Excel, SPSS, and NVIVO. For Study 1 (Survey), analyses will be carried out using Excel and SPSS, in addition to using data collated from the Bristol online survey (BOS) report. Much of this analysis will be descriptive and will aim to show cross tabulations and percentages relating to individual choices of travel and decisions around driving cessation. Questions that require longer explanatory answers will be treated as qualitative data and will be analysed using either Excel or Nvivo.

The data in Study 2 will also produce both quantitative and qualitative data. The qualitative data will be analysed using thematic analysis in NVIVO, with the quantitative data being analysed within SPSS. A Spearman's correlation is planned to compare the relationship between variables.

The third study will employ a One-Way ANOVA in order to replicate the analysis carried out by Read (2001). This will serve to examine the similarities in operation between the original test and the rebuild. Secondly a Spearman's correlation was carried is planned in order to provide a comparison across measures based on a level ranking. This will serve to highlight the strength and direction of the relationship between variables. Direction will not be assumed leading to the analysis to be entered as two-tailed.

The fourth and final study will be analysed using Interpretative Phenomenological Analysis (IPA). A discussion detailing the qualitative analyses follow in the section below. The quantitative analyses will be discussed as they arise in the discussion sections for each of the relevant studies.

4.11 IPA

This research focuses on relationship between people and driving – their experiences as drivers and also as adults approaching driving cessation. It explores some of the issues of becoming an older driver and what adds to the definitions of this status. It presents a new tool designed to act as a personal decision aid as this time approaches and asks this group of people whether this tool has relevance for them and whether or not they might be likely to welcome it and make use of it.

As such, the research requires methods of data gathering and analysis commensurate with this important, and indeed invaluable, information. The combination of semi-structured interviews and IPA analysis provide this opportunity. Participants are able to lead the discussions and are able to define the themes based on their interpretation of the questions. This provides the researcher with alternative views and experiences that serve to create an honest and well-rounded report.

The researcher with a background in human factors and health psychology supports the bid of (Smith, 1996) to harness a discipline-based qualitative approach within Psychology (Smith et al, 2009).

The use of IPA provides this whilst also enabling the researcher to gain insight into the way that people make sense of their interactions with the world. Categories are able to emerge from peoples' own words as they unravel the different levels of their experiences. Flowers and Larkin suggest the use of an analogy of going for a swim after not having swum since childhood. On one level you experience a flow of consciousness where you suddenly notice the pebbles underfoot, or arrive at the cold water, but over and above this is another layer of the experience to you – you might be taking this swim as a return to fitness after an injury, which might then create additional significance. This might be the first time that you have uncovered since surgery

This research utilises the method proposed by Flowers and Larkin (2009) but refers closely to Langdridge 2007 due to the clear practical guide for carrying out their approach. This was used as an educational guide by the researcher.

Smith's (2009) aim to highlight relevance of qualitative approach. This research embraces this importance of the experience of the individual and the relevance of the qualitative approach (Smith et al 2009). While OMEDA PLUS has been created to provide answers to a problem, it is of great importance to examine the relevance of this tool as much as is possible through the eyes of those who may or may not be destined to use it. One valid way to ensure this research is justified is to discuss the issues with those concerned. To begin to appreciate their lived experience especially as part of the method of measuring the relevance of OMEDA PLUS. These discussions can also serve to direct the intended use – to justify its use in a more private and less commercial setting.

Study 4 in particular respects the value of human experience regarding the attitude towards and perceived relevance of OMEDA PLUS.

There will be a need for the researcher to retain an understanding of the potential influence that their own personal experience and opinions might hold, and the need for reflexivity will be upheld. The need for a conscious retention of an interpretivist approach will be maintained. This is an advantage of IPA – whereas the researcher at the end of the day hopes that OMEDA PLUS will work successfully and be perceived as relevant, the emphasis placed on the responses from participants allows for honest and less biased perspectives to be reported.

It is acknowledged also that the researcher is not on the cusp of driving cessation and is therefore separate from the purposive sample for study 4. As such, an interpretivist stance is supported by the researcher holding an external position to the research. A sense of epoché (that separation between researcher and participant) (Langdridge 2007) will be actively retained so as to ensure that the words ant themes can be fully drawn from the participants' interpretations of the questions asked.

There will be a need to manage the potential for any sense of power imbalance arising from the circumstances in which the interviews will be held. Study 4 will be carried out against the backdrop of the Covid-19 restrictions. As such care will be made to ensure that participants are assured that any sense of power imbalance between researcher and participants has been removed by ensuring that questions are sent ahead of time. This will also to remove any sense of the interview being perceived as a test of any kind. Emailing the interviews prior to online discussion will also serve to provide the beginning of a rapport between researcher and participant. It will also allow for extra reminders of the right to withdraw from the research.

This research considers the effect that the epidemic has been seen to have on the existing digital divide and the increased need to remain connected through technology (Xie et al. 2020). The necessity to use technology in order to keep in touch with others, or for example to manage finances has led to an increased use of online functions by people who had not previously made use of such services. This has included a section of older people who had formerly represented part of this digital divide (Centre for Ageing Better 2020b). An acknowledgement was also made by the researcher of potential digital divide effects at each stage. Any instructions will include a step-by-step guide to ensure that all individuals are supported to carry out elements of the research such as playing the attached video or returning emails. Participants will also be offered the option of chatting over the telephone in order for interviews according to their preferred methods.

The sampling for Study 4 which will be utilising the IPA method will be discussed later in the Studies Chapter. It will be a purposive and homogeneous sample who will be invited to take part in a semi-structured interview using open questions allowing for participants to lead the discussion based on their perceptions (Langdridge 2007; Smith et al 2009).

This was chosen as a method of analysis will serve to empower the participant to share what they are comfortable to disclose, whilst at the same time enabling the researcher to identify topics that might have been averted. This sense-making approach arguably served to retain the sense of a cognitive paradigm (Fiske and Taylor 1991). This consideration of the human brain having similar storage and working facets to a computer has been a dominant theme in the research so far (McLeod 2015).

The planned steps within the process being shown below:

1. Created a document showing each transcript line-by-line
2. Added interpretative "researcher initial notes"
3. Created initial coding
4. Used initial codes to create superordinate themes by "clustering"
5. Added line numbers of quotes to each Cluster/superordinate theme
6. Linked superordinate theme to lines in transcript
7. Repeated this for each participant
8. Created "master" file that contained all themes and line numbers for each participant according to codes created across individual participant.
9. Examined similarities and differences across the sample.

Once completed, the themes will be verified by an independent researcher.

-

4.12 Thematic analysis

Whilst Study 4 will be analysed using IPA, the flexibility and lack of attachment to a particular theoretical stance of Thematic Analysis (Braun and Clarke 2006) is preferable and more effective for the interrogation of the data collected in the first two studies. The standardised method for carrying this out has been laid out by Braun and Clarke (2006), and is broken down into the following stages:

1. **Familiarization of data:** this is aided by transcription, and by annotation of the script throughout the reading stages.
2. **Initial coding:** listing initial codes across the data set.
3. **Create initial themes:** synthesize initial codes into themes, and group all data under heading.
4. **Review themes:** Review to ensure that themes can represent the data. Generate a thematic map.
5. **Define the theme:** This includes ensuring that each theme is clearly described.
6. **Report results:** description of themes incorporating quotes to reflect answers to research questions.

The methods used to examine the data in the first 2 studies will employ these methods. The qualitative data from Study 1 will comprise responses to the open-ended questions in the survey. This will include examining attitudes to driving, self-regulation/cessation and perceived definitions of the “older driver” across people of different age groups and levels of experience. Study 2 requires a larger scale analysis of interviews carried out alongside the computer-based testing. The qualitative data will serve to highlight the differences between self-reported driving and accident behaviours and the responses measured in the UFOV and OMEDA PLUS tests for safe driving.

4.13 Conclusion

The pragmatic methodology with the employment of mixed methods has been justified as being the most appropriate approach when applied to this research. It will serve to ensure that the tools are capable of providing reliable measurement of TTC and safe driving ability; whilst also ensuring that OMEDA PLUS is developed in line with usability testing by, and discussion with, members of the public. In addition, the research will be able to examine opinion as to the relevance of its existence and potential usage as a test of safe driving. OMEDA PLUS in conjunction with interviews and questionnaires, will allow for the examination of variables other than chronological age when measuring fitness-to-drive. This mixture of methods are capable of providing a richer source of data, which will serve to lead to more comprehensive answers to the research questions.

5. The Studies

5.1. Chapter Summary

The following chapter summarises the aims and objectives for the studies carried out and outlines the analysis methods and tools used. It shows the flow of the research and describes the ethical considerations required for the studies undertaken and provides a description of each of the studies with an explanation of the iterative process with which they were designed and carried out. The chapter then concludes with a discussion and conclusion drawing the studies together before moving onto the broader discussion of the research as a whole.

5.2. Introduction

Four studies were designed to expand an existing OMEDA test (Read 2001). The research was interdisciplinary and aimed to support those labelled as older drivers to retain their driving status for as long as they safely chose to do so. It considered existing UK driving licence policy, in addition to referring to terms used in cognitive psychology and within engineering. The research questions reflected this multi-faceted nature. Whilst on the one hand it required an examination of individuals' responses to the OMEDA test (later referred to as OMEDA PLUS), it was also necessary to ensure that the tool worked in line with the original.

The original OMEDA research had failed to capture the perceived relevance and likelihood of use for the tool. This research sought to fill this particular gap. Additionally, it was found that the lack of portability represented a limited inclusivity of design. Creating a version of the test that would be able to be taken to homes and workplaces would lead to an increase in its usability among individuals with either limited mobility or time. Furthermore, creating a version of the product that might be able to be accessed independently within the home would potentially enable concerned individuals to attempt the test without scrutiny as they privately considered their driving options. The development of a tool allowing this independent consideration was uppermost in this research.

This inclusivity of design would seek to provide a tool that would help drivers to examine their fitness-to-drive where concerns or question may have arisen due to a perceived change in driving ability. This would be able to be applied regardless of age.

5.3. Studies at a glance

Working from a pragmatic stance, a variety of methods were employed to explore the **Error! Reference source not found.**outlined in the Introduction chapter. A summary of the studies can be seen in **Table 5.1** below. A second table (**Table 5.2**) links each study to its specific research questions, aims and objectives, and methods used. This also serves to present the pathway of the research by placing each study in context and showing the relationship between itself and the other three studies.

Table 5.1: Summary of studies showing breakdown of methods

<table>
<tr><td></td><td>Survey to examine driving and eye health behaviours, and accident experience by age</td></tr>
<tr><td></td><td>
The study was conducted to examine driving habits and reasons and effects of driving cessation and self-regulation. It sought to investigate types of accidents that occurred and explored potential factors for their occurrence.

The survey comprised 45 questions, and was launched on Bristol Online Survey software (BOS) (now known as Jisc online surveys) between 3 December and 18 January 2019, and was distributed via the Doctoral College newsletter, Twitter and Facebook. 124 people responded. 5 were excluded due to being non-UK based or living where driving conditions were different from mainland UK. N=119, age range 18-84 (mean 45.24).

<table>
<tr><th>N=119</th><th></th><th>Male</th><th>Female</th><th>Not stated</th></tr>
<tr><td>Drivers</td><td>108</td><td>42</td><td>65</td><td>1</td></tr>
<tr><td>Non-drivers / retired drivers</td><td>11</td><td>2</td><td>8</td><td>1</td></tr>
<tr><td>Totals</td><td>119</td><td>44</td><td>73</td><td>2</td></tr>
</table>
Because of the nature of responses, and further plans for Study 2, the groups were reorganised into Older and Younger groups as can be seen below:

<table>
<tr><th>N=119</th><th></th><th>Male</th><th>Female</th><th>Not stated</th></tr>
<tr><td>Younger group (18- 43 years)</td><td>59</td><td>20</td><td>37</td><td>2</td></tr>
<tr><td>Older group (45 -84 years)</td><td>60</td><td>24</td><td>36</td><td>0</td></tr>
<tr><td>Totals</td><td>119</td><td>44</td><td>73</td><td>2</td></tr>
</table>
Analysis was carried out using SPSS (IBM Corp 2017), Excel (Microsoft 2016) and NVIVO (QSR 2018).
</td></tr>
<tr><td>Study 2</td><td>Introducing and testing OMEDA PLUS</td></tr>
<tr><td></td><td>
A mixed methods design was employed in order to test the robustness of OMEDA PLUS. The tool was used to measure errors made in judgement of TTC across age groups and now across differing levels of experience. Compared to results generated by original study (Read 2001) and also with the results obtained in the UFOV test by the current sample. This study experienced difficulty with recruitment, and lost potential participants due to both portability, and the decision to mirror the age groups from the original study.

The study took place between 29 April and 31 July 2019 across Coventry University locations and comprised:

Driving Habits Questionnaire (DHQ)
OMEDA PLUS test (both subtests)
UFOV test (all 3 subtests)
Semi-structured interview
Number plate recognition test for visual acuity

<table>
<tr><th>N=18</th><th></th><th>Male</th><th>Female</th></tr>
<tr><td>Younger group (18-25 years)</td><td>10</td><td>5</td><td>5</td></tr>
<tr><td>Older group (≥ 60 years)</td><td>8</td><td>4</td><td>4</td></tr>
<tr><td>Totals</td><td>18</td><td>9</td><td>9</td></tr>
</table>
Analysis was carried out using SPSS and NVIVO.
</td></tr>
</table>

Table 5.1 continued: Summary of studies showing breakdown of methods

<table>
<tr><td>Study 3</td><td>Examining the comparative usefulness of the useful field of view test and OMEDA PLUS Preliminary Results</td></tr>
<tr><td></td><td>The methodology employed was experimental, employing a within-participants design with all participants being asked to carry out the same selection of tests. The study was covered by Coventry University’s ethical approval, and each participant undertook the four tests outlined below between 11 and 29 October 2019:

DHQ (inclusive of health and medication questions)
OMEDA PLUS (both subtests)
UFOV (all 3 subtests)
Number plate recognition test for visual acuity

<table>
<tr><th>N=40</th><th></th><th>Male</th><th>Female</th></tr>
<tr><td>Younger group (23-47 years)</td><td>21</td><td>6</td><td>15</td></tr>
<tr><td>Older group (47-89 years)</td><td>19</td><td>7</td><td>12</td></tr>
<tr><td>Totals</td><td>40</td><td>13</td><td>27</td></tr>
</table>

The portable version of the study continued to test the robustness of OMEDA PLUS whilst examining the variables that appeared to affect TTC. N=40 with age groups split around the median of 47. Recruitment was successful due to portability and a change in age and health inclusion criteria. The DHQ asked participants to declare illness and medication that might affect driving but did not exclude them.

Analysis was carried out using SPSS.</td></tr>
<tr><td>Study 4</td><td>Remote interview to establish relevance and likelihood of use for OMEDA PLUS – to be analysed using Interpretative Phenomenological Analysis (IPA)</td></tr>
<tr><td></td><td>Online Semi-structured interviews took place 1 -7 July 2020 amongst a homogenous group of drivers aged over 55 years. Inclusion criteria required drivers to have either ceased driving or to have begun to show signs of self-regulation. The study aimed to examine perceived relevance and likeliness of use regarding OMEDA PLUS.

<table>
<tr><th>N=7</th><th>Sex</th><th>Age</th></tr>
<tr><td>Participant 1</td><td>Male</td><td>59</td></tr>
<tr><td>Participant 2</td><td>Female</td><td>75</td></tr>
<tr><td>Participant 3</td><td>Female</td><td>75</td></tr>
<tr><td>Participant 4</td><td>Male</td><td>76</td></tr>
<tr><td>Participant 5</td><td>Male</td><td>91</td></tr>
<tr><td>Participant 6</td><td>Male</td><td>67</td></tr>
<tr><td>Participant 7</td><td>Male</td><td>64</td></tr>
</table>

Interviews were carried out online and over the telephone. Interpretative Phenomenological analysis (IPA) was carried out using Excel as NVIVO was unavailable at the time.</td></tr>
</table>

Now follows the aforementioned **Table 5.2**:

Table 5.2: Iterative studies with detail

Study Number	Research questions addressed	Aims	Objectives	Methods used	Timeframe (i.e. length of study and when it was carried out)	Flow of studies
1	**1. How can the older driver be defined?** **2. Is there an alternative to chronological age when measuring fitness-to-drive in older drivers?** **3. What is the impact of cessation?**	**Explore definitions of older driver** **Examine alternative factors to chronological age when measuring fitness-to-drive in older drivers.** **Address impact on cessation.**	**Via an online survey query the definitions given to the term "older driver" by groups of older and younger groups.** **Examine responses in order to extract factors other than chronological age when defining "older drivers" in an attempt to ascertain alternative factors.** **Query value of driving and thoughts about cessation.**	**Online survey** ***Quantitative (Quant) and Qualitative (Qual) data obtained.***	**Duration 7 weeks** **3/12/2018 to 18/01/2019**	**Opportunity to access data from current and retired drivers of all ages. Began to highlight factors other than chronological age which might affect fitness-to-drive** **Highlighted importance of driving and the effects of cessation** **Justified work on OMEDA PLUS**
2	**1. Does OMEDA PLUS reflect reported workings and results of the original OMEDA study?** **2. Do patterns of errors within this version of OMEDA reflect those of UFOV under divided attention conditions?** **3. What factors appear to affect errors in TTC as measured in OMEDA?**	**Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.** **Establish usability of OMEDA PLUS**	**Test OMEDA PLUS with results being compared against those of the original studies reported (Read 2001). Testing to be supported by a comparison to the second subtest of the Useful Field of View test (UFOV2) (Ball and Owsley 1993), which also assesses accurate reactions to, and recall of, objects under divided attention. In addition, the overall crash risk measurement provided by UFOV will serve to provide extra triangulation between accident history / likelihood and TTC awareness measured**	**Driving Habits Questionnaire (DHQ) *Quant & Qual data obtained.*** **OMEDA PLUS test (both subtests) *Quant data obtained.*** **UFOV test (all 3 subtests) *Quant data obtained.*** **Semi-structured interview *Qual data obtained.***	**Duration 15 weeks** **20/04/2019 to 31/07/2019**	**Showed OMEDA PLUS to work – still in need of further testing of reliability and validity.** **Design problem in choice of age groups – to be altered in study 3** **Also lost some potential participants due to their mobility and ability to access university – strengthened argument to work on extending the portable aspect of OMEDA PLUS**

			in OMEDA PLUS. This comparison between theoretical OMEDA, OMEDA PLUS and UFOV will be continued in Study 3. This will require the examination of results based on variables other than chronological age as explored in Study 2.	Number plate recognition test for visual acuity *Quant data obtained.*		
3	1. Hypothesis 1: OMEDA PLUS will show a sensitivity to age, with mean errors increasing from younger to older age groups 2. Hypothesis 2: OMEDA Plus will show a sensitivity accident risk 3. Hypothesis 3: OMEDA PLUS tests of CD and TTC will mirror that of UFOV2 4. Hypothesis 4: OMEDA PLUS errors will mirror those of the original version of OMEDA 5. Hypothesis 5: Time driving licence has been held, average	Develop a prototype of a portable version of a tool capable of measuring errors in judgement of time-to-contact of oncoming objects. Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.	Test OMEDA PLUS with results being compared against those of the original studies reported (Read 2001). Testing to be supported by a comparison to the second subtest of the Useful Field of View test (UFOV2) (Ball and Owsley 1993), which also assesses accurate reactions to, and recall of, objects under divided attention. In addition, the overall crash risk measurement provided by UFOV will serve to provide extra triangulation between accident history / likelihood and TTC awareness measured in OMEDA PLUS. This comparison between theoretical OMEDA, OMEDA PLUS and UFOV will be continued in Study 3. Test OMEDA PLUS in different settings, using a laptop to establish its usability and portability.	DHQ (inclusive of health and medication questions) *Quant & Qual data obtained.* OMEDA PLUS (both subtests) *Quant data obtained.* UFOV (all 3 subtests) *Quant data obtained.* Number plate recognition test for visual acuity *Quant data obtained.*	Duration 2 weeks approximately 11/10/2019 to 29/10/2019	Portable version of OMEDA PLUS tested – found to work in the same way as in Study 2. Still need for further validation and reliability testing. Further face-to-face testing prevented by Covid-19 leading to a changed Study 4

	miles driven per annum and number of days driven per week will have an effect upon OMEDA PLUS results with regards to TTC errors made		This will require the examination of results based on variables other than chronological age as explored in Study 2.			
4.	1. When on the cusp of self-regulation / driving cessation is there: a) Perceived relevance for the potential application of OMEDA PLUS? b) How likely would this group be to engage with the test? c) To what degree would this group trust the measured results and their intended use?	Gather opinion regarding the relevance, and likelihood of use of the proposed tool, OMEDA PLUS.	The interviews planned in Study 4 will seek to discuss the perceived relevance and likelihood of use of OMEDA PLUS by individuals who may be approaching these decisions.	Semi-structured interview *Qual data obtained.*	Duration 1 week 01/07/2020 to 07/07/2020	Intention to gather opinion from older drivers regarding OMEDA PLUS was always planned. This study was re-designed in light of Covid-19 restriction Served to gather opinion from older drivers regarding value and likelihood of use of OMEDA PLUS

The studies emerged in an iterative way. The first step was to ensure that the research was justified and that there was a need of the public to discuss the need for more agency over the process of changing driving behaviour. This was a project that would only be carried out if it was deemed to potentially be useful to people in the long run.

Study 1 was designed to be deliberately broad so that it could enable elements alternative to chronological age to emerge. During the early ages of the research it was important to allow for the data to be explored via the experience of the participants. This may have included physical, emotional or geographical factors. In this way the survey questioned the broader related topics related to the impact of cessation, and the choices made where alternative transport needed to be located.

The broad nature of the study, and the discussions around “older driver” definition gave rise to potential factors such as:

- Chronological age
- Experience
- Changes in driving style
- Length of time the driving licence had been held
- Levels of age-related health
- Proximity to retirement
- Functional ability
- Driving exposure on a day-to-day basis
- Comparative age
- Levels of confidence

In addition the responses to queries regarding the level of importance of driving (74% for drivers and 64% for retired drivers) also suggested that the level of agency over driving cessation was important to explore. This strengthened the need to examine ways in which the test could become accessible on a private level.

Study 2 included a semi-structured interview which was used to add to the usability report / testing for OMEDA PLUS. Participants were invited to discuss their opinions of the test from a point of view of the task, but also with the hardware in mind.

Overall the study was designed with two main issues in mind. Firstly, it needed to begin the testing for the reliability and validity of OMEDA PLUS, whilst also continue to explore the themes that might emerge as alternatives to chronological age when discussed with members of the public. It also served to examine the types of crashes and near misses that had been experienced by participants.

Had the relationship between incidents and the TTC results been completely negative, this would have brought into question the reliability of the tool.

Study 3 continued to investigate the reliability and validity of OMEDA PLUS. It retained the tests used in Study 2 but this time realised the need for portability. Configuration was examined in order to ensure that the researcher could travel to different sites with laptop or other static computers. This also allowed sessions to be booked with individuals around their working day. It also served to highlight issues that would need to be considered in order to ensure that the tests was taken under suitable circumstances regardless of location – for example it would be necessary to place the screen out of the way of glare. The groups tested were broader than study 2 in that the age groups were not divided between younger and older groups ahead of the study. The division occurred when required by the analysis depending on what aspects of age and function were being explored.

Study 4 was originally designed to test further with participants in order to strengthen the reliability but was curtailed by Covid-19 restrictions. This fortunately allowed the opportunity to carry out important research regarding the opinions of OMEDA PLUS and the likelihood that people might have for using such a tool. This necessitated the need to create an explanatory video showing the test in action, so that people would be able to provide their opinions. Because it was decided to use IPA as an analysis tool for this study, it was necessary to secure a purposive sample. This was limiting in that it required people with a shared experience. The time limits of the research prevented opinion to be gathered from potential stakeholders at this point.

The section below describes the ethical and recruitment considerations undertaken for each of the studies. This is then followed by reports of each of the individual studies in turn showing the development of the research.

5.4. Ethical considerations

All research was carried out after having gained ethical consent from Coventry University. The primary Certificate of Ethical Approval is located at the front of the thesis with the rest of them together with the Records of Approval documents following in **Appendix A** as required by Coventry University Postgraduate Research Thesis & Submission: Information and Guidance (Coventry University 2018). Guidelines for the relevant professional body, the British Psychological Society Guidelines (BPS 2018) were also followed. The researcher also upheld a valid online account with the Disclosure and Barring service.

Participants were asked to provide informed consent at the start of any experiment/interview. Covid-19 created the need for a slight change in the indication of consent for Study 4. Participants were sent an email that included the statements:

1. **Your return email will represent your consent), it would be helpful if you would complete and return this short questionnaire.**

And:

2. **Consent decision**
   ***I Agree to take part in the study / I would prefer to not take part in the study (*Please delete as appropriate - Due to Covid-19, your agreement within this email will be taken as the equivalent of you signing the consent form).**

This provided a two-stage check that individuals had chosen to consent. In retrospect, statement 2 became unnecessary as nobody who returned the email as per statement 1 chose to opt out of the study. Had they done so, the participant would have been thanked and assured that they would not be contacted again regarding the study.

Each participant, in each of the studies, received a detailed Participant Information form and an Informed Consent form. In order to minimise any sense of a power imbalance, time was taken to create a sense of rapport over email ahead of any interviews. This included sending interview questions and Participant Information sheets ahead of the meeting so that the participant felt comfortable to discuss any questions or issues prior to the process. In order to ensure the comfort of participants during interviews in the final study, a choice of communication methods was offered comprising online virtual semi-structured interviews via Skype and similar platforms, and telephone interview. Had the situation arisen, thought had also been given to the use of email interviews.

Individuals were assured of confidential and safe management of their data which was stored online on Coventry University OneDrive with any paper copies being stored in a secure room until the date for destruction 31 March 2021. Recordings, however, were deleted once transcripts had been completed.

People were reminded of their right to withdraw from participation during any time throughout the process and were assured that their data would be destroyed at any point at which it might be requested.

Rewards, as noted in each ethics application were offered for studies 1, 2 and 3. Participants were reminded that any choice to withdraw would not alter their access to rewards. Rewards were as follows:

- Study 1: Chance to win a £25 Amazon voucher
- Study 2: £10 Love2Shop voucher for each participant
- Study 3: Chance to win a £50 Amazon voucher

All experimental and interview sessions ended with a written and/or verbal debrief where participants were also reminded of the channels of complaint available to them.

Consideration had been made in case of the following conditions:

1. Non-driver unable to complete test – this happened on one occasion as the participant in question found the use of the computer difficult when carrying out the UFOV test. With this in mind, the decision was made to shorten the test without making the participant feel that it had anything to do with their ability, but that they had provided the information required about the test. They were thanked and debriefed with a cup of tea to ensure that they were otherwise well.

2. Driver unable to complete test and show signs of being unsafe to drive, or having been in situations that highlighted an unsafe level of driving – this did not occur, But the planned action would have been to have stopped the test at an opportune moment and suggest a chat over a coffee away from the study room. The chat would include talking about safe driving and how they were feeling post-test – This would include the input of a supervisor if required. A taxi would then be suggested and arranged in order to ensure their safe journey home. This might also then include signposting towards their GP, Optician or to an assessment centre where they could gather more information about their circumstances.

5.5. Risk assessments

Studies 2 and 3 both required research to be carried out under lone-working conditions necessitating the completion of a risk assessment for each study. To ensure a safe working environment, the researcher formed a “buddy” relationship with a colleague who was given the contact details of the relevant supervisory team. This buddy was contacted by text at the start and end of each data collection session.

5.6. Recruitment

Advertisements for recruitment for all of the studies were placed on social media platforms Twitter and Facebook. The research was also promoted via Coventry University online newsletters. Great support was offered by the Coventry Libraries who advised on the poster design for their visitors and welcomed and supported researcher presence into some of their smaller libraries. The FabLab Coventry (an innovative space that provides an environment and materials that enable researchers and the broader community to meet and share skills) offered invaluable help by supporting advertising on their Twitter and Facebook pages, and offering premises on a regular basis to carry out research.

Recruitment was also aided by links to a local Retirement Village that advertised the studies but asked to remain nameless, and offered a regular day and premises in which to carry out research. Online forums such as the Older Voices Coventry, the Road Safety Knowledge centre, and the Older Drivers Forum also shared the adverts.

In addition walk-in drops of paper advertisements were also carried out at local coffee shops, with emailed advertisements being sent to local groups specifically attended by older people.

5.7. Data Collection

Data collection for all of the studies occurred between 3 December 2018 and 7 July 2020. The **table (5.3)** below indicates the tools and methods that were employed for each study. A description of each study follows.

Table 5.3: Data Collection methods per study

Methods and Tools	**Used in Study yes ☑**			
	1	2	3	4
Online Survey	☑			
Driving habits Questionnaire A		☑		
Driving habits Questionnaire B			☑	
Driving habits Questionnaire C “initial questionnaire”				☑
Number plate test for visual acuity		☑	☑	
UFOV test – 3 subtests		☑	☑	
OMEDA test – 2 subtests		☑	☑	
Semi-structured Interview A & B		☑		
Semi-structured Interview C				☑
Factsheet				☑
Video				☑
Map representations		☑		

5.8. Piloting

Study 1

Survey was first piloted with 5 people between 01/11/2018 and 05/11/2018. They were asked to complete the survey to ensure that the skip logic worked. They were also asked to report any lack of clarity in language and any typos.

This served to improve the language. One tester suggested that some of the questions used jargon and suggested that I change it to move regularly used language:

> ***Sometimes people temporarily regulate their driving due to certain factors such as coping with a cold or being tired. Have you ever altered your driving in this way?***

Was changed to

> ***Sometimes people temporarily change their driving due to certain factors such as coping with a cold or being tired. Have you ever altered your driving in this way?***

One tester suggested grammatical changes that needed to be carried out:

> ***3rd paragraph of first page - lose comma before "and". "And" always acts as a comma in a sentence.***

Another pointed out some of the problems that occurred with the formatting of the questions that offered "other" as an option.

> ***I think it would be good if when respondents select 'other' if only then the additional fields they need to complete appeared - rather than them disappearing if they are not needed (this is actually something that happens throughout the survey).***

The survey was updated according to the reports provided by the testers and then 12 people were invited to work through the study one more time between 6/11/2018 and 11/11/2018 in order to ensure that the changes worked and that the survey flowed smoothly. The survey was then launched on 3 December and closed on 18 January 2019.

Study 2 and Study 3

Prior to study 2 OMEDA PLUS was tested from a usability point of view by colleagues (user-centred / human factors professionals) at the National Transport Design Centre. The process and outcomes are described as Section 3.1.

This was carried out again prior to the launch of Study 3.

The interviews for study 2 were practised with colleagues from in order to measure likely timings.

Study 4

The piloting for the questions in Study 4 occurred during Coronavirus restrictions and were tested with family members and friends so that the online technology (email, Skype WhatsApp and MS Teams) could be tested.

5.9. Study 1: Survey to examine driving and eye health behaviours, and accident experience by age

5.9.1. Introduction

The aim was to survey between 100 and 150 drivers, both current and retired. This would encompass individuals aged 18 and above and would serve to examine driving behaviours and experience. It was presented online via Bristol Online Survey and ran for 6 weeks. Analysis was carried out using Excel and SPSS.

This study sought to examine alternative factors to chronological age when measuring fitness-to-drive in older drivers. A definition for the term "older driver" was also explored in order to begin to build a clearer picture of who might populate this group.

The following three questions were therefore examined:

- How can the older driver be defined?
- Is there an alternative to chronological age when measuring fitness-to-drive in older drivers?
- What is the impact of cessation?

5.9.2. Aims and Objectives

Aims	Objectives
• **Explore definitions of older driver** • **Examine alternative factors to chronological age when measuring fitness-to-drive in older drivers.** • **Address impact on cessation.**	• **Via an online survey query the definitions given to the term "older driver" by groups of older and younger groups.** • **Examine responses to extract factors other than chronological age when defining "older drivers" in an attempt to ascertain alternative factors.** • **Query value of driving and thoughts about cessation.**

5.9.3. Method

5.9.3.1. Participants

The original concept was to collate data from students and residents of Coventry, but early responses to local recruitment were low, and so the survey inclusion criteria were expanded to include responses nation-wide.

Participants were recruited via social media platforms Twitter and Facebook, through Coventry University and local Coventry libraries. A paper version of the survey was advertised in local coffee shops and the local Coventry library. The details of the research were also shared via participants leading to an increase in recruitment through the help of this snowballing effect.

The eventual number of respondents was 124. Respondents to the survey comprised drivers and retired drivers aged 18-84 (mean 45.24 years). Five of the participants' responses were excluded for the purpose of the analysis due to being based in countries that made use of different road systems to mainland UK creating a different driving experience which would arguably create compounding variables when examining the data.

N=119 (drivers=108, retired drivers=11; female=73, male=44, preferred not to say=2). A list of 50 participants who were willing to take part in future research was collated at this point.

5.9.3.2. Materials

Online survey (BOS online software – now called Jisc online surveys) available at https://admin.onlinesurveys.ac.uk/.

Paper version of survey printed in 16-font type to be shared with local coffee shops and libraries. This version however failed to yield any participant interest.

5.9.3.3. Procedure

The survey ran on Bristol Online Survey software (BOS) between 3 December and 18 January 2019. Drivers and Retired drivers were invited to take part in the survey via an online link. The survey comprised 54 questions that included requests for demographic data and informed consent. The questions employed skip logic so that neither group (drivers and retired drivers) had to consider questions irrelevant to their driving status. This served to ensure that the time investment required by participants was kept to a minimum.

Analyses were carried out using Excel and SPSS, in addition to using data collected directly from the Bristol online survey (BOS) report. Questions that required longer explanatory answers were treated as qualitative data and was initially analysed within Excel in order to link themes between respondents. This was reinforced using NVIVO at a later date. The results can be seen below. Each of the relevant research questions are answered in turn.

5.9.4. Results

5.9.4.1. How can the "older driver" be defined (does this include factors other than chronological age?

There exists a gap in academic literature regarding the definition of the "older driver". The drivers within the study, being aged between 26 and 79, were asked if they considered themselves to be older drivers. 22% placed themselves into the older driver category with reasons falling into 5 categories:

- Chronological age
- Experience
- Driving style
- Length of time that driving licence had been held
- Level of age-related health

Respondents felt that they were automatically older drivers because of their chronological age:

> ***Silly question? I am 79! Why is this answer a problem? If I did not consider myself to be an older driver, I would be delusional!***

While others felt that their experience equated to belonging to the older driver category:

> ***I have been driving for over 40 years and have basically seen it all when it comes to car drivers/motorbikes/HGV drivers/cyclists/pedestrians-the good, the bad and the downright stupid ones***. [Aged 58]

In contrast, 78% of those still driving did not see themselves to be within the older driver category. However, age did often appear as a factor when asked to define the older driver. This group suggested the following factors as being contributory to older driver status (ODS).

- Being of retirement age
- Driving style
- Functional ability
- Driving exposure

One driver felt that older driver status occurred when someone was of retirement age. They also suggested that being an "experienced driver" was not the same as being an "older driver".

> ***I think an older driver might refer to someone who has retired? I think I'm an experienced driver which is a different thing.***
>
> [Aged 51]

Another implied that driving style might change when an individual becomes an older driver:

> ***My style and attitude to driving is the same as when I was in my thirties.***
>
> [Aged 75]

Another respondent inferred that deficits begin to become apparent upon gaining older driver status:

> ***I do not feel that my age has yet produced significant enough deficits to affect my driving safety.***
>
> [Aged 60]

5.9.4.1.1. Older versus younger respondent group

It was of interest to discover how these points of view varied across age groups. The respondents were split around the median of 45.24. Those 45 years and over were placed into the older group with those under 45 populating the younger group.

A cross tabulation was carried out within SPSS using "Age group" and the responses to the question "Do you consider yourself to be an older driver?" in order to ascertain the number of people within each group who either did or did not consider themselves to have achieved older driver status. This enabled the age group data to be examined alongside the responses given to the aforementioned question. For the purpose of this calculation the answers for drivers and retired drivers was combined. The original question posed to the retired driver group, now amalgamated, had previously been, "When you retired from driving did you consider yourself to be an older driver?"

The results follow in **Table 5.4** below.

Table 5.5: Cross tabulation for who considers/considered themselves to be an older driver

Age group x "Do you consider yourself to be an older driver?" Cross tabulation		
	Yes	No
Younger group	4	55
Older group	23	37
Total	27	92

When the group was combined, and the 27 respondents were examined, those who did not see themselves to belong to the older driver demographic ranged from 18 years to 75 years, with a mean of 40.84 years.

By contrast, it was found that those who considered themselves to be older drivers ranged in age from 26 years to 58 years with a mean of 60.26 years. This overall younger group of people tended to identify with being older drivers whereas the group that contained the 75 year old did not. This tendency begins to show a break down in the link between chronological age and the defined older driver. Indeed perhaps it is not age per se, but some alternative factor that leads to this self-perceived older driver status. Some of the potential factors are discussed below.

Examining the second group who identified with belonging to the older driver category, reasons included:

- Age
- Comparative age
- Levels of experience
- Length of time driving
- Change in attitude towards driving
- A separation of age from ability to drive

One 30 year old claimed to be within the older driver category because of their age-based identity:

> ***I'm old***

As did another aged 64:

> ***I'm 64***

This was, however, directly contrasted by an older respondent claiming that they had not yet become an older driver because:

> ***I'm only 62!!***

One respondent attributed their identification with the older driver contingent to their comparative age:

> ***I'm 50 years old and there are so many younger drivers on the road***

Other participants attributed their ODS to the length of time they had been driving in terms of years, and the level of experience that they considered they had gained on the roads, with one 28 year old stating:

> ***Been driving for 10 years, and been doing far more miles per year than anyone I've met who doesn't drive for a living.***

Another driver, aged 50, explained:

I've been driving 33 years, I have a lot of experience at urban and long distance travel I suppose I have more experience than the average driver

Another theme that emerged was the change in attitude that was a contributory factor to identifying as an older driver:

I have been driving approximately 20 years, I often have my son in the car too. Which I think contributes to a more mature attitude and less risk-taking. [Aged 38]

Within this group of respondents, the concept of separating age from the ability to drive arose:

***I do not think my age reflects on my driving ability [**Aged 67]*

5.9.4.1.2. Relative age

One other set of data examined with regards to examining a potential definition of the older driver was that of relative age. Here taken to be the difference in age between the proposed "Older driver" age, and the age of the individual suggesting it.

25.2% of the total respondents suggested an age at which they considered older driver status (ODS) was achieved. OriginAge refers to the age of the participant, while DiffAge refers to the difference between their age and the age that they deemed to define the older driver. On some occasions the participant proposed their own age and so the difference was calculated at 0 to signify no difference **(Table 5.5)**.

Table 5. 6: Relative ages proposed for achieving ODS

OriginAge	DiffAge
26	39
26	44
30	0
32	33
35	25
36	29
36	34
38	22
39	31
43	22
43	22
45	15
46	-6
46	19
46	19
47	23
50	0
51	14
57	8
60	-10
63	0
64	0
68	0
69	0
69	0
74	0
76	-16
77	-10
77	3
79	0

From the image below it can be seen that as the original age of the participant increased, there was a tendency for the ODS to be set at an age nearer to their own, whilst younger respondents tended to suggest an age much further in the future **(Figure 5.1).**

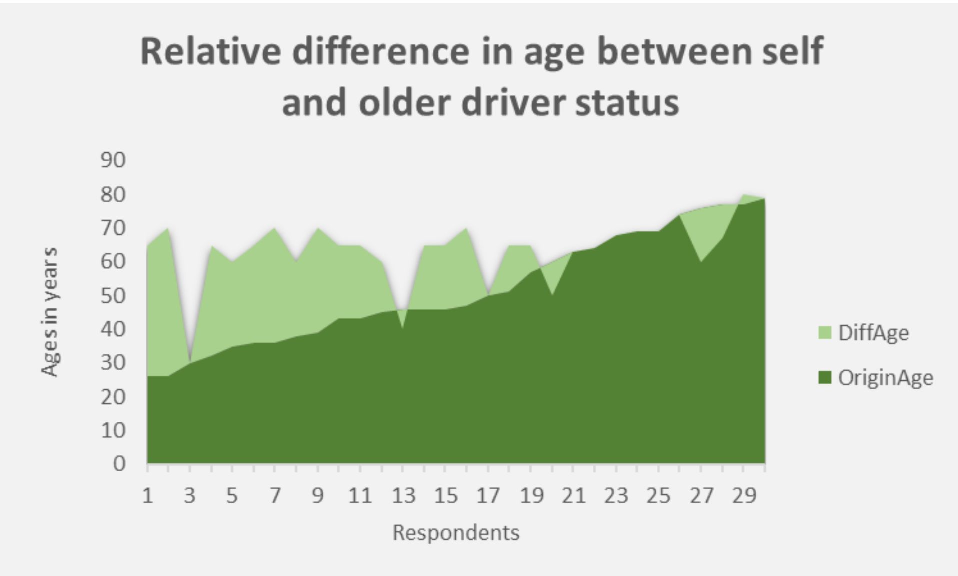


Figure 5.1: Relative difference between actual age and ODS

5.9.4.1.3. Stereo-types

In addition to the above, the concept of stereo-types also arose when examining the issue of the defining the "older driver". One of the members of the younger participant group referred to other younger drivers suggesting that they often felt that they were unlikely to come to harm on the roads:

> ***Yeah I think it's very risky at the beginning for the young drivers when they just get their driving licence because you think you're invincible. You think who am I? I am so strong in my car! But yeah after that I was very careful.*** [Aged 23]

Another younger driver provided a different stereotype referring to older drivers as being slow and unsafe on the road:

> ***In my view it's people over 70 are not so good drivers in my experience. It's usually the old ones who are kind of a bit slow.*** [Aged 25]

This particular stereotype was debunked by a 73-year-old driver describing her enjoyment of driving on the motorway based on the freedom to drive at a faster speed:

> ***I mean, that's why I like motorway driving. I do. I do like motorway driving. Because you can more or less drive at your own speed. I always start with 70 ...conserving petrol... and then you think oh get out of my way!***

5.9.4.2. Is there an alternative to chronological age when measuring fitness-to-drive?

The section above attempted to define the older driver, and in doing so also managed to signpost to factors that may be considered as alternatives to chronological age when measuring fitness-to-drive. These included:

- Age-related health
- Functional ability
- Driving style and attitude
- Confidence
- Experience
- Driving exposure
- Length of time holding driving licence / Years driving
- Time spent driving per week

5.9.4.3. What is the impact upon lifestyle of changing driving status?

Drivers were asked about their relationship with driving in order to assess the impact on potential cessation. When asked to rate the level of importance that driving represented on a scale from 1 to 5, where 1 was the lowest count and 5 the highest, approximately 74% ranked importance at 4 or 5 **(Figure 5.2).**

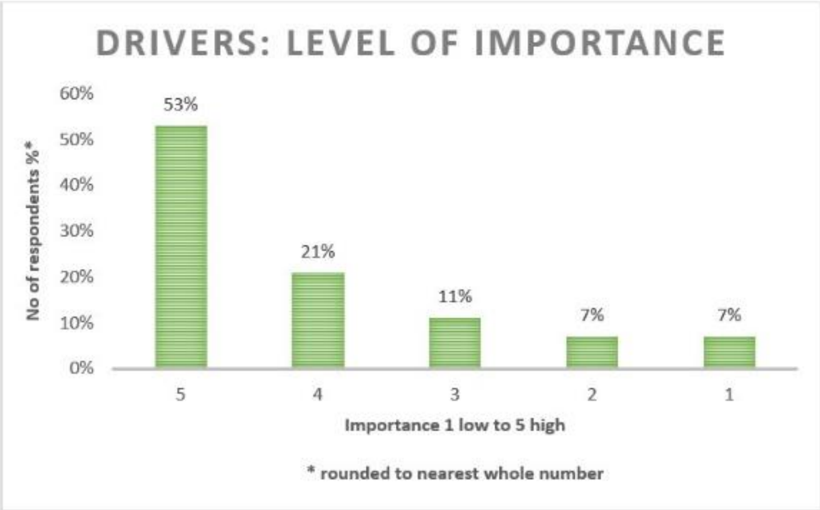


Figure 5.2: Importance of driving (Drivers)

Retired drivers were asked to rate the level of importance that driving had signified for them when they were still driving. Drivers who had ceased driving highlighted its importance, with 64% rating it at 4 or 5, where 5 was the highest level **(Figure 5.3).**

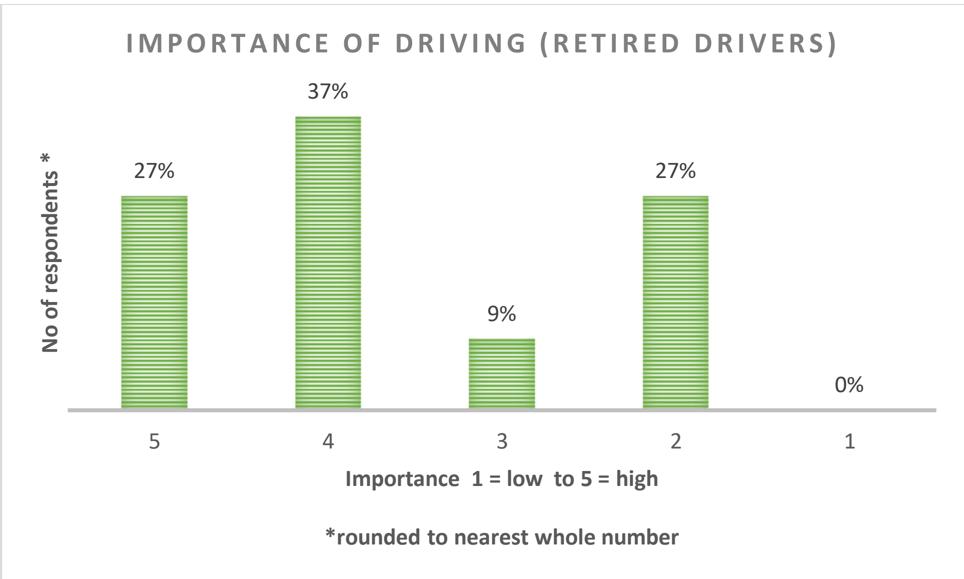


Figure 5.3: Importance of driving (Retired drivers)

The survey asked retired drivers about their chosen methods of transport before and after ceasing driving, and were found to cite public transport as the most highly chosen method of transportation at both stages **(Figures 5.4 and 5.5)**.

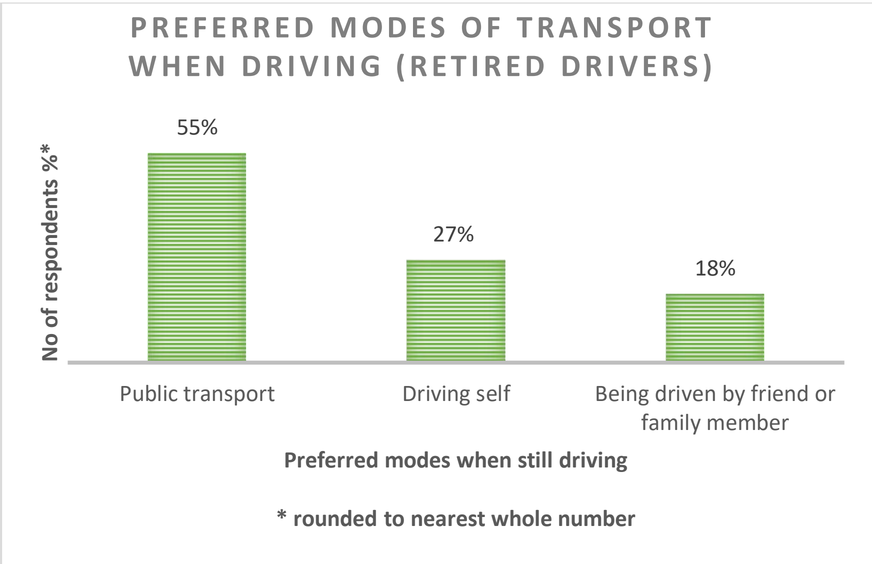


Figure 5.4: Preferred transport when driving (Retired drivers)

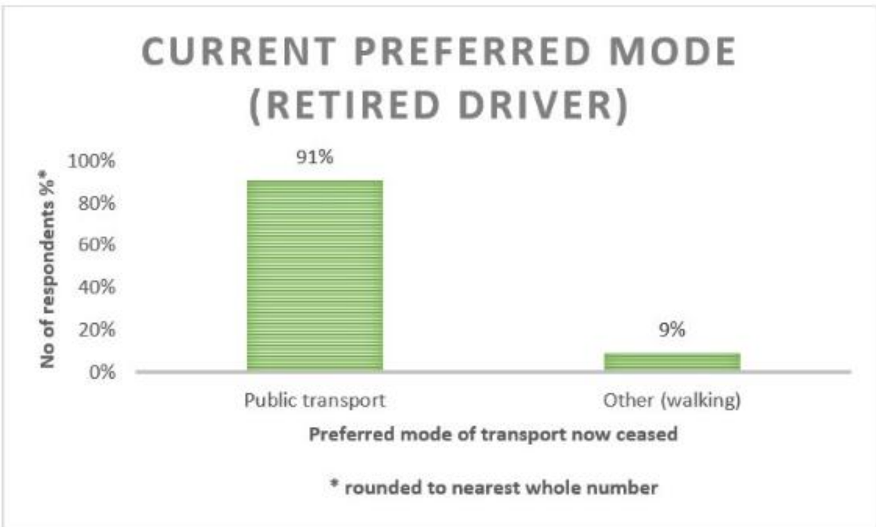


Figure 5.5: Current modes of transport (Retired drivers)

Retired drivers were asked about the impact that giving up driving had had on their lifestyles. In terms of the scale where 1 was the lowest amount of impact and 5 the highest, the highest ratings of 4 and 5 amounted to 36% **(Figure 5.6).**

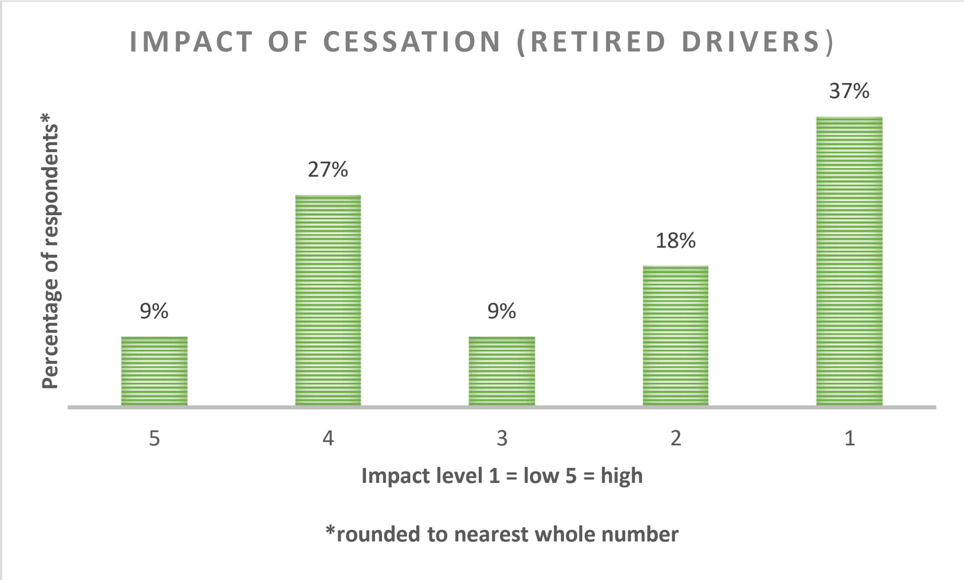


Figure 5.6: Levels of impact of driving cessation upon retired drivers

Independence (36% of respondents) and loss of freedom to explore ad hoc places (18%), in addition to a greater reliance on family or friends as transport (18%) were amongst the factors that were impacted as a result of retiring from driving. However, not all impact was negative. Some respondents were content to use public transport (27%) and welcomed the option of walking (9%). See **Figure 5.7** below:

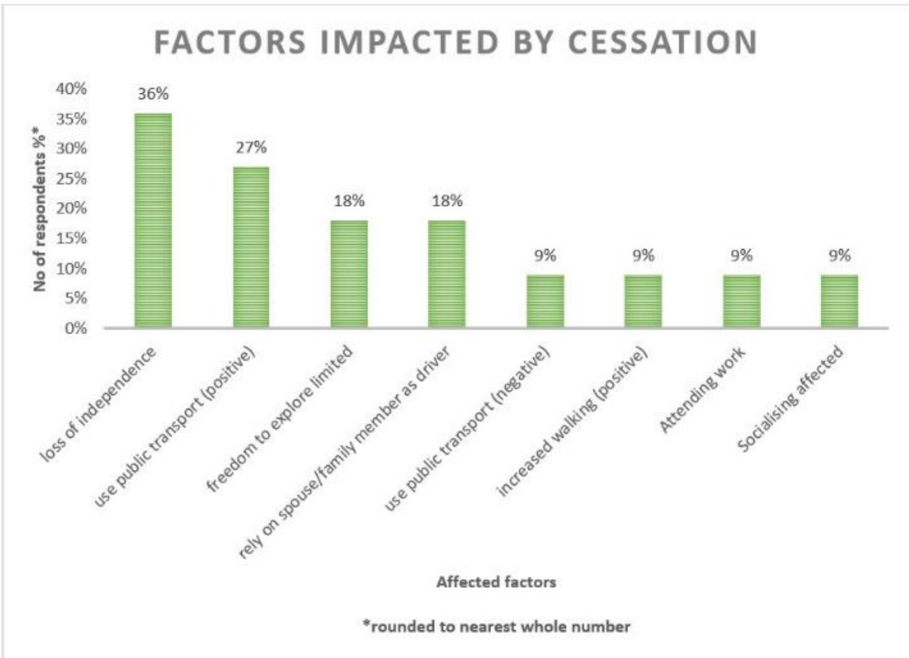


Figure 5.7: Factors affected by cessation

The impact was also examined from the point of view of the practical changes that were reported within the survey. The table below shows the ranking that each of the retired drivers gave to the impact that they felt from giving up driving. The practical change in their modes of transport can also be seen in **Table 5.6** below.

Table 5.6: Transport and lifestyle impact after cessation

Transport before cessation	Transport after cessation	Change to transport?	Reported lifestyle impact 1=low 5=high
Being driven by a friend / family member	Public transport	Yes	5
Driving by myself	Public transport	Yes	4
Driving by myself	Public transport	Yes	4
Being driven by a friend / family member	Public transport	Yes	4
Driving by myself	Walking	Yes	1
Public transport	Public transport	No	3
Public transport	Public transport	No	2
Public transport	Public transport	No	2
Public transport	Public transport	No	1
Public transport	Public transport	No	1
Public transport	Public transport	No	1

Four out of the five respondents who had changed their mode of transport after cessation scored the impact at 4 or 5, while one respondent scored it as 1. Those who had not changed their mode of transport tended to rate the impact with scores between 1 and 3.

The 5 participants who rated the impact of cessation between scores of 3 and 5, referred to loss of independence, and restrictions on going out as being the reasons for the greatest impact. One respondent mentioned the reliance on family due to an unreliable bus service.

55% of these individuals rated the impact of cessation as low (scored between 1 and 2). This is of interest as one individual who relied on a spouse viewed this more positively, rating their impact as 1. Amongst 5 of the 6 respondents who rated the impact of cessation as lower with scores between 1 and 2. (1 participant did not offer a specific reason for their rating), there tended to be access to good public transport, and in one case, everywhere that the participant found relevant to visit was within walking distance. One participant lived in a city and felt that driving was inconvenient as parking was difficult. Driving also impacted on their life as it prevented them from drinking when socialising.

Reasons provided by the respondents for this rating included the following:

- Good access to public transport
- Having all chosen venues within walking distance
- Dwelling location – where city living made parking difficult and therefore inconvenient.
- A preference of having a lifestyle where socialising and drinking was not hindered by relying on a car.

In addition 5 out of 6 of these individuals also reported no change to their chosen method of transport before and after cessation, stating that they preferred the use of public transport prior to cessation and continued using this method once they had decided to cease driving. As such, there had been little alteration to their chosen lifestyles from this perspective. The other 45% who rated the impact of cessation as higher reported a more defined difference in their lifestyles where they had undergone a change in their required mode of transport. They arguably had a sense of loss whereby they had once travelled more independently and now relied on the times and availability of public transport (See **Figures 4.6** and **4.7** and **Table 4.6**).

5.9.5. Discussion

The division between drivers and retired drivers was less equal than desired leading to a weaker comparison between responses provided by each of those specific groups.

There were issues with recruitment which necessitated an extension of the study in terms of time and geographic reach. This latter change became advantageous as it provided qualitative data regarding lifestyles and location type (rural / urban) when examining the overall importance of driving. One participant mentioned that there was little need for a car as they lived in London, a place with extensive public transport, and so had ceased driving.

The attempt to define the older driver served as a sensible starting point of discussion which encouraged individuals to consider ageing and driving as an overall topic. In this way the concern about the survey being broad actually proved to deliver useful and appropriate data in a natural and more inductive manner in line with the theoretical approach.

The broader method of questioning gave rise to the emergence of a variety of factors which might be considered as alternatives to chronological age when examining fitness-to-drive. Of interest was the concept of “experience” as a variable. This came to be mentioned in terms of length that driving licence had been held, and amount of driving exposure per week. The level of confidence also emerged as a highlighted factor.

This move to examine a factor alternative to age was also supported by the inability to link responses, where individuals considered themselves or others as older drivers, to any specific age. There was however, a tendency for younger respondents to view older driver status as existing further into the future than the older participants did (Fig 4.2).

In terms of the levels of importance of driving, 64% of retired drivers and 64% of current drivers ranked the importance within the top measures of 4 and 5. This may have been due to the sample of retired drivers being relatively small, but also due to the 55% majority of this group who reported a low impact of cessation largely due to a lack of change to their chosen mode of transport from before cessation.

5.9.6. Limitations

The main limitation of this study was the limited Sample size of retired drivers. This tempered the robustness of the data related to the effects of driving cessation upon lifestyle. The survey also neglected to ask individuals how long they had held their driving licences as this would have provided the opportunity to examine crash experience reported in line with experience.

The survey was held online which may have limited respondents. However this was balanced by the paper version of the survey being distributed. Unfortunately, none of these were completed. However, the planned sample size was achieved despite the division of groups not being ideal.

5.9.7. Conclusion

Taking the above discussion into consideration, the planned research felt justified. Although the impact of cessation had been low for 55% of this albeit small sample of retired drivers, for 45% their mobility now came to rely on friends, family members and the use of public transport – where this had previously not been a preferred mode of transport.

The lack of consensus as to what defined the older driver increased the need to refute the tendency for fitness-to-drive and licence renewal within the UK to be based on age. It became apparent that experience might be a factor worth exploring as an alternative.

It therefore became necessary to devise a series of tests that would enable a single aspect of driving to be measured across factors and groups of people. The knowledge of the previous existence of OMEDA (Read, 2001) provided that single aspect – the judgement of time to contact (TTC). Further exploration would require the development of OMEDA PLUS.

The study which followed would serve to begin to test the reliability of OMEDA PLUS, and would begin to establish its usability. This would require a mixed methods approach befitting of the pragmatic philosophical stance.

Testing of OMEDA PLUS would require a more deductive approach as the study would need to prove that this version worked at least as well as the now non-existent original. With this in mind, the study would reflect the work reported in Read (2001), and would be largely designed with that original research in mind.

It would however, also be required to discuss the product with the same participants, necessitating the addition of a semi-structured interview.

The second study which follows will serve to test the tool required to examine TTC across different factors in order to ascertain elements other than chronological age which might have a bearing on fitness-to-drive measurements. It will also gather opinion of the participants in relation to the usability of OMEDA PLUS.

5.10. Study 2: OMEDA PLUS as a tool for measuring fitness-to-drive using Time to contact judgement

5.10.1. Introduction

Study 1 examined the impact of cessation, highlighted the problems with basing the decisions around fitness-to-drive solely on age, and also began to encourage alternative researchable factors to emerge. These factors justified the research and also the development of OMEDA PLUS as an accessible, portable and non-judgmental tool which could be used in private by people considering their future driving status.

Study 2, served to examine the newly constructed and augmented version of OMEDA, OMEDA PLUS. The study was designed to reflect the study used by Dr Read when testing the original version. For this reason the age ranges used matched the original study. This was so that the working and sensitivities of the tool regarding crash likelihood and TTC errors could be fairly compared.

This second study also built upon this original and aforementioned study in two main ways. It now was able to compare the working of the new software with the results of other tests. Firstly, with the original Read (2001) results thus supporting its reliability and validity. It was also compared to the established UFOV test.

Secondly the interview with all participants served to build upon the accompanying Driving Habits Questionnaire by deepening the details of driving experience, and also served to enable discussion about the usability of the product. It also served to highlight any differences between reported accident history and measurements of error when using the software. Were major discrepancies to occur, this might draw into question the reliability of the test itself.

The aim was to recruit two groups of drivers, a younger group comprised of people under 25 years, and an older group of drivers over 60 years. This would be a mixed method design encompassing interviews and experimental elements. Analysis was carried out using Excel, SPSS and NVIVO. The study took place between 29 April and 31 July 2019 across Coventry University locations.

This study sought to test OMEDA PLUS and to establish its level of usability. The following three questions were therefore examined:

- Does OMEDA PLUS reflect reported workings and results of the original OMEDA study?
- Do patterns of errors within this version of OMEDA PLUS reflect those of UFOV under divided attention conditions?
- What factors appear to affect errors in TTC as measured in OMEDA PLUS?

5.10.2. Aims and Objectives

Aims	Objectives
• **Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.** • **Establish usability of OMEDA PLUS**	• **Test OMEDA PLUS with results being compared against those of the original studies reported (Read 2001). Testing to be supported by a comparison to the second subtest of the Useful Field of View test (UFOV2) (Ball and Owsley 1993), which also assesses accurate reactions to, and recall of, objects under divided attention. In addition, the overall crash risk measurement provided by UFOV will serve to provide extra triangulation between accident history / likelihood and TTC awareness measured in OMEDA PLUS. This comparison between theoretical OMEDA, OMEDA PLUS and UFOV will be continued in Study 3.** • **This will require the examination of results based on variables other than chronological age as explored in Study 2.**

5.10.3. Method

5.10.3.1. Participants

As a reflection of the original OMEDA study (Read, 2001), participants were placed into a younger category (aged under 25) and an older category (over 60). However, unlike the original study, this research sought to examine factors other than age that might affect TTC. Levels of driving experience and driving exposure indicated by the length of time individuals had held their driving licence, and average miles driven per year were also were also collected. The recruitment for this study remained conservative to limit the risk of “wasted” data being collected by the untested system OMEDA PLUS.

Participants were excluded and asked to not volunteer if they had illnesses or were taking medication that might have affected the ability to drive. Inclusion criteria required the participant to have experience of driving within the UK, and to be aged between 18 and 25, and 60 years and over.

The study recruited 18 participants split into 2 groups (**Table 5.7**):

Table 5.7: Participant split for Study 2

N=18	Male	Female
Younger group (range 21-25)	**5**	**5**
Older group (range 60-78)	**4**	**4**

A female member of the older group had to be excluded from the UFOV analyses due to computer issues on the UFOV test, and so for the UFOV test only, n=17.

5.10.3.2. Materials

- Driving Habits Questionnaire A (DHQA)
- OMEDA PLUS (2 subtests)
- UFOV (3 subtests)
- Interview schedule (A and B) [VISUAL AIDS]
- Number plate recognition test
- Recording device

5.10.3.3. Procedure

Participants were asked to complete the DHQA and the two computer-based tests. These were counter-balanced to manage effects of fatigue. Once the participant had completed each of the tests, they were asked to take part in an interview. This study concluded with a test of visual acuity (Number plate recognition). Comfort breaks were offered throughout the procedure which lasted on average 45 minutes.

Once completed, the interviews were transcribed using OTTER software (Otter AI 2016) and analysed within NVIVO. Quantitative data was analysed using SPSS.

5.10.4. Results

A Spearman's Correlation was carried out in order to examine the likelihood of previous near misses or crashes having an ability to predict TTC error scores. This also served to examine a link between OMEDA and UFOV tests. This chosen method of analysis allowed for rankings to be equalised among variables so that they might be measured on an equal scale. The correlation highlighted the strength and direction of relationships between variables.

An independent t-test was employed to compare mean results between age groups.

This study primarily provides the usability testing of OMEDA PLUS as a tool. Because of the need to test the operation of OMEDA PLUS, this study was carried out across a conservatively sized sample of participants. Comparisons with UFOV helped to highlight strengths and weaknesses of OMEDA PLUS as a potential diagnostic tool.

The semi-structured interviews were analysed using NVIVO, and served to gather information related to driving and accident experiences of the participants. The results of this section of the interviews can be seen below.

There was a need to establish a level of usability of this version of OMEDA, and therefore the interviews examined peoples' views on OMEDA as a tool in addition to their performance within the test. The results regarding the usability of OMEDA PLUS can be found in the DEVELOPMENT OF OMEDA chapter.

5.10.4.1. Spearman's correlation

SPSS (2017) was used to analyse quantitative data. A Spearman's correlation enabled the systematic exploration of the relationships between the relevant factors. The output can be seen below in **Table 5.8**:

Table 5.8: Spearman's correlation for study 2

	TTC errors in OMEDA	Total incidents	Age of participant	UFOV2_Divided attention	UFOV_CRASH RISK 1-5	Age at time of last incident	Years licence held	Number of days / week driven	approximate annual mileage	confidence scale 1-5
TTC errors in OMEDA	1.000	-0.173	.685**	.595*	.659**	0.178	.660**	.578*	0.220	0.141
Total incidents	-0.173	1.000	-0.239	-0.225	-0.293	0.412	-0.146	-0.106	-0.009	0.082
Age of participant	.685**	-0.239	1.000	.737**	.581*	0.258	.901**	.564*	0.363	0.260
UFOV2	.595*	-0.225	.737**	1.000	.665**	0.191	.786**	.749**	0.419	0.386
UFOV Crash risk 1-5	.659**	-0.293	.581*	.665**	1.000	-0.151	.577*	0.478	0.022	.507*
Age at time of last incident	0.178	0.412	0.258	0.191	-0.151	1.000	0.409	0.313	0.365	0.231
Years licence held	.660**	-0.146	.901**	.786**	.577*	0.409	1.000	.577*	0.381	0.341
Number of days / week driven	.578*	-0.106	.564*	.749**	0.478	0.313	.577*	1.000	0.492	0.218
Approximate annual mileage	0.220	-0.009	0.363	0.419	0.022	0.365	0.381	0.492	1.000	0.473
Confidence scale 1-5	0.141	0.082	0.260	0.386	.507*	0.231	0.341	0.218	0.473	1.000

*Significant at 0.01 level (2-tailed)

** Significant at 0.05 level (2-tailed)

5.10.4.2. Does this version of OMEDA reflect reported workings and results of the original OMEDA study?

5.10.4.2.1. Sensitivity to safe driving?

The original version of OMEDA reported that it was sensitive to safe driving. It would be expected that as incidents experienced increased so would errors made in TTC judgement within OMEDA PLUS. Total recent accident history of the participants was gathered via the Driving Habits Questionnaire (DHQ).

Spearman's correlation showed a weak, negative and statistically non-significant relationship between total incidents and TTC errors in OMEDA; ρ (16) = -.173, p = .493

There was a slight tendency for TTC errors in OMEDA to increase as the number of incidents decreased.

5.10.4.2.2. Sensitivity to age decrement?

In line with the functions of the original OMEDA, it would be assumed that as age increases, so do the errors made in TTC judgement within OMEDA PLUS.

> **Spearman's correlation showed a strong, positive and statistically significant relationship between age of the participant and number of TTC errors made in OMEDA; ρ (16) = .685, p = .002**

As age increased so did the number of errors made in TTC judgement.

Data within SPSS and the DHQ also highlighted the number of incidents experienced and the total number of TTC errors made within each age group tested. The older group was seen to have made more errors in TTC judgement within OMEDA and had also experienced more incidents within the last 2 years (**Table 5.9**).

Table 5.9: Incidents and TTC errors per age group

	Younger group	Older group
Total incidents in last 2 years	**8**	**12**
TTC Errors in OMEDA	**30**	**120**

An independent t-test, allowing a comparison of means, found the difference in TTC errors made by each age group to be statistically significant (**Table 5.10**).

Table 5.10: Independent t-test TTC errors per age group

Levene	Younger mean	Older mean	t	df	ρ (2-tailed)	Mean difference	95% confidence interval Lower to upper
.000	3	15	4.34	8.09	.002	12	-18.37 to -5.63

Null hypothesis stated that there would be no difference between age groups in terms of errors in TTC judgement.

Equality of variance was not assumed with Levene being 0.000. The independent t-test showed that the difference between age groups was significant, t=4.34, df = 8.09, ρ =.002, two tailed.

5.10.4.3. Do patterns of errors within this version of OMEDA reflect those of UFOV under divided attention conditions?

OMEDA requires the TTC judgement to be carried out under conditions which include a secondary distractor task which causes the attention to be divided. The UFOV subtest 2 (UFOV2) is similar to in that it also provides a test for divided attention. The previous section showed that TTC errors of judgement increase with age, the UFOV2 test shows that the time taken to respond to each presentation within UFOV2 was longer for the older group than for the younger group (**Table 5.11**).

Table 5.11: UFOV 2 measurements per group

	Younger group (25 and under)			Older group (60 and over)		
UFOV2 Divided attention Measured in milliseconds	mean	minimum to maximum	range	mean	minimum to maximum	range
	46.5	24-70	46	104.86	53-187	134

The Spearman's correlation showed a strong, positive and statistically significant relationship between performance on UFOV2 and number of TTC errors made in OMEDA; ρ (16) = .595, p = .012

5.10.4.4. What factors appear to affect errors in TTC as measured in OMEDA?

The results above show that age affects the performance of TTC while the following section examines the relationships between TTC and factors which will be examines as alternatives to age:

- Days driven per week
- Years driving licence has been held
- Approximate annual mileage
- Level of confidence

Returning to the Spearman's correlation, each of these relationships is outlined below:

I. TTC errors and days driven per week

The Spearman's correlation showed a strong, positive and statistically significant relationship between the number of days driven per week and the TTC errors made in OMEDA; **ρ (15) = .578, p = .015**

II. TTC errors and years driving licence has been held

The Spearman's correlation showed a strong, positive and statistically significant relationship between the number of years that participants had held their driving licences and the number of TTC errors made in OMEDA: **ρ (16) = .660, p = .003**

III. TTC errors and approximate annual mileage

The Spearman's correlation showed a weak, positive and statistically non-significant relationship between approximate annual mileage and number of TTC errors made in OMEDA; **ρ (15) = .220, p = .397**

IV. TTC errors and confidence

The Spearman's correlation showed a weak, positive and statistically non-significant relationship between the reported level of confidence when driving on the road and the number of TTC errors made in OMEDA: **ρ (16) = .141, p = .576**

5.10.4.5. Further discussion around accident experience

The interviews were carried out in order to provide an additional layer of information regarding the types and locations of accidents that had been experienced by the participants. It was also important to examine data that reflected the factors emerging which might prove to be an alternative to chronological age. This included Confidence and driving exposure.

Despite practice or levels of confidence, accidents occur. Participants were specifically asked about incidents that had occurred at junctions, roundabouts and merging onto the motorway. None of the participants could remember having experienced incidents whilst merging onto the motorway but junctions and roundabouts both featured.

5.10.4.5.1. Roundabouts

Accidents at roundabouts were reported by members of each group. The emergency services had not been required at any point. One member of the older group had experienced their incident by approaching the roundabout in the wrong lane:

> ***Yeah, I have had one accident on a roundabout. And that was caused by - I was in the wrong lane approaching the roundabout. And a vehicle came outside me as I was moving across and I hadn't noticed him. So I just clipped his back wing…***
>
> [Aged 60, driving licence held for 42 years]

In the case of the younger participant, their incident occurred as a result of wrong judgement of gap between their vehicle and that of the oncoming car:

Just me pulling out when I thought there was enough space and there wasn't. And I've had to kind of put more acceleration on.

[Aged 22, licence held for 1 year]

5.10.4.5.2. Junctions

Two of the younger participants mentioned incidents at junctions that might have been considered to have been their fault. There were none such incidents reported by members of the older group. The first had been driving with friends and chatting on a sunny winter day after only having their driving licence for a short time:

I only had my driving licence for a few months…I was with my friends and it was during the winter. The road was very icy. However I was driving towards a junction … I think because I was involved in a conversation with my friends, I didn't really pay attention and I thought the car [in front] ***was moving and it was stationary. ..I reacted quite fast. I don't remember exactly how, but yeah that was my luck that no car was coming towards me.***

[Aged 23 with driving licence for 6 years – had only been driving for a few months at time of incident]

Another had a near miss with a lorry when misjudging the gap when pulling out of a junction:

I probably pulled out when I shouldn't've. And it was a truck coming … and I thought it was going slower than it was – and I pulled out fine but obviously I then had to get up to speed - and I forgot that I had to get up to speed… It ended up fine as the gap was closing I thought "oh my God that's a big truck".

[Aged 25, years driving licence 8]

5.10.4.5.3. Level of confidence

Participants were asked what their perceived level of confidence in driving. The scores ranged from 1 to 5 with 1 being the lowest and 5 being the highest. Reasons for their chosen score included:

- Driving exposure
- Accident experience
- Level of health
- Reaction times
- Level of experience
- Perceived ability to multi-task

Individuals claimed that the time spent each week on the roads led to a high level of confidence:

5.10.4.5.4. Driving exposure

Individuals claimed that the time of spent each week on the roads led to a high level of confidence:

> ***So I do that at least once a week on average, so that's about 50 miles. So you know...then I tootle around town for the rest of the time or leave the car in the garage. I do a mixture of long journeys and short journeys.***
>
> [Aged 73, confidence level 4]

In addition, the length of time that a person had been driving, in addition to the variety of roads travelled tended to elicit a high level of confidence:

> ***Probably the length of time I've been doing it. And I think also the fact that I've driven across the country really ... You know, I've done the A roads, B roads and motorways, you know, I've done all those or combinations in both kind of urban and rural settings. You know, I know what I'm doing, I think.***
>
> [Aged 61, confidence level 5]

Members of each of the groups suggested that their high level of confidence was based on a lack of serious accidents:

> ***I've never had a big crash. I've only had I think I put 2 bumps on that [DHQ]. But the bump was literally where I just tapped a metal bar. The only accident I've ever had was when I first started driving and I was parked, and someone reversed into me…so I have a good track record.***
>
> [Aged 25, confidence level 5]

And:

> ***Well, I think because I have been driving for a long time. I've had no major accidents. I've had a couple of minor scrapes, but nothing particularly serious. So yeah, I mean, I've got full no claims bonus and all that sort of things. So yeah, just get in the car and drive and it's never been an issue for me.***
>
> [Aged 60, confidence level 5]

On the other hand, one 21-year-old driver suggested that it was precisely the fact that some accidents had occurred that had made her feel more confident:

so I've been travelling ever since I got my licence like even though it was quite daunting at first but yeah, I think I've got through enough small accidents to know what to do and what not to do and so yeah I think to experience I'm more confident now.

[Aged 21, confidence level 4]

5.10.4.5.5. Health and reaction times

For others, there was a belief that it was the good level of health in addition to good reaction times increased their level of confidence on the road:

I like to think I've got good reactions which I hope that the task mirrored...My eyes are decent. I've never had a big crash…

[Aged 25, confidence level 5]

A member of the older group agreed that having good reaction times added to a level of confidence, but also acknowledged a tendency to be more cautious on account of their increased level of awareness:

Well, I'm guessing, but I think it's because I think I've still got reasonably quick reactions, right? …Even though I think my reactions are just as fast as they used to be, I do tend to hang back a little bit more rather than say, there's plenty of room. It's my right away. So I do hang back more than I used to.

[Aged 67, confidence level 4]

5.10.4.5.6. Experience: positive and negative

Experience in itself was seen to be a reason for an increase in confidence:

erm I would say my calmness in different situations. erm and also the driving experience and er the amount of mileage I drove in the past. So I think experience is very important

[Aged 23, experience level 5]

However experience as a concept was also considered to have negative connotations. One younger participant felt that the driving was harder than when they drove within the quieter environment in which they had learnt:

***… I feel like I'm always driving in quite hard environments so it's like I have more negative experience probably than I would if I was driving where I learnt to drive which was really easy* [aged 24, confidence level 2]**

5.10.4.5.7. Lack of practice

For members of the younger group, lack of practice after passing the driving test diminished the feeling of confidence:

> ***But when I was in the car on my own I didn't drive that much so I was like not used to it. One of the other things was that I passed my test a year before I got my car. So I had to then remember how to do everything. It was a bit nerve-wracking on my first test drive with my vehicle, and then it was like "oh, ok I can start remembering it now".***
>
> [Aged 25. Confidence level 4]

5.10.4.5.8. Multi-tasking

One member of the younger group had not yet developed a level of aptitude for multi-tasking feeling that they amount of concentration required was extensive:

> ***Learning how to drive. At the start, you're basically in a ton of metal and if you put pressure on that pedal you will careen off and slam into a wall. There's a certain kind of "let's be very cautious with this thing". And then as I got used to it and slowly worked my way around back roads and got used to timings and predicting things, and not having to pay as much attention to doing everything in the car all the time and I could start using my muscle memory to do those more automatically I got more confident. When you've only got so much concentration, and you have to put a lot of it into making sure you do the right things in the car, it means you don't have as much to spend on paying attention to stuff outside the car.***
>
> [Aged 22, confidence level 4]

In addition the interviews also served to inform us further about the participants. It discussed the importance of driving to the sample.

Driving was seen to be a source of freedom, with one of the older participants stating:

> ***I mean, the reason I like driving is its freedom. Its freedom to be able to do what you want as and when you want it. And I think going up in the mountains, in north Wales is, you know, just being able to and you come from motorways to mountain roads. Which is great. [Aged 78]***

Another agreed but added that there was now less pleasure to be found in driving as an activity:

> ***There's not so much pleasure in driving now as there used to be. it's a reason to do something. It's the freedom to go and do what you want. Yeah. I mean, the journey these days isn't part of the holiday.***

There was little difference in the use of the car between the older and younger participants, with all individuals driving for work, leisure and shopping. There was the reminder that working life continues till the age of 60 and beyond, with one 60-year-old using the car to commute and visit family:

> ***Well, I commute into work, and I live in Solihull, so it's about 40 mile round trip. My father is 91 and he lives in Somerset. So I go down and see him probably every three weeks. So that's like a 250 mile round trip. And then I do, I think probably a whole range of journeys. Obviously I do like just going to the shops and things.***

Individuals also used the car to attend medical appointments, not just for themselves but also to support family members.

> ***Yes. I have to take him to the hospital a lot. Yeah. And lumping his wheelchair in the back, it's given me muscles. but no, I have to be at the drop of a hat. Yeah, being able to get in a car. couldn't do without it. If I didn't if I had to take a test and i failed, I would be absolute... Well, he would be stumped. It wouldn't bother me. I've got free bus pass...***

It also highlighted some other important factors. Firstly that changes to health occur at different times for people of all ages:

Individuals noted differences that had occurred over the time of their driving. This was as much the case for younger participants as it was for the older drivers. Categories that were noted included physical changes to the body and also in levels of confidence perceived when driving. People in each of the groups had noticed a change in their eyesight between the time of starting to drive and the present day:

> ***…yes. I've only been wearing glasses since last December. My eyesight. It's not terrible but it deteriorated pretty quickly like probably in a month or so. So it was really noticeable for me even though my prescription is quite small… erm and at the same time as kind of when I started driving in Coventry, and that kind of stressed me out because I didn't know my way round, and I also couldn't read the signs. But I didn't realise that I couldn't read the signs. I just thought that "my eyes are perfect like I've always had perfect eyes so I'm just too far away, and then when I got glasses it made a big difference to my confidence when I was driving coz I could see where I was going.***
>
> [Aged 24, driving licence held 6 years]

And to a slightly less degree:

> ***Well, I mean, what I've passed my test I didn't wear glasses. Now I don't wear glasses to drive now I wear glasses for reading. And I'm aware from my last eye test that I have one... but one eye is extremely good on distance and actually compensates for***

***that which is a bit average on distance. But so if that affected my drive, I don't think so because I'm not consciously aware that I my vision is worse. But it probably is. But I guess the change has been so gradual that I've not really, really noticed that*.**

[Aged 60, driving licence held 42 years]

This same 60-year-old had previously carried out charity trips abroad that required a team of drivers. He felt that he would still be able to do this, but might get a bit more tired now:

…and I was part of a charity that took trailer loads of supplies out to hospitals in Romania, so that that's the longest road trip I've ever done. And we basically did it nonstop from here to Romania but we had four drivers and we just rotated around. …which was quite incredible. Yeah. I think I could still do that now. I mean, oh, to drive is say we were four of us in our vehicle. One of them was 60. And I was by far the youngest, I was in my thirties. And the other two guys were in their fifties… the chap who was 60 he definitely got most tired out of the four of us. So I guess were I to do it. Now. I'd be in that position. And probably I'd get the most tired out of the four of us, but I still think I'd be to able to do it.

Members of each group acknowledged the need to take a break on long journeys in order to manage stiffness in the body:

…maybe recently on long journeys I realise I have some back pain if I don't take a break – because as I said for me it used to be very relaxing…and still is relaxing to drive but er I realise if I don't take a break erm some back pain appears.

[Aged 23, driving licence held for 6 years]

And equally:

I've noticed now that if I'm in the car for longer than about - if I do more than about 150 / 170 miles, my legs start to stiffen up. So I have to get out and walk around… It's usually about halfway.

[Aged 70, driving licence held for 45 years]

5.10.5. Discussion

The use of the Spearman's correlation was advantageous as it levelled the ranking of each of the variables allowing for a more balanced comparison. In this way, the strength and relationship of each of the factors was able to be explored.

The results show that there was a slight tendency for TTC errors in OMEDA to increase as the number of incidents decreased. This may be due to some difference between the computer test and the on-road driving experience. The original OMEDA found the computer-based test to reflect behaviour on a simulated driving activity. However, this was based on searching for a blanket difference in results based on age. OMEDA PLUS examines variables in a finer way. While age per se may indeed be seen to create changes in performance, OMEDA PLUS seeks to examine individual elements that might occur within age.

However, the sensitivity to age did parallel that of the original OMEDA showing a strong, positive and statistically significant relationship between TTC errors and AGE showing that both increased at the same time.

When examined between age groups via the t-test which enabled a comparison of means, the older group were seen to have experienced significantly more crashes or near misses than the younger group, and also showed a tendency to make more TTC errors. However the results from the Spearman's correlation brings into question the actual reason for this difference. This was an unexpected result, but it also became an interesting one. If the test appeared to work in the same way as the original OMEDA test yet provided different results when being examined more closely for specific factors, perhaps there was some factor being hidden by the assumption that this result was due to age.

OMEDA PLUS is also a computer-based test. As such, the performance may well be dependent on the experience and confidence in computer use rather than the actual performance when driving. This might, to some degree, explain the increase in TTC errors where actual crashes were reported to decrease.

The added factor of crash reports being reliant on self-reporting may also have led to the provision of inaccurate or misremembered data.

When comparing the UFOV and OMEDA PLUS tests, there was a strong, positive and statistically significant relationship between performance on UFOV and OMEDA PLUS. This indicates a link between TTC errors and crash likelihood. This served as a useful triangulation of testing.

An exploration of relationships between TTC errors and elements that might be linked with experience such as days driven per week, years driving licence had been held, approximate annual mileage and confidence began to highlight variables that might arguably begin to emerge as alternatives to age.

Days driven per week provided a strong, positive and statistically significant relationship. Showing that TTC errors tended to increase with number of days driven per week, years driving licence held, annual mileage and levels of confidence.

Arguably then, perhaps these experience-based variables showed a tendency to be more linked to changes in driving over time rather more than age per se. This data would suggest that increased experience and confidence arguably led to a tendency to perform worse on OMEDA PLUS. While age appeared to have a diminishing effect upon the ability to judge TTC when looked through a wide lens, perhaps this assumption that age was the major factor was obscuring the finer detail.

5.10.6. Limitations

The study experienced a lower number of participants than planned. This was largely due to the decision to adhere to the two separate age groups that had been used in Read (2001). As such, individuals aged 26 years to 59 years were excluded from the study. This was only a disadvantage in that the sample size was small, but supported the research by providing a definite comparison between and older and a younger group of participants. It was also advantageous in that this sample served as a test group for the product, and the smaller sample allowed for emphasis to be placed on results from the interviews. These semi-structured interviews supported the testing of OMEDA PLUS as a whole as they served to triangulate data between actual driving experience, performance on OMEDA PLUS and performance on the UFOV test.

Because of the difficulties in recruitment of participants, it was agreed by the team that the criteria requiring a UK driving licence would be extended to allow participants with non-UK driving licences as long as they had UK driving experience.

The UFOV test relied on a strong Wi-Fi signal to work effectively. This failed on occasion and so no results for the UFOV test were able to be extracted. In this way some of the comparative UFOV crash likelihood measurements were unable to be investigated.

The lack of portability of the test became a problem as it prevented people with limited mobility, lack of transport or time commitments from being able to attend the test site at Coventry University.

5.10.7. Section summary

Study 2 showed this version of OMEDA to be a working prototype but the limited reach to participants created a need to make the test portable. This would increase access for participants with mobility or transport issues. The interviews also provided a test of usability highlighting the sense in retaining the original foot pedal and hand button. Study 3 tests the robustness of the augmented OMEDA PLUS, and examines its sensitivity to age and accident risk. It examines variables which study 2 began to see emerge as alternatives to chronological age when measuring fitness-to-drive.

The small sample size of Study 2 began to justify the need for developing a portable test. This would enable participants to be visited at locations and times at their convenience. There would be a need to ensure that there was access to Wi-Fi so that the comparison with the UFOV test could be examined further.

The semi-structured interview served to gather data about crashes and driving behaviour and exposure, but also served to provide opinion about the test itself. This had been omitted from the testing of OMEDA, and was paramount in this research.

The portability would also be a chance to examine ways in which OMEDA PLUS could be made more accessible from a point of view of cost to the driver. For the product to be available to a broad spectrum of drivers, it would need to ultimately be reasonably priced. It would also need to be easy to deliver either in app form or via email.

Study 3 examines the working of a more portable version set up on varied computers. This would be made possible by the ability to configure the size of the test according to screen size. Study 3 would also aim to be carried out across all age groups so that differences might be examined on a continuum, allowing the opportunity to identify points at which differences in performance in TTC judgement might occur.

5.11. Study 3: Examining the comparative usefulness of the Useful Field of View test (UFOV) and OMEDA PLUS - Preliminary Results

5.11.1. Introduction

Study 2 justified the aim to make OMEDA PLUS portable and more accessible. The ability to configure the programme to different sized screens and also to transfer it to other sites via email enabled this to be explored.

The sample size was designed to be larger and would incorporate participants of all ages above the age of 18. The ability to attend different sites also made the more study more inclusive and could reach people for whom visiting the university might be less possible.

This study aimed to test 5 hypotheses whilst aiming to examine its effectiveness as a tool in terms of its reliability and validity. It was necessary to know that the tool measured TTC judgement accurately and that these measurements would be consistent. In addition results needed to also be consistent with those reported by Read (2001) at this point. Additional measures of validity were made more robust by the additional testing using the UFOV test. Where increased TTC errors indicated less safe driving, a parallel with the crash likelihood measurements of UFOV would help to strengthen the validity and reliability of OMEDA PLUS.

Statistical analyses, using SPSS were carried out in order to answer the hypotheses set out below:

1. **Hypothesis 1: OMEDA PLUS will show a sensitivity to age, with mean errors increasing from younger to older age groups**
2. **Hypothesis 2: OMEDA Plus will show a sensitivity accident risk**
3. **Hypothesis 3: OMEDA PLUS tests of CD and TTC will mirror that of UFOV2**
4. **Hypothesis 4: OMEDA PLUS errors will mirror those of the original version of OMEDA**
5. **Hypothesis 5: Time driving licence has been held, average miles driven per annum and number of days driven per week will have an effect upon OMEDA PLUS results with regards to TTC errors made**

5.11.2. Aims and Objectives

Aims	Objectives
• Develop a prototype of a portable version of a tool capable of measuring errors in judgement of time-to-contact of oncoming objects. • Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.	• Test OMEDA PLUS with results being compared against those of the original studies reported (Read 2001). Testing to be supported by a comparison to the second subtest of the Useful Field of View test (UFOV2) (Ball and Owsley 1993), which also assesses accurate reactions to, and recall of, objects under divided attention. In addition, the overall crash risk measurement provided by UFOV will serve to provide extra triangulation between accident history / likelihood and TTC awareness measured in OMEDA PLUS. This comparison between theoretical OMEDA, OMEDA PLUS and UFOV will be continued in Study 3. • Test OMEDA PLUS in different settings, using a laptop to establish its usability and portability. This will require the examination of results based on variables other than chronological age as explored in Study 2.

5.11.3. Method

5.11.3.1. Participants

The figures for the sample were examined. The Kolmgorov-Smirnov test showed the distribution of the study sample to not be significantly different from the population (P = >0.05). Data was slightly skewed towards the younger age group, but this was not seen to deviate significantly from the mean. N=40 with ages ranging from 23 to 89 years. Gender was split into females = 27 and males = 13 (mean 48.5 / median 47).

Individuals were invited to participate if they were either a current or former driver with a UK driving licence and over the age of 18. They were also offered the opportunity to be entered into a prize draw to win a £50 Amazon voucher by way of a reward. Each session lasted for approximately 45 minutes

A planned sample size was set at 40. This figure exceeded the 5-user assumption conventions within human factors (Virzi 1992) and sought to allow for a number that sat within the range of a ‘15-participant minimum’ (Japp 2019), and 20 participants within each group when the overall sample needed to be split for analysis (Faulkner 2003). Ages were generally considered as a continuum, but some comparisons required ages to be divided into manageable bins. In these instances, participants were split into two groups around the median age of 47. This served to provide the older and younger half of this particular sample.

Participants numbered 40, and were aged 23 to 89 (mean 48.45 years / median 47 years). 13 were male and 27 female. 4 participants had ceased driving.

Participants displayed varied levels of capability and confidence in relation to using computers. Most participants were able to complete all sections of the study, but for one participant it felt ethical to sensitively curtail this section of the study in order to ensure that a lack of understanding did not lead to a sense of having failed to complete the task. In addition, another participant was unable to complete the UFOV as a result of a decrease in the Wi-Fi signal. As a result, 40 participants completed the OMEDA PLUS tests, 38 fully completed the UFOV test. The UFOV test was further affected by 1 participant pressing the close button and losing their results for each of the subtests. However, the overall crash risk was recorded before this occurred, and so in this way, comparisons of crash risk comprise 37 participants.

5.11.3.2. Materials

- Driving Habits Questionnaire B (DHQB)
- OMEDA PLUS (2 subtests)
- UFOV (3 subtests)
- Number plate recognition test

5.11.3.3. Procedure

Participants were asked to complete the DHQB followed by the two computer-based tests which were again counter-balanced to manage effects of fatigue as had been the case in Study 2 (See Study 2 above). The study concluded with a test of visual acuity (Number plate recognition).

5.11.4. Results

Study 3 relied solely on SPSS. Two separate analyses were run. Firstly a One-Way ANOVA was carried out in order to replicate the analysis carried out in the original OMEDA study (Read 2001). This served to examine the similarities in operation between the original test and the rebuild.

Secondly a Spearman's correlation was carried out in order to take advantage of the ranking of scores that would be achievable across the different measures. The correlation highlighted the strength and direction of relationships between variables.

Relationships were analysed between results for UFOV, OMEDA PLUS, the number plate test, and variables that may relate to experience and driving exposure namely, confidence rating, annual mileage and days drive per week, total number of incidents and years that a driving licence had been held.

Two main analyses took place. The first, a One-Way ANOVA was attempted in order to examine the data in a similar way to the original OMEDA study (Read 2001). The second was a Spearman's correlation test which served to examine the relationships across the different factors. The hypothesis will be each examined in turn.

5.11.4.1. ONE-WAY ANOVA

In order to examine the sensitivity of OMEDA PLUS to age, one-way ANOVAs were employed in order to compute the difference in means across age groups. This was carried out in order to mirror the analysis which had occurred in the original OMEDA study (Read 2001). The dependent variables were as follows:

- TTC error
- Shape matching error OMEDA PLUS1 (referred to as TTC subtest)
- Collision Detection error
- Shape matching error OMEDA PLUS 2 (referred to as CD subtest)
- Ability to detect collisions whilst carrying out the shape matching task in OMEDA PLUS
- UFOV2 measurements

For the purpose of this analysis, the overall group was divided into two groups, separated around the median of the sample in order to distinguish the reactions and results of the younger half of this specific sample from the older contingent.

5.11.4.2. Spearman's correlation test

Analysis was also carried out using the Spearman's correlation test. This was chosen in order to take advantage of the ranking of scores that would be achievable across measures. The correlation would then highlight strength and direction of relationships between variables. A direction was not assumed, leading to the analysis to be entered as two-tailed. Relationships were analysed between results for:

- UFOV
- OMEDA PLUS
- Number plate recognition test
- And variables that might relate to experience
    - Driving exposure
    - Annual mileage
    - Days driven per week
    - Total number of incidents
    - Years that driving licence had been held
    - Confidence rating

Table 5.12 below shows the results of the test. Figures in bold represent relationships that achieved statistical significance.

Table 5.12: Results of Spearman's correlation for study 3

	Age	Age group	UFOV1	UFOV2	UFOV3	UFOV CRASH RISK 1-5	Licence years	confidence scale 1-5	Number plate test	Miles / year	Days / week	Total incidents	OMEDA(N)1 TTC errors	OMEDA(N)1 Match errors	OMEDA(N)2 CD errors	OMEDA(N)2 Match errors	correct cd and shape matching out of 12
Age	1.000	1.000															
Age group	1.000	1.000															
UFOV1	0.314	0.274	1.000														
UFOV2	.650**	.563**	0.314	1.000													
UFOV3	.524**	.399*	0.302	.701**	1.000												
UFOV CRASH RISK 1-5	.480**	.358*	.474**	.772**	.715**	1.000											
Licence years	.895**	.734**	0.269	.434**	.366*	.355*	1.000										
confidence scale 1-5	0.126	0.181	0.056	-0.037	-0.098	-0.178	0.131	1.000									
Number plate test.	-0.116	-0.143	.339*	0.092	0.147	0.127	-0.230	0.121	1.000								
Miles / year	-0.022	-0.002	0.246	-0.012	0.266	0.111	-0.029	.416**	0.186	1.000							
Days / week	0.056	0.016	0.237	0.160	0.275	0.192	0.094	.434**	-0.024	.521**	1.000						
Total incidents	-.494**	-.554**	0.046	-0.271	-0.043	-0.225	-.444**	-0.045	0.095	0.237	0.233	1.000					
OMEDA(N) 1 TTC errors	.424**	0.302	0.221	.399*	.405*	.452**	.392*	-0.083	-0.138	0.110	0.076	-0.134	1.000				
OMEDA(N) 1 Match errors	0.212	0.087	0.293	.448**	.464**	.525**	0.114	0.041	0.010	.346*	0.285	0.164	.413**	1.000			
OMEDA(N) 2 CD errors	.406**	.400*	-0.289	0.284	0.240	0.116	.360*	0.100	-0.276	-0.116	0.065	-.352*	.522**	0.021	1.000		
OMEDA(N) 2 Match errors	0.204	0.057	0.296	0.313	.400*	.355*	0.127	-0.104	0.045	0.144	0.247	0.144	0.145	.758**	-0.049	1.000	
correct cd and shape matching out of 12 possible correct	-.437**	-.372*	-0.258	-.462**	-.399*	-.363*	-.416**	-0.036	0.097	-0.148	-0.286	0.191	-.573**	-.507**	-.626**	-.520**	1.000

Bold figures <0.5 and found to be statistically significant

5.11.4.3. The hypotheses

5.11.4.3.1. Hypothesis 1: OMEDA PLUS will show a sensitivity to age, with mean errors increasing from younger to older age groups.

Table 5.13: Results of one-way ANOVA

Measures	*Means*		*F*	*p*
	Younger group	***Older group***		
OMEDA 1				
TTC error	4.57	8.53	F(1,38)=3.455	p>0.05
Distractor task	5.19	6.11	F(1,38)=0.323	p>0.05
OMEDA 2				
CD error	24.9	27.11	F(1,38)=5.33	P<0.05
Distractor task	4.81	5.00	F(1,38)=.009	p>0.05
OMEDA2_all correct	9.48	6.74	F(1,38)=5.357	P<0.05
UFOV 2	62.00 ms	135.06ms	F(1,35)=11.106	P<0.05

Results for the one-way ANOVA appear in **Figure 4.13** above. The means for all of the measures showed a decline in performance as age increased. However, these differences only reached statistical significance on two of the OMEDA PLUS tests – namely Collision Detection errors and OMEDA2_all correct. This second measurement showed a decline in means where participants were required to both predict a collision, and detect a match within the distractor task.

The UFOV2 test provided an increased mean for time responses for the older group than for the younger groups. This attained statistical significance.

The **Spearman's correlation** supported this as can be seen from the results below:

The relationships between AGE and TTC ERRORS, and AGE and CD ERRORS each produced significant moderate and positive relationships:

AGE and TTC ERRORS: ρ (38) = 0.424, p = 0.006
AGE and CD ERRORS: ρ (38) = 0.406, p = 0.009

The relationships created by matching the distractors in each case, created a low and positive relationship which was not significant.

OMEDA PLUS, Subtest 1 MATCH ERRORS: ρ (38) = .212, p = 0.188
OMEDA PLUS, Subtest 2 MATCH ERRORS: ρ (38) = .204, p = 0.206

As age increased, so did the errors in judgement of TTC and CD together with the ability to accurately identify the matching distractor in each case.

There was a moderate relationship between age and the errors made in judging TTC and CD, showing that as age increases, more errors are made. This was however, only a moderate relationship albeit significant. Less significant was the positive but low relationship between errors made during the distraction task in each subtest within OMEDA PLUS. This showed that the increase in age did not appear to be related to a higher number of matching errors made.

It can therefore be concluded that the null hypothesis can be rejected with evidence to show that OMEDA PLUS exhibits a sensitivity with age.

5.11.4.3.2. Hypothesis 2: OMEDA PLUS will show a sensitivity to accident risk.

As errors in matching **the** distractors increased, so did the errors made in UFOV2.
The relationship between incidents and OMEDA PLUS were low, with the link between the ability to judge TTC creating one which was negative:

INCIDENTS and TTC ERRORS: ρ (38) = -0.134, p = 0.411
INCIDENTS and CD ERRORS: ρ (38) = 0.164, p = 0.311

Showing a weak relationship, and in the case of judgement of TTC, a negative one.

In the interest of producing a meaningful analysis, the measurements between INCIDENTS and AGE were also examined. This produced a significant negative moderate relationship:

INCIDENTS and AGE: ρ (38) = -.494, p = 0.001

The results from the Spearman’s correlation show a statistical significance between number of incidents and age, with the strongest negative correlations occurring with age and “age group”. This suggests that crashes decrease with age. However, examining the correlation with UFOV crash risk, a moderate correlation is indicated at a point of statistical significance. Further investigation may be required before confidently rejecting the null hypothesis.

The link between accident risk and the likelihood to make increased errors in judgement of TTC and CD was low, and in the case of TTC judgement negative. This offered evidence to suggest that OMEDA PLUS' ability to measure accident risk might be low.

However, the link between INCIDENTS and AGE provided an interesting result. It showed a significant, and negative, moderate relationship between the two. This indicated that as age increased, accidents diminished suggesting that increasing age might not be automatically linked to accident risk. This would indicate that other factors had at least an equal effect.

5.11.4.3.3. Hypothesis 3: OMEDA PLUS tests of CD and TTC will mirror that of UFOV2.

The relationship between the UFOV 2 and TTC ERRORS was one which was low to moderate, and significantly positive:

UFOV2 and TTC ERRORS: ρ (35) = .399, p = 0.014

The relationship between UFOV2 and CD ERRORS was not significant, and was low and positive:

UFOV2 AND CD ERRORS: ρ (35) = .284, p = 0.088

This showed that the tendency to make errors within the divided attention condition of the UFOV test increased as the errors in TTC and CD judgement increased to a slight degree.

Means reported by the results of the one-way ANOVA tests for OMEDA PLUS matched the pattern of movement within the results from the original test OMEDA. The complete matching of patterns enables the null hypothesis to be rejected, as a clear link between result patterns for both tests can be seen.

The means reported by the results of the one-way ANOVA tests showed a clear tendency for performance to decrease with increasing age, in terms of errors made within OMEDA PLUS and the time taken in milliseconds taken to complete the UFOV subtest 2.

The results from the one-way ANOVA for OMEDA PLUS and UFOV2 tests show a matched decrease in performance with increasing age. The Spearman's correlation for UFOV2 Crash Risk met TTC scores at a point of statistical significance. With this, in addition to the ANOVA results, the null hypothesis is rejected

5.11.4.3.4. Hypothesis 4: OMEDA PLUS errors will mirror those of the original version of OMEDA

These results reflected those reported by the original OMEDA study (Read, 2001) as can be seen in **Figure 5.8** below:

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Figure 5.8: Results from ANOVA test in original OMEDA study – Screenshot from Read, 2001

As seen from the ONE WAY ANOVA carried out for Hypothesis 1, it can be seen that the pattern of mean errors move in a similar pattern between OMEDA and OMEDA PLUS, with both showing a sensitivity to age.

5.11.4.3.5. Hypothesis 5: Time driving licence has been held, average miles driven per year and number of days driven per week will have an effect upon OMEDA PLUS results with regards to TTC errors made.

The relationships shown via the Spearman's correlation for the factors mentioned above will be examined. In addition, the relationships between TTC and Confidence will also be examined.

There was a moderate positive relationship reaching significance between TTC and years licence had been held.

TTC and Licence years: ρ (38) = .392, p = .012

In this way, as individuals were seen to have held their driving licences for a longer period of time, there was a tendency for TTC errors to increase. This followed the results of Study 2 as seen above.

The remaining factors examined failed to reach significance and presented weak relationships, with confidence indicating a negative relationship.

TTC and Miles/year: ρ (37) = .110, p = .504

As miles driven per year increased so did the number of errors made in the judgement of TTC. This was the same or days driven each week. Study 2 also showed a tendency for TTC errors to increase with days per week driven.

TTC and Days/week: ρ (38) = .076, p = .641

In the case of confidence, as confidence fell there was a slight tendency for TTC errors to increase. However this relationship was week and failed to reach significance.

TTC and Confidence scale: ρ (38) = - 0.083, p = .612

5.11.5. Discussion

Before discussing the hypotheses in relation to the data generated by the study, it is worth revisiting the methodological choices in light of previous research. In this sense, the original decision to use mainly UFOV2 as a comparative test to OMEDA PLUS stems from previous research that found UFOV2 and UFOV3 to be the most predictive of the three subtests, with subtest 2 (UFOV2) tending to be the most reliable predictor of accident likelihood (Owsley et al.1998; Rubin et al. 2007). Previous research showed TTC to decline with age as drivers begin to develop UFOV decrements (Rusch et al., 2016). This decrement, coupled with the somewhat 'star status' of UFOV2 (according to its reported reliability) led to the decision to concentrate on the results reported for the measures for UFOV2 and TTC.

This study served to point towards an accessible version of OMEDA, OMEDA PLUS via the use of a laptop as opposed to desktop computer, enabling individuals to participate regardless of their level of mobility. The intention to test its robustness as a tool with the ability to effectively measure fitness-to-drive, was carried out using statistical tests.

1. **Hypothesis 1: OMEDA PLUS will show a sensitivity to age, with mean errors increasing from younger to older age groups**
   This continued to be shown when looking at the results through the broad lens. As age increased there remained the tendency for TTC errors to increase. This was expected and showed that OMEDA PLUS had been managed to retain the way of working as reported by Read (2001) when referring to OMEDA.

2. **Hypothesis 2: OMEDA Plus will show a sensitivity accident risk**
   OMEDA PLUS does show a sensitivity to accident risk. However it isn't the relationship that was expected. As reported accidents increased, there was a tendency for TTC errors to decrease. This might have been as a result of many factors. It might possibly show a difference in the working of OMEDA and OMEDA PLUS, and therefore warrants further testing of the new product's reliability. The difference in sample might also have had a bearing on the results. In this case the age range was more of a continuum. There was also more refined focus placed on factors other than age which might have begun to emerge.

   The link between accident risk and the likelihood to make increased errors in judgement of TTC and CD was low, and in the case of TTC judgement negative. This offered evidence to suggest that OMEDA PLUS' ability to measure accident risk might be low. However, the link between INCIDENTS and AGE provided an interesting result. It showed a significant, and negative, moderate relationship between the two. This indicated that as age increased, accidents diminished suggesting that increasing age might not be automatically linked to accident risk. Perhaps other factors also had at least equal effect.

3. **Hypothesis 3: OMEDA PLUS tests of CD and TTC will mirror that of UFOV2**
   OMEDA PLUS mirrored the UFOV2 test in that increased TTC errors matched the pattern of increased crash risk as shown by the UFOV. The link between number of errors made in the judgement of TTC, and to a lesser extent CD, mirrored the tendency for errors to be made within the divided attention condition of the UFOV test (UFOV2). From the results above, it could therefore be argued that as age increased so did the tendency to make increased errors in judging TTC and CD, and also in UFOV2. By way of using UFOV2 as a basis against which to test OMEDA PLUS, it could be considered that the rebuilt test is seen to produce moderate but meaningful results.

4. **Hypothesis 4: OMEDA PLUS errors will mirror those of the original version of OMEDA**
   When examined through the broader lens, TTC errors increased as expected.

5. **Hypothesis 5: Time driving licence has been held, average miles driven per annum and number of days driven per week will have an effect upon OMEDA PLUS results with regards to TTC errors made.**

These factors seemed to lead to increased TTC errors as they increased. Potentially indicating a tendency for increased exposure led to a less careful approach leading to more errors. In this way, perhaps attitude towards driving as a result of driving experience might be a more sensible point for scrutiny of drivers to be increased instead of the customary age-based system.

5.11.6. Limitations and Further Research

The study experienced some limitations. Firstly, the manual for the UFOV test (Posit Science (Brain HQ), 2019) suggests that it is administered in a quiet and preferably dark room. This was not always possible, but the study followed guidelines for ensuring that light was kept to a minimum, and glare avoided.

In addition, a limited understanding of computers, led to one participant finding the process taxing. With this in mind, the session was sensitively brought to a close.

Further research is required to test the limits of OMEDA PLUS. This is considered to be valuable because of its unique attempt to examine the higher order cognition process of judgement making.

5.11.7. Conclusion

A Spearman's correlation was used to explore the factors that might affect TTC. Interestingly it showed accidents to diminish with age potentially inferring that another factor might be affecting the results. OMEDA PLUS continued to work in a similar way to both the original version of the tool and UFOV2. Importantly, the portable version of OMEDA PLUS was seen to work as effectively as the static version.

The following section examines the perceived relevance of OMEDA PLUS, and through interviews seeks to establish the likelihood that individuals might choose to engage with it.

5.12. Study 4: Remote interview to establish relevance and likelihood of use for OMEDA PLUS – to be analysed using Interpretative Phenomenological Analysis (IPA)

5.12.1. Introduction

Having developed OMEDA PLUS, it was important to explore how it might be received, and to gather opinion regarding the likelihood of use. This had been an important element of the research that had been neglected with the development of the original OMEDA. Two lines of research had been planned - firstly, discussion with adults on the cusp of driving cessation and secondly, discussion with other stakeholders such as medical professionals, Occupational Therapists and Assessment centres amongst other groups. However, time constraints and delays that occurred as a result of the Coronavirus global pandemic led to one of these avenues being dropped. As such, Study 4 sought to establish the perceived relevance and likelihood of us for OMEDA PLUS amongst adults considering ending their driving career.

5.12.2. Aims and objectives

Aims	Objectives
• **Gather opinion regarding the relevance, and likelihood of use of the proposed tool, OMEDA PLUS.**	The interviews planned in Study 4 will seek to discuss the perceived relevance and likelihood of use of OMEDA PLUS by individuals who may be approaching these decisions.

5.12.3. Method

5.12.3.1. Participants

This study sought a homogenous group through purposive sampling. This included individuals over the age of 55 who had ceased driving, or who were beginning to self-regulate and show signs that they were now driving less than they once had done. There was an intended group size of at least 6 participants, in accordance with Interpretative Phenomenological Analysis (IPA) conventions.

Studies which had been examined tended to refer to the "older driver" as being anywhere from 55 to 70+ years. In this way, the study sought to collect data from adult drivers across this age range. It had previously been a consideration to create a comparison between younger and older drivers. However, IPA requires the engagement of a homogenous participant group. Rather than inviting participants from a range of ages and levels of experience, the research was streamlined to include individuals who shared a single experience – that of being on the cusp of considering self-regulation and/or driving cessation. This proposed group of "older drivers" would be able to provide data about their current perceptions that would be able to be enriched by data regarding their younger selves. This would enable comparisons to be drawn out longitudinally across an individual's life span as opposed to a providing a less related data set from a separate, younger individual.

Out of 25 interested parties, 22 were sent the introductory information and invited to take part as they appeared to fulfil the criteria based on their introductory emails. 8 of these responded and wished to continue with the process after having indicated informed consent and completed the initial questionnaire. Interviews were carried out with this 8 based on the information received via this form.

Upon completing the interviews, 1 respondent was perceived to be a less accurate fit for the criteria, and so this participant was removed from the analysis. Therefore, n=7 with ages ranging from 59 to 91 years. Two females and five males chose to take part. Of interest was the division between those who were deemed to be experienced drivers, and those who were not. A table detailing levels of experience will be presented in the Results chapter.

5.12.3.2. Defining the group

The interviews with 7 of the 8 participants were found to be viable. The people who took part had begun to show signs of self-regulation with one having retired from driving completely. The people interviewed included 5 men and 2 women:

- "Christine" and "Catherine" (both 75 years old)
- "Sean" (59)
- "Nick" (76)
- "Peter" (91)
- "Mark" (67)
- "Clive" (64)

A table introducing each individual with details of their driving exposure, accidents reported and levels of experience can be found below **(Table 5.14)**.

Table 5.14: Introducing the participants

"Sean" is a 59-year-old man. Not actively considered giving up, but tends to drive for local trips, and now chooses to use the train for longer distances, and so is arguably showing signs of self-regulation within his driving. Part of his decision-making stems from having experienced a panic attack whilst driving on the motorway. As a result, he tends to use city, rural and single carriageways 2 to 3 times a week, and only uses the motorway for one trip a month. This is a short trip. He took an advanced driving training course to actively regain confidence behind the wheel. He has held his driving licence for 42 years and drives an average of 2 hours 40 a week. He has experienced 1 minor incident that did not require any medical support, and that was not his fault, at the age of 52. He reports a measurement of confidence as being 4 out of 5, where 5 is the highest, and a measurement of self-perceived skill of 4 on the same scale. He was happy to communicate over Skype. The interview lasted for 38 mins 52 seconds.
"Christine" is a 75-year-old woman who has held her driving licence for 56 years and has been fortunate enough to have had no accidents. She now drives a maximum of 4 hours a week, using urban and rural roads. She rarely uses carriageways and motorways. She has recently been experiencing problems with eye health but has been given medical agreement to continue to drive, as her level of sight currently stands. She reports a self-perceived ability level of 4 out of 5, and a level of confidence of 3 out of 5. She was unaccustomed to using online discussion platforms, and had limited confidence with computers, and preferred to carry out the interview over the telephone. The interview lasted for 13 minutes and 44 seconds.
"Catherine" is a 75-year-old woman who no longer drives but has chosen to keep her driving licence in case of emergency. She has held her driving licence for 51 years, and only experienced one accident at the age of 44 for which she was not at fault. She reported a confidence level of 2 and a skill level of 4.   We chatted on the telephone for 21 minutes and 02 seconds.
"Nick" Is a 76-year-old man who has had his driving licence for 22 years. He has experienced 2 accidents aged 53 and 57 and was at fault for one of them. Emergency services were not needed for either of them. He drives for an average of 3 hours a week, using city and rural roads once a week, and single carriageways 2 to 3 times a week, and motorways monthly. He reported both confidence and skill levels of 3. We chatted on WhatsApp video for 1 hour, 9 minutes and 16 seconds.
"Peter" is a 91-year-old man who has unfortunately recently experienced ill health. He has held his driving licence for 68 years and trained to become an advanced driver. He has experienced one crash which occurred when he was 90 whilst diving an unfamiliar car. This was seen to be his fault and the emergency services were needed. Peter rarely drives on city roads or on the motorway and drives locally on rural roads and single carriageways 2-3 times a week. He reported a confidence level of 3 and a skill level of 4. He preferred to carry out the interview over the telephone. This lasted 38 minutes 04 seconds.
"Mark" is a 67-year-old man who continues to drive and who also learnt to drive abroad at the age of 16 and passed the UK test shortly after turning 17. He trained as an advanced driver, and reports a confidence level of 5, with a skill level of 4. He has held a driving licence for 49 years, and only drives for about 2 hours a week unless he is going on holiday. He has had 2 accidents with on at age 17 and the other aged 50. He was not at fault in either case, and the emergency services were not needed. He drives on city roads and motorways about once a week, and rural roads and single carriageways 2.3 times/week. He was happy to carry out the interview over Skype. We chatted for 51 minutes and 54 seconds.
"Clive" is a 64-year-old man who has decreased his driving and now only drives 14 hours a week. He has experienced 3 incidents aged 35, 45 and 56 with none being considered to be his fault, and where no emergency services were needed. He has held is driving licence for 46 years and is an advanced driver. He only drives 2-3 times a week on the motorway. He drives daily on city, rural and single carriageways. He reports confidence and skill levels of 5. He chose to speak over Skype. The interview lasted 22 minutes and 25 seconds.

5.12.3.3. Materials

- Driving habits Questionnaire C "Initial questionnaire" (DHQC)
- Video
- Factsheet
- Recording device
- Access to Skype / WhatsApp / telephone

5.12.3.4. Procedure

Once participants had registered interest, they were asked to complete the initial questionnaire that asked demographic questions and queried driving habits. The return of these acted as a consent to take part. They were then forwarded a copy of the video and factsheet that explained the purpose of OMEDA PLUS and demonstrated its use. They were also sent a copy of the interview schedule so that they would be able to answer questions in an informed manner, and without the additional stress of a test experience. Once the interviews had been completed, they were transcribed using OTTER software available at https://otter.ai/, and were analysed using IPA.

5.12.4. Results

Study 4 was analysed using IPA. This was chosen as a method that would empower the participant to share what they were comfortable to disclose, whilst at the same time enabling the researcher to identify topics that might have been averted. This sense-making approach arguably served to retain the sense of a cognitive paradigm (Fiske and Taylor 1991). This consideration of the human brain having similar storage and working facets to a computer has been a dominant theme in the research so far (McLeod 2015).

The analysis was planned to occur within NVIVO but a difficulty to renew the licence under Covid-19 employment levels, led to alternative means to be used. Instead the researcher returned to a method previously used with Excel. Once the data had been transcribed, it was added to Excel for the IPA analysis to begin. The planned steps within the process being shown below:

10. Created a document showing each transcript line-by-line
11. Added interpretative "researcher initial notes"
12. Created initial coding
13. Used initial codes to create superordinate themes by "clustering"
14. Added line numbers of quotes to each Cluster/superordinate theme
15. Linked superordinate theme to lines in transcript
16. Repeated this for each participant
17. Created "master" file that contained all themes and line numbers for each participant according to codes created across individual participant.
18. Examined similarities and differences across the sample.

Once completed, the themes were verified by an independent researcher. All themes were agreed, with one missing theme “mental health” being suggested by this colleague. The analysis did not find the quantity of data to support the use of Mental Health as a separate theme. A decision had also been made at the outset of the research to consider the approach of the parity report and viewed mental and physical health issues under the overarching theme of health (Panday 2016).

The main themes and subordinate themes can be seen below **Table 5.15.** This is repeated and augmented in **Appendix B4.1** and includes references to lines of text indicating the input from each participant for the combined interview.

Table 5.15: Themes and subordinate themes from IPA analysis

Codes	Subordinate code
Accidents	
Age versus function	
Ageing	
Alternative transport	
Car industry awareness of older demographic	
Car use	convenience
Cessation	opinion
	consideration
	conversation
Changing traffic environment	
Confidence	
Covid-19	technology
Definition: Experienced driver	
Definition: fitness-to-drive	
Definition: older driver	relative age
Disability and driving	
Driving	testing
	emotive topic
	level of importance
	responsibility
Driving environment	
Driving licence	renewal
Driving skills and training	
Enjoyment	
Family vs GP recommendation	
GP responsibility	
GP reverence	
Health	physical
	physical fitness
	eyesight
	cognitive
	hearing
History of driving	

OMEDA PLUS	**licence renewal**
	test effect
	a test of fitness to drive
	ability to engage
	concerns
	licence renewal
	need for validation
	opinion
	perceived purpose
	relevance
	real world relevance
	recommendation
	relevance
	suggestions
	technology
	test: Licencing
	willingness to engage
Other driver story	
Other drivers	
Policy	
Regulation by others	**friends and family**
	DVLA
Responsibility as driver	
Retirement	
Self as driver	**confidence**
	new driver
	experience
	skill
	advanced driver
Self as older driver	**relative age**
Self-regulation / Cessation	**avoided scenarios**
	familiar routes
	due to health
Technology	**advantage**
	generation differences
	in car
technology and ageing	**assumed access**
	assumed knowledge
	loneliness
	generation differences
terminology	
Value of self-opinion	

The overall results of this study were compiled from a combination of DHQ and interview responses. The main purpose of this study was to address the following research questions:

The results of this study were compiled from a combination of DHQ and interview responses, with the latter being analysed using the Interpretative Phenomenological Analysis (IPA) technique. Although the interviews collected data regarding definitions of the “older driver” and potential measurement factors that provide an alternative to chronological age, the reporting of responses is kept to a minimum in this section in order to avoid duplication. The main purpose of this study was to address the following research questions:

When on the cusp of self-regulation/driving cessation is there:

a. Perceived relevance for the potential application of OMEDA PLUS?
b. How likely would this group be to engage with the test?
c. To what degree would this group trust the measured results and their intended use?

However, the following two overarching questions will be briefly examined:

- **How might we define the older driver?**
- **Can we measure fitness-to-drive in functional rather than chronological terms?**

In addition, a succinct examination of the overall relationship with driving and cessation will be shown with a view to providing some background to views about OMEDA PLUS.

5.12.4.1. The Interviews

The themes emerging from the interviews provided an extensive range of topics. These were further synthesized into a working map of themes which was devised to reflect the overarching research questions. This can be seen in **Appendix B4.2.** The themes relevant to the proposed research questions for this section, together with those retained to introduce new information, can be seen in **Table 5.16** below:

Table 5.16: Codes retained for results section Study 4

Codes retained	Subordinate codes
Accidents	Causes and effects
Ageing	Attitudes and descriptions
Cessation	Points of view Conversation with others GP Reverence Alternative transport
Chronological versus functional age	as a measurement of fitness-to-drive
Confidence	Changes over time
Covid-19	Changes experienced Technology factor
Definitions	The Experienced Driver
	Fitness-to-Drive
	The Older Driver
Driving	Skills and training Testing Car use Emotive topic Level of importance Responsibility Enjoyment
Driving environment	Opinions and Changes Car industry
Driving licence Renewal	Opinions and the process
Health	Physical Visual cognitive Auditory
OMEDA PLUS	Licence renewal A test of fitness-to-drive perceived purpose Relevance Willingness and ability to engage Opinions Concerns

5.12.4.2. How might we define the older driver?

Throughout this research, there has been an attempt to define the “older driver”. Results from Study 1 suggested that the following issues might contribute to this classification (**Table 5.17**):

Table 5.17: Older driver classification

Age	**Chronological** **Comparative / relative** **Specific - Retirement age**
Health (age-related) *	**Presence of Age-related health decrement**
Experience *	**Length of time driving licence has been held** **Length of time driving (in years)**
Driving exposure *	**type of roads / scenarios** **How often**
Driving style	**Positive and negative comments:** **More careful** **Too cautious / too slow** **More aware**
Driving attitudes	**Changes over time**
Ability to drive	**Changes in skills over time** **Reaction times*** **Perceived ability to multi-task***

Study 2 explored some of these factors from the point of view of links to driving confidence. The topics that fell into similar categories appear with an asterisk (*) in **Table 4.10** above.

This study sought to recruit adults aged 55 years and over who had either ceased driving, or who were showing signs of self-regulation in terms of a decrease in the miles that they were now driving on a weekly basis. It did not work on the assumption that individuals considered themselves to be older drivers because part of the aim of the study was to examine the factors that might contribute to this identity. Discussions about ageing provided interesting perspectives:

5.12.4.3. AGEING

The concept that individuals age at varying rates became clear from discussions with participants.

Mark suggested that the changes that occur in ageing are not uniform:

> ***...while I think there's no doubt that various faculties decline, there is - faculties decline with age your eyesight gets poorer, your mobility gets***

poorer. Your brain function deteriorates, though clearly not at the same rate for all people.

Despite any changes that may occur, Peter suggested that there should be more of a sense of equality regardless of age:

... should an 80 year old or a 90 year old be treated any differently from a 30 year old?

In terms of defining the positionality of each of the members of the group, and in order to highlight the subjective nature of this matrix, the participants were asked if they considered themselves to be an older driver. The responses along with their ages appear in **Table 5.18** below:

Table 5.18: Perceived older driver status

Would you consider yourself to be an older driver?		
Name	**Yes / No**	**Age**
Peter	Yes	91
Nick	Yes	76
Sean	Yes	59
Catherine	No	75
Christine	No	75
Mark	No	67
Clive	No	64

The group provided varied answers highlighting the complexity of the attempt to create such a definition. They each provided another layer of perspective.

Peter, Sean and Nick considered themselves to be older drivers. These three included both the youngest and the oldest participants.

Peter felt that he would definitely consider himself to be an older driver. He attributed his decision to his age of 91 years:

Oh without doubt! Well surely it has to be age… I can't think it can be anything other than that. Er, I mean my wife, for instance, didn't get an ordinary licence till she was 40, er, but she's now approaching 80, but er she still drives, so I'm sure if you asked her the same question, she'd, she would still regard herself as being an older driver…

Nick also considered himself to be an older driver based on his age. He also took into consideration that there might be age-related decrements of which he currently remained unaware.

Because I'm older! I mean I'll be 76 in October. Being stuck in lockdown has given me lots of time to think about all sorts of things. And I thought

oh my God, four years' time, I'll be 80. I can't believe it! Here I'm still that 45 [pointing to head signifying the mind] but my body doesn't tell me that. Erm, why do I think I'm an older driver? I suppose age is the primary thing. Erm, I suppose your reaction is possibly a bit slower. I'm not aware of that. Somebody watching my driving I think could possibly think my reactions are slightly slower to a situation. Er, And I can't say I'm more cautious as I get older really. I don't take chances but I'm not a cautious driver. I'm not a speeder, but I'm not cautious.

Nick also discussed his driving style, alluding to the image of the older driver as being someone who is over cautious. Regardless, he placed himself in the older driver category.

Sean was a little less certain about his position. He started off by saying that he felt in some ways he felt that he would be considered an older driver, but that in other ways he would not. He referred to the lack of desire to allow the shift in identity to reflect an older self, while also explaining that he drove with more caution now than he had done when he was younger.

Um, err…Sort of in denial! You don't want to get old if you know what I mean, but I think I'm more cautions now, yeah.

After consideration, Sean decided that he did think that he was an older driver but did not like to think of himself in this way:

…yeah, so I think I am an older driver, but I don't like thinking of myself as one.

Christine, aged 75 years, considered her position within this demographic based on a comparison with other drivers in her local area:

…Well, I don't actually because I think I live in a very – you know, the population around here tends to be elderly. And when I think old, I'm thinking of some of the people around here in their sort of late 80s and 90s. And I don't consider myself like that.

Christine also provided a story about another driver known to her in order to support these differences. This seemed to be a common tool used by the group when discussing their own driving.

…And they don't seem physically that fit, even though a lot of them are still driving. I always looked at them. In fact, I had a neighbour and I was waiting for her to come home, I felt worried I thought that she shouldn't have gone out this late. And in the end, the police brought her back, because she'd been driving so erratically. And still, she wouldn't give up driving. They really had to sort of force it in the end. And I always thought, well, if I got to a point, when I felt I was dangerous, I'd

go and take a test. That was something that I've always had in my mind, because I've seen a lot of elderly people have very near misses, you know, there's not a corner on their cars that's remaining - scraped everywhere. And I would never risk that.

Catherine, also aged 75, ascribed the older driver category to drivers over the age of 80.

No. I didn't really. I think of an older driver as 80 plus.

She also explained via another known driver, why she did not currently fit into that category. This included a description of the driving style of those who she felt belonged to the group:

Well. Very slow and hesitant drivers are often seen to be old drivers aren't they? I mean, we have a neighbour who is in her 80s, and she for example – I mean she was partly the reason I stopped driving. Coz when she came to a T-Junction, she would always stop about 4 car lengths before the actual junction, and she couldn't really see, coz obviously she was too far back, and I thought "if she is beginning to drive like that, you know, perhaps if I stop now, coz I don't want to get to that stage", that makes sense.

Clive similarly compared himself to other drivers on the road, and also provided a story about a driver other than himself, but concentrated more on the style of driving than age itself:

Well I don't think I drive like some old people I see driving on the road. I mean, you will, I mean, my children, I mean this, but my children have always called people DOGs – Dozy old Git – and you've still got dozy old gits on the road, they're probably people who've never driven very well in their lives. I don't think age really makes you drive slower, or anything like that - I don't think it does. I mean, my mother's had 2 or 3 speeding tickets before I took her licence off her.

Mark acknowledged that he was an older man in terms of age, but did not think of himself as an older driver because he considered himself overall to be fit and in good health. He also considered that his lifestyle interests were potentially delaying him from achieving older driver status:

*…**No, I don't think I would. I mean, I am in that I'm a 66 year old, who has had some medical problems and doesn't drive a great deal. So, yeah, I suppose if you just looked at that, you would say yes, I am. But I mean, I don't feel an old person. You know, I'm still fit as I say, I can cycle…I'm beginning to get one or two minor medical conditions - my mind is, is active, I'm still involved in things that test my mental faculties... So I'm not sure if that, if I'm not an old person, then I don't think I'm an***

older driver - other than just looking at my age and obviously I am you know - getting into that category.

5.12.4.4. Can we measure fitness-to-drive in functional rather than chronological terms?

The interviews introduced factors other than chronological age which might be considered when looking at fitness-to-drive. The topic of age versus function arose:

5.12.4.4.1. **Age versus function**

Mark considers that someone aged 80 or above would be considered to be an older driver, he adds that younger drivers with illnesses or health decrements such as poor eyesight might be seen to function as an older driver.

> ***80+ people are older drivers if they're still driving, but younger than that, I think you can still be an older driver. If you have some form of health or one or more health problems; now, an obvious one would be eyesight, it's very important for driving. Hearing is not quite so important for driving though it does help. But if your eyesight is poor, then there's an argument for not driving but of course people get poor eyesight when they're in the 20s and 30s.***

This implies a personal measure of perceiving decreasing ability as a driver ages, whereby a substantially younger driver may be seen to have the qualities of an older driver once they begin to show signs of decreasing health.

Mark continues, however, to make the point that although there are some functional declines that occur with ageing, arguably leading to altered reaction times, that perhaps actually there is less to do with age per se. Stressing the fact that people age in different ways and at different rates.

> ***...while I think there's no doubt that various faculties decline, there is - faculties decline with age your eyesight gets poorer, your mobility gets poorer. Your brain function deteriorates, though clearly not at the same rate for all people.***

Clive considers driving to be a skill and questions whether it might be the case that some people have more of an aptitude for it than others. He notes that changes with ageing might have an effect, but so might illness:

> ***… You know, the reaction times and things are probably going to decrease, or it could be that you're ill! You know, or is it because you were NEVER able to park the car that you keep crashing now? …the roads got busier... I think it's just "are you competent or aren't you?"***

Here Clive also raises an important point. Perhaps it is not the ageing of the driver that should be called into question, but an acknowledgement that over time the traffic environment has become more complex, with roads have become more complicated and increasingly populated.

Catherine supports this concept of driving as a skill that requires aptitude with some people being better at executing it than others.

> ***...probably people who've never driven very well in their lives. I don't think age really makes you drive slower, or anything like that.***

She also considers that as a skill, perceived ability should not be measured by age but by the ability to carry out the activity:

> ***I'm quite interested in the project because I do think that you know driving skills shouldn't be judged just by age, because it's not to do with that. It's to do with ability I think...***

5.12.4.4.2. Fitness-to-drive

Another important consideration when attempting to extract ability to drive from age, is actual fitness to drive. When directly asked to define what "fitness-to-drive" meant to them, some made the point that to them it referred to ability more than age.

5.12.4.4.3. Control of the car and overall competence

Catherine, Christine, Nick and Sean all made reference to the importance in being able to control the car. Sean had thought about this, and suggested:

> ***…it's er control of the car really. Ability to control the car, yeah. Erm, sight, concentration, attitude, emotion, maturity. I've written it down…it has to do with ability and control, yeah.***

Mark looked at this from a completely functional perspective, saying that a person should have the skills necessary to enable them to pass a driving test which would be the way to determine fitness-to-drive:

> ***Well, I suppose it would be … could you probably with some…refresher training, pass… a practical driving test…You know, if you couldn't then - and therefore, if you hadn't a license already, you wouldn't get a license, then I don't think you're fit to drive…Erm but I think if you can't control the car in a variety of circumstances, to the satisfaction of a driving examiner, then you're probably not fit to drive. And controlling the car involves both physical things like turning the wheel and***

pressing the pedals and looking around you so that you don't drive in front of somebody or knock somebody over erm, but also the ability to react to unexpected happenings - like somebody stepping in front of you or a car swerving in front of you. So all these things probably don't happen in the driving test, at least not normally…But if I had a month's notice, and I couldn't pass the test in a month, then I think I would be unfit to drive.

5.12.4.4.4. Physical and cognitive fitness

The topic of physical fitness arose. Christine referred to the leg strength required for pressing the brake effectively, and also the need to be the correct height for the car in question. She does add the important point that people with disabilities are able to have adaptions made to a car to make them drivable:

> ***Well I think physically fit for a start, because I see a lot of people who don't even look as if they can see over the steering wheel, and so I think, you know and limp in and out of cars. Obviously people with disabilities have adaptions, and I don't think that is unfit to drive, but they're usually tested anyway. As far as age is concerned, I think you know, if you've got um an arthritic hip, and you can't put your foot on the brake as quick as you should do, that kind of thing. And size as well. You know, if you actually can't see over the steering wheel, I don't think that's very healthy.***

Clive examined fitness-to-drive from the point of view of physical and cognitive capabilities. He stressed the need to wear appropriate spectacles, and the importance of being able to comprehend the driving environment:

> ***Well I think it's a physical ability as well as mental ability. But definitely mental ability. Have you still got all your faculties about? Can you hear? Can you see? …Are people able to still see? I mean I wear these things [glasses] so I can see you on the screen. When I drive I don't need them, but there are a lot of people out there who probably should wear glasses but don't. That's a fitness-to-drive thing.***
> ***There is also the fact that some people are starting to get slower in their mental capacities as well. If they are actually struggling to remember their name, they're probably going to struggle to remember what the road signs mean, and things like that, so a double thing. It's the physical side, and the mental side of things as well.***

Catherine suggested that the onset of illnesses such as Alzheimer's disease affected the ability to make judgements whilst driving which showed a detrimental effect on fitness-to-drive:

> ***Oh, yes. Yes. Partly to do with cognitive ability I suppose. Erm, I have another friend who I think has the very beginnings of Alzheimer's and I don't feel safe being in her car now. Erm, Because I know she's not making judgments quickly enough.***

Nick stressed the need to remain alert, and also separated age from the ability to drive:

> ***…Well I suppose really, how alert you feel you are, erm how quickly you can react to circumstances, erm how confident - if you begin to lose your competence at driving. Erm and I think you would know - I would know I think that I'm thinking, Oh, I'm not as good as I was, not as alert as I was, should I really be doing this? I don't think it's a question of the age as much as you, and how you perceive your abilities.***

Catherine agreed that fitness-to-drive might not be based on age per se, but felt that the experience gained through driving for a long time, and also having a mature attitude increased the level of fitness:

> ***Well I think it shouldn't be linked to age completely because you know, I know drivers in their 50s that are 10 times worse than my friend who's 92. Erm, so it's got nothing to do with age, but everything to do I think with erm …well I don't know what…what does determine good driving? I suppose she's driven all her life. And she's a very sensible, competent person anyway. So I suppose that influences it a bit…***

Peter agreed with the importance of having a mature attitude and told of an accident experienced by a younger driver that he knew:

> ***…and I think it would also be fair to say, you need to have a bit of maturity. I'm saying this in mind, er, because, just across me, my neighbour, his 18-year-old son, er qualified, was always a bit rash, within 6 months of driving had piled a car completely and got a 12 month ban... He's come out of it ok. Yes, luckily he was not seriously hurt. Another 3 teenagers in with him. They were obviously larking about…***

Another interesting point made by Peter was regarding the car itself. He stressed the need for comfort and good maintenance:

> ***… But going back to the question, you need to be comfortable, you need to have good vision, you also need to have a car that is well maintained. I've seen too many, what I would call now, old bangers on the road. There the ones that are going to break down, but I appreciate that people can't afford anything else…***

Nick summed the thoughts of the participants up, also mentioning the potential effect of confidence upon fitness-to-drive as he explained:

> ***To sum up, It's not …chronological age is it? It's how you perceive your abilities really, and confidence. You might just think "oo I can drive, I'm confident"…But yeah, you're not as sharp as you were. And maybe it requires your family to point out to you you really hadn't ought to be driving.***

5.12.4.4.5. Experience as a considered alternative factor

Participants from the previous studies had mentioned the concept of experience as being an alternative to age when looking at who the older driver might be, and how fitness-to-drive might be measured. This group was asked their thoughts about this. As in previous studies, these participants confirmed that the sense of feeling experienced stemmed from the following factors:

- Length of time they had been driving in terms of years
- Miles driven
- Types of driving situations encountered
- Regularity of driving

Christine's explanation demonstrates some of these factors:

> ***Well I think driving in different situations. I mean at the moment, I'm only gonna be driving around locally, but I have done motorway travel. I've driven all the way up to Newcastle and all over the place really. Driving has never bothered me. I've driven abroad. So I'd say that has given me experience as a driver. Some people literally only go up the road and back again forever don't they? So I think that makes me experienced.***

Peter discussed the length of time that he had been driving, and the number of miles he had covered. He adds an interesting point whereby he does not necessarily consider experienced to mean competent:

> ***On the basis of the years I have been driving, and in that same process, the miles I have driven, I think it would be fair to say I am an experienced driver. It doesn't mean to say I think I'm a good driver, but I'm an experienced because I knew a lot of people who may have been driving for as many years as I have, but in the process, have only used the car for purposes, and therefore have not driven anything like the miles or the distance that I have.***

Catherine felt that regularity of driving was an important element of being an experienced driver:

> ***Well, I think if they drive regularly…I think, my husband always makes comments about the Sunday drivers – people who only get their cars out at the weekend to go to the shops and have a little run out …***

Clive disputed this by suggesting that gaining experience requires learning from mistakes, and that the regularity with which a person drives does not automatically make them experienced:

> ***…I think an experienced driver is somebody who's learnt from their experiences, and have probably had some training as well? Because just driving lots and lots and lots doesn't necessarily make you a better driver.***

5.12.4.4.6. Accidents

The other alternative factor to age with regards to fitness-to-drive that this research has been examining that of the accidents experienced. Three out of the seven participants specifically brought up the topic of accidents.

Peter, aged 91 had only recently had his first accident at the age of 90. He considered himself to be an older driver but attributed the tendency to have accidents not to age, but to competence:

> ***Because on the road with a motor car, you're just as liable to case an accident if you're not capable as any other one***

Peter felt that his accident had occurred due to a lack of familiarity with the vehicle that he was driving.

> ***She's got a car as well as mine. And much more modern than mine is…The accident I had was in her car, er, and I am nothing like as familiar with it as I am with my own.***

Mark held a licence for 49 years, reported accidents at the age of 17 and 50. However, he referred to an accident that had been his fault "20 or 30 years ago". Currently at the age of 67 years, this would have made him either 37 or 47. He attributed his first crash at 17 to overconfidence, but was glad to have not had any accidents more recently. He also mentioned that this accident had occurred soon after getting his licence which might allude to a lack of experience:

> ***And I did have – not, by no means a serious crash, but I did have a crash through overconfidence when I wasn't, I hadn't passed my test very long. And I have had one or two accidents since but touch wood I haven't had an accident for many, many years. And I mean, the last one that was my fault was a long time ago - 20 or 30 years ago, again, it wasn't a serious accident. So it wasn't a serious action [accident]…***

Nick who was now 76 had been driving for less time than the other drivers, and attained his driving licence at the age of 53 approximately 22/23 years before. He reported 2 crashes where he had been at fault for one of them. His first that occurred a few weeks after passing his driving test. His mention of being a new driver, is interpreted as an attribution to being a novice driver, and therefore lacking experience. Here Nick is not someone to have started driving at 17 years. He feels confident now, 22 years on, but took an early knock to his confidence:

> ***No, I feel easy getting in the car. In the early years, like I said, I was very nervous, and erm, errr. In fact, I'd only been driving for a few weeks, And I, it was at a roundabout. I, and my friend was driving the car in front. I thought he was going to go off and he didn't. I went into the back of him. Well that didn't do much for my confidence did it?***

5.12.5. Relationship to driving, cessation and self-regulation

In the process of expressing their views on OMEDA PLUS, the participants discussed their relationship with driving, and the concepts of self-regulation and cessation in addition to the changes to their lifestyle that these notions might represent. An understanding of these associations provide a background that serves to substantiate their views on the tool itself.

5.12.5.1.1. Cessation

Similarly Christine felt that she would retire from driving if she started to notice a decline in her own driving:

> ***In fact, I had a neighbour and I was waiting for her to come home, I felt worried I thought that she shouldn't have gone out this late. And in the end, the police brought her back, because she'd been driving so erratically. And still, she wouldn't give up driving. They really had to sort of force it in the end. And I always thought, well, if I got to a point, when I felt I was dangerous, I'd go and take a test. That was something that I've always had in my mind, because I've seen a lot of elderly people have very near misses, you know, there's not a corner on their cars that's remaining - scraped everywhere. And I would never risk that.***

Another reason for this perceived deflection might also have been due to the emotiveness of the topic of driving and cessation. Clive summed this up:

> ***as a as a police officer dealing with people on the road, you can tell somebody that they've been off philandering with somebody's wife, but you couldn't tell them they're a bad driver. They deny one, and [unclear] the other if you know what I mean.***

Peter and Catherine who had both retired from driving discussed different factors that had led to their cessation. Peter was sadly terminally ill, and had been affected by the first and only driving accident he had experienced at the age of 90.

> ***...and I went all those years without having an accident of any consequence***

The accident had occurred on an odd occasion where he had driven his wife's car to which he was unaccustomed:

> ***The accident I had was in her car, er, and I am nothing like as familiar with it as I am with my own***

He felt that having his wife as an alternative driver helped to make this decision a little easier.

My wife's car has got on it, additional drivers, one is our son, and the other is me. It's coming up for review in the next couple of weeks, and I'm going to take myself off it.

Catherine mainly decided to give up driving because of the road driving environment:

…I think the thing that stopped me driving is that there are so many idiots on the road. I got so cross with some of the driving, and being cut up – and, you know, these young boy racers and everything. But I realised, me getting so wound up by it wasn't actually keeping me driving very well… so that was my main reason for giving up.

Catherine had never particularly enjoyed driving, and so arguably approached her cessation with less trepidation:

I never really enjoyed it. I had to do it for my job before I retired, so …and I always had my own car until about 7 or 8 years ago.

Nick, had been driving for relatively less time than the others, only 23 years, and still relished the freedom that it provided:

Do I enjoy driving? Yes, on the whole I do. On the whole. Erm, not so much driving in, in heavy traffic in the city. But I'd said right at the start. I broke the lockdown rules to give my car a run to charge up the battery. Very little traffic on the road and I went out into the country areas. And it was wonderful. The open road, it was a lovely day. Got the window open, the birds were singing, and I thought "this is lovely!"

Mark and Sean, however, both noted a decline in their enjoyment of driving over time. This had largely been to the change in the driving environment, with Mark acknowledging:

I don't enjoy it as much as I did when I was younger because mainly, because …the roads are so busy … and … many of the local roads are in a poor state. The main roads are okay. And so the idea of driving for pleasure in that sense doesn't really exist anymore.

5.12.5.1.2. Self-regulation

There was evidence of self-regulation across the group which had seen to appear as a result of illness or concerns about health. Sean was now wary of panic attacks as he had experienced one previously on the motorway and this had caused him alarm:

… I'm happy to drive shorter distances, but not long drives…So, short local journeys are ok, routes I know are fine, not roads I don't know… I tend to think about train use for longer journeys. Shopping locally I go by car. So that's it really!

Christine had had recently begun to suffer from macular degeneration. She approached her driving differently now:

> ***…As I say, I'm not gonna go anywhere where I don't know it because I mightn't be able to read the road sign or something like that… but when I'm going where I know, I'm not worried about that, and I certainly would see it if somebody stepped off the kerb…I'm limiting it very much to just local, you know, the supermarket and the garden centre, perhaps to the beach. So nowhere far at all. But I'm not giving it up for any other reason really, other than I've got to be wary of my sight …***

Mark had stopped carrying out his volunteer work that included driving shortly before beginning to experience eye difficulties. His decision to change his driving behaviour shows a sense of self-awareness and responsibility as a driver.

> ***So there was a group of volunteers who, who drove them to the hospice. And, and I felt I could do that. And I did for, oh, getting on for 10 years, I think. But I stopped, actually, just before my eyes started to go wrong. So maybe I realized what was happening.***

5.12.5.2. The research questions

The participants all took the time to examine the video provided, with evidence of thoughtful preparation ahead of the interviews.

This section now returns to answering the questions specific to this 4th study regarding the relevance and likeliness of use of OMEDA PLUS.

5.12.5.2.1. When on the cusp of self-regulation/driving cessation is there:

a) Perceived relevance for the potential application of OMEDA PLUS?

The members of the group had varying responses when asked if they felt that the test had relevance.
Peter queried the relevance of a computer-based test of this sort when testing fitness-to-drive feeling that an on-road test would be more applicable:

> ***I tend to think that the best way to test whether anybody is suitable and capable of carrying on driving, is to take them out on the road. As opposed to sitting behind a desk, you know, with a computer. ..***

Catherine felt that there was cause to have a test such as this, but felt that it was not particularly relevant to her situation as she had already retired from driving barring emergencies:

> ***Yeah. I think, you know, safety-wise, it could be a good test…because if you can't judge the speeds very well, and the distances, then that is going to compromise your driving isn't it? … Not to me personally, but I could see that it could to people in a similar situation…there's a relevance definitely... yes…***

Mark felt saw the test as a potentially useful tool for examining collision detection:

> ***And I think it's relevant. It clearly is relevant to collision avoidance, which is an important part of driving and you know…I think it's both straightforward, relatively simple and relevant...***

Sean considered it to be a good method of creating a measurement of safe driving at a specific point in time, but also felt that a less abstract design might add to its relevance:

> ***I think it's relevant yes...It quantifies you on the day... I think you need to be a bit more realistic so to speak. Perhaps work with the actual image … But I think, yeah, there is a place for it...***

5.12.5.2.1.1. Suggested uses

The participants suggested potential settings in which OMEDA PLUS might have specific relevance. These included GP surgeries, optician services, and as part of on-going testing both linked to licence renewal and to fitness-to-drive testing in general.

5.12.5.2.1.2. The cessation conversation

Catherine felt that it was a good litmus test for driving ability:

> ***Well I think if they said "I'm not sure if I should be driving or not". I think I might say "well, why don't you see if you could take this test…And if they were doing reasonably well, it could reassure them, but if they were doing very badly, it's a firmer signal that maybe they should give up driving.***

Participants, therefore, felt that OMEDA PLUS would be a useful tool to aid the start of the conversation about driving cessation. Sean suggested:

> ***Yeah, but again I'd think of it as guidance, not the final answer... It would be the start of a conversation, or part of the conversation that you have about stopping driving.***

Specific settings such as the GP surgeries and optician services were mentioned as a potential place for this conversation to start.

But I think, yeah, there is a place for it, I think - I envisage it actually at a GPs [unclear] so:

> ***"are you still driving?"***
> ***"yes".***
> ***"Have you thought about giving up?"***
> ***"Don't know"***
> ***"Just try this test"***

you could have it sort of set up on this lap top or whatever, and just say "give it a go,". ... and it could be again the start of the conversation from the GP's perspective to say you know "you didn't score very well, have you thought about...?" That would be a real-world application for it. [Sean. Imaginary conversation between driver and GP]

In addition, there tended to be a sense of GP and/or professional reverence, whereby individuals would feel much more comfortable, and be more likely to comply if a professional suggested taking the test as opposed to friends or a family member.

if an eye doctor said well really, I'm not comfortable with you going back to driving, unless you do this test, then that would obviously be very important because you know, ultimately they have they would have the power to to report you to DVLA and stop you driving. So I might not want to do it, but I would understand why it was necessary to do it. erm And again, if if some other professional, an optician perhaps or someone, I'm trying to think of other you know if I had some other condition, perhaps a neurological condition and the neurologist was saying well you know, we need you need to be checked out before you can go back to driving. We have this test, we'd like you to do this and see how it goes, then obviously I would, I would take that very seriously. Actually, I might not have a choice, it might be that they say 'you have to do well in this test or we'll not let you continue to drive which case I mean, I would, I would want to, I don't want to give up driving without thinking about it, without having a good reason to giving up driving, don't just want to give up. I want to keep driving for as long as I feel able to drive. And others feel able to let me drive including professionals feel feel that I am safe to drive. You know, if that stops happening, then I'll stop driving. [Mark]

For Nick, the thought of his family suggesting that he took the test would make him worried:

…Suggested it for me to do the test? I'd think Well, what do they know that I don't know. What are they seen that I'm not seeing. Are they getting worried that my driving is not up to scratch or could be dangerous? Then I'd sort of feel worried.

5.12.5.2.1.3. On-going fitness-to-drive testing

Clive suggested that it might be useful for all drivers to carry out on-going testing to ensure that they were fit to drive, and that a test such as OMEDA PLUS might be relevant here. He reiterates a point considered in earlier studies that people age at different rates:

> ***…the vast majority of people have completely forgot what the Highway Code is. They never read it, so perhaps they need to do a bit of a refresh on the Highway Code at various times...they need tests throughout their driving career to see, you know, "are you still up to driving this car?" because people start to get memory loss, the perceptions and things go at various stages throughout life, don't they?***

He added that it might be useful to introduce this at the time of licence renewal, or maybe earlier:

> ***…for something to come along at the same time as the licence renewal would be good. But whether it should be earlier or not, I don't know.***

Sean felt that it could usefully be incorporated into awareness course testing:

…you know awareness courses. I was thinking that it could be incorporated into part of that. I guess it also draws people's attention to how fast things can go. Because actually the test is quite fast…

5.12.5.2.2. 3b. How likely would this group be to engage with the test?

All of the participants were in agreement that, were the test to be a requirement, they would engage with it at a point in time which felt relevant to their situation, regardless of their views as to its relevance.

Christine felt that it was useful to keep testing skills as ageing occurred:

> ***I think it's quite good to test a lot of things as you get older. Test your ability to do things, I think it's a good thing to challenge yourself and things. Make sure everything's working as it should!***

Nick was, however, less enthusiastic about OMEDA PLUS becoming a mandatory test:

> ***…But If it was part of the DVLA process I think a lot of people would niggle at that "ooh why should I do?" …I think I think possibly me included if I was honest, I would be anti the test but I would realize I've got to do it if I wanted my license renewed, but I wouldn't be doing it in a good frame of mind.***

Regardless of the willingness to engage on some level with the test, many barriers were mentioned with regards to potential cost to policy, access to technology, and the sensitivity of the promotion.

5.12.5.2.2.1. Technology

It was felt that there was an assumed knowledge of, and access to, technology within the design of OMEDA PLUS. Nick makes the point,

> ***Because of the generation you're dealing with. If you were doing this with younger people, there wouldn't be such an issue with it because they have grown up with computers. It's second nature to them. But the essential point, I think, with my generation is, are computers more of a barrier and a hindrance than a help in a situation like this, so therefore, you might not get the true result of our reactions.***

He continues by saying that there is an assumption today that everyone has access to computers:

> ***…it's not a criticism, believe me. It's everywhere on the television. The radio – everywhere. They assume everybody can go online and now that you've got smartphones.***

Nick also makes the point that even with access to, and knowledge of computers, sometimes there is simply not the inclination to want to engage with them. It's a matter of personal choice:

> ***…it is not important to my life. I can live without it. However, I'm not a complete dinosaur. We're talking obviously on an iPhone…And…I absolutely couldn't do without it. I got into that very well... But particularly in the aftermath of the lockdown, everywhere you turn is "download the app download the app", and I think to myself, If I hear that phrase again I'll scream. I don't want to download an app to go to the pub…that is to tell you that I'm not completely happy with computers and systems. So if a computer says "no", I wouldn't be very happy with the computer***

This comment also highlighted the backdrop of the Covid-19 pandemic, and the changes in computer use and online interaction that had been happening as a result.

Christine felt that she would be able to use OMEDA PLUS, but was uncertain as to whether or not she would be able to load it onto her computer:

I don't know about fitting it on my computer and all that stuff. That might stump me a bit…

It was felt that a pseudo-vehicle set up with a pedal might help those less conversant with computer-based tests, as would a good practice session Clive suggested:

I mean it's harder for us older people, because we've not possibly grown up with gaming and things like that. The younger generation coming through will be far more comfortable with the setup then if you like, than perhaps the older person, but if you set it up sensibly, like a foot pedal is like your brake pedal or something like that… It might be a good idea to put something out there that they can practice on in the first place.

5.12.5.2.2.2. Administration

In addition to comments regarding the prototype version of OMEDA PLUS, consideration was given to the potential effect upon administration costs were it to become part of required testing, as Mark outlines:

…there's an administrative cost…somebody has to pay for that, whether it's the 70 year old has to pay to renew their license by going through this battery of tests. …or you know, the government could just decide that they would pay for it because it's in the interest of safety…

5.12.5.2.3. 3c. To what degree would this group trust the measured results and their intended use?

Another set of barriers lay in the levels of trust that were held in the potential uses of the test. Requirements were mentioned which would needed to be satisfied before there would be a contented and official engagement with OMEDA PLUS.

5.12.5.2.3.1. Validation

More testing and validation needs to be carried out on OMEDA PLUS in order for it to be trusted by this group. Clive mentions that he would trust the results if he knew that this had taken place:

I think so. I think if the test was valid, and had been validated, by lots of people doing it and seeing whether they act when you actually went down with them to drive - whether the two things correlated if you know what I mean. You could be rubbish at that test but you could be a very good driver. So your correlations got to be done. …Basically, if you validate it,

and it correlates with all other types of information that you get about peoples' driving. Yeah. I'm confident with it.

This bore relevance to Christine's observation that her blurred vision only affected long distance vision, but that she could see clearly on a computer screen:

… I think doing it on a computer screen would be easy for me, well I hope so, um, but I don't know how it would relate to my actual driving experiences?...I can see those things on the screen, that's fine. In fact my double vision tends to be more in the distance than close to.

5.12.5.2.3.2. Outcomes need to be clear

Sean was concerned that steps were taken to ensure that the test was not used by a body who might use it to manipulate the driving population:

… It depends - could it be manipulated? Could it be used by whoever to get certain people off the road? It's a fear of manipulation. That's why I see it as a guidance, as a part of the conversation, not as a definite "you will stop driving".

There was a requirement to ensure that there was clarity regarding the outcomes that would arise as a result of "good" or "bad" scores on the test:

…well it depends on what the boundaries are of the test. Whether it says you've done badly so you definitely shouldn't drive, or you've done reasonably badly so perhaps think about it, or you've done really well so perhaps you shouldn't consider it. It sort of depends what the boundaries are.

5.12.5.2.3.3. Not only test

Mark also stressed the need for the test to reach across ages, as targeting older drivers might prove unpopular. He was also of the opinion that OMEDA PLUS should be part of a group of tests as opposed to being a standalone measure. As Sean states below, there also has to be a clear and transparent way of providing measurements of the test outcomes:

I think to bring in this test that 70 would be potentially unpopular… It shouldn't be the only test you have at 70. I think there should be a number of tests, this would be one of them, and, and there would be some criteria and rationale as to what the tests were, and what the scores were, obviously, people who did badly would at least potentially have their driving licenses removed.

5.12.5.2.3.4. GP Reverence

In terms of level of trust, there also tended to exist a sense of GP and/or professional reverence whereby individuals would feel much more comfortable, and be more likely to comply if a professional suggested taking the test as opposed to friends or a family member. Mark explains:

> ***if an eye doctor said well really, I'm not comfortable with you going back to driving, unless you do this test, then that would obviously be very important because you know, ultimately they have they would have the power to report you to DVLA and stop you driving.***
>
> ***… If some other professional, an optician perhaps or someone… perhaps the neurologist was saying well you know, we need you need to be checked out before you can go back to driving. We have this test, we'd like you to do this and see how it goes, then obviously I would, I would take that very seriously.***

5.12.6. Discussion

The interviews were invaluable to this research and provided a much required response to a gap in the previous research by Dr Read (20010. Speaking to this group of individuals gave insight into the perceived relevance by a tool such as OMEDA PLUS in addition to the sense of trust and likelihood of use.

These interviews were carried out remotely during the Coronavirus epidemic. As a result, special care was given to create the rapport between participant and interviewer. Extra effort was also made to ensure that any sense of power imbalance was eliminated. For this reason, pre-interview questionnaires were carried out via email prior to the interview. In addition, the participants were provided with the interview schedules ahead of the interview. Participants were also offered the opportunity to chat using their chosen method – over the telephone or via video calling in order to ensure their comfort.

In this way, the interviewer met with those who were the experts of their own opinions in an equal discussion about OMEDA PLUS and the genuine opinions that had been formed via prior viewing of a video showing the tool in its working form. The conversations included discussions around ageing and the definition of the older driver. However the prime purpose was to identify opinions to the tool.

Queries over a computer-based test as opposed to an on-road test. Some found relevance as a test for collision avoidance also as a spot check of safety to drive on a regular basis. People suggested that it might be relevant as a part of the cessation conversation to be had either with family or medical professionals. Some suggested that this tool may well have its place as part in driving awareness training or as a test taken around licence renewal.

In terms of likelihood to engage with OMEDA PLUS, there was a willingness. However, this willingness came with provisos, and may well have been tempered by the one 2 one nature of the interview. Perhaps it was not possible to exclude all researcher effects.

The participants found it important to know who would be administering the test and what would happen with the data. Another potential barrier lay in the access, understanding and indeed interest in computers. The Coronavirus epidemic had placed many people into a position that required learning and there was a difference in levels of comfort that each of the individuals placed upon using technology.

Importantly, and with a bearing on future research, the group felt that it was important to continue to validate OMEDA PLUS by broadening its testing to include comparisons with on-road testing. Once this process had been seen to be complete, it would also be important to the participants that OMEDA PLUS was presented part of a suite of tests as opposed to taken in isolation.

5.12.7. Limitations and Further Research

As mentioned above, despite all attempts to reduce any researcher effects, it may not have been completely possible. In addition the lack of face-to-face meeting could potentially have created difficulty with rapport building. Luckily, the interviews ran smoothly and no evidence of broken rapport appeared to exist.

It is acknowledged that further research should include interviews with different stakeholders such as medical practitioners. This was not carried out as planned due to time restrictions experienced as a result of the global pandemic.

5.12.8. Section Summary

It can be seen that OMEDA PLUS is accepted to a point in that it can be seen that it has relevance, and that there would be uses within varied industries for its application. However the willingness to engage might tend to vary depending upon the organisation administering it. The test itself presents barriers to users which would need to be addressed before it was comfortably accepted. The next chapter focuses on the Discussions surrounding the research as a whole.

6. Discussion chapter

6.1. Chapter Summary

This chapter serves to examine and bring together the results of the studies within the context of the aims, objectives and research questions set out in this research. It will examine how the results begin to examine the gaps identified, and will discuss the implications that the results might have upon safe driving research. In addition, the chapter will evaluate the methods used, and discuss recommendations for further research.

6.2. Introduction

This research has been carried out to examine the likelihood that accident occurrence in older adults may not occur solely as a result of chronological age, but also due to functional factors such as the limited ability to judge the time at which an oncoming vehicle may reach a junction (TTC). Phases of the study were of mixed design and comprised an online survey, and two iterations of an experimental study aiming to test the usefulness of the OMEDA software under development. The final phase of the research comprised a semi-structured interview carried out with 7 participants over the age of 55 years and on the cusp of driving cessation. This tool, OMEDA PLUS, was compared to the Useful Field of View test (UFOV) that is a long-standing measurement of safe driving.

OMEDA PLUS was recreated using information taken from the original thesis in absence of a working model. As such, part of this ongoing research has been to ensure that the rebuild works in a way identical to the original. It has long been acknowledged that an applied tool is needed, and the original OMEDA (Read 2001) certainly goes a long way to fulfilling this brief. However, what it lacked was portability, leading to potential non-inclusion of individuals who may have limited mobility.

OMEDA PLUS makes the point of adding this functionality with several issues in mind. Older people have often been prevented from taking part in research (Hardy et al. 2009), and this research wished to provide an element of flexibility that would ensure that the study would enable a high involvement from older people regardless of their mobility, and that the eventual product would be accessible to all. In addition, travelling to and from test sites requires an increased time investment from participants which portability is able to minimise. This function also allows the tool to be introduced to people who may not possess a computer, thus further increasing its reach.

This portability therefore also aims to address the digital divide (Matthews et al., 2019) between generations where the uptake of technology for adults over 55 appears to occur at a slower rate than their younger counterparts (Age UK 2010, Centre for Ageing Better 2020b). With the assessments being carried out on an individual basis, the 1:1 visit of the researcher also aims to provide a documented need for support and reassurance in the use of technology that some individuals desire (Age UK 2010, Centre for Ageing Better 2020b). This approach would also hopefully serve to provide a situation where any potential power balance between researcher and participant might be equalised. While the researcher is providing the test, the participant remains in complete control of their environment. The ethical promise that the participant may halt proceedings at any time is indisputable, potentially rendering the process fairer all round.

With this emphasis on portability, accessibility and usability in mind, the design features were also examined. In terms of usability, OMEDA PLUS has been developed in XML as opposed to the original C++ language. In its current form it is able to be manipulated easily by the researchers with minimal training required. The hand button and foot pedal of the original version were retained to ensure an inclusive design. These buttons also supported the perceived difference in levels of computer knowledge, and the potential age- or health-related differences experienced in the ability to perform finely–tuned movements, and to produce the force required to create a response measurement from the devices (Walker et al. 1997; Charness et al. 2004).

Test anxiety was another consideration. This is likely to occur when undergoing an assessment such as this (Whitbourne 1976), and portability might be seen to assuage this by enabling the test to be taken in a familiar and less confrontational environment (Lang, Parkes and Fernandez Medina 2013). This option to undertake the test at home or within their familiar work environment, may serve to overcome elements of White Coat Syndrome, leading to a more reliable and real measurement (Pickering et al. 2002; de la Sierra, A, 2013; Westin et al. 2010).

The research sought to make original contributions to knowledge within the contexts of safe driving research and more specifically Human Factors research – a discipline which by its nature considers the human, the machine and the systems within it to be of equal importance. The research and its methods serve to reflect this holistic perspective. The aims have been re-ordered in order to allow for a clear flow of discussion and can be seen in **table 6.1** below. Those coloured in green are considered to have been met while those in yellow are partially met and form part of the recommended future research. Aim 5 stands separately as it was partially met as an aim, but it was answered indirectly throughout the research, and was not linked to a specific research question. It was however, an important underlying theme throughout.

Table 6.7: Progress of research aims

	Aim	Met?
1	Develop a prototype of a portable version of a tool capable of measuring errors in judgement of time-to-contact of oncoming objects.	Met
2	Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.	Met
3	Address the justification for retaining a UK licence renewal age of 70 which appears to be based on chronological age as opposed to an ability to carry out tasks related to safe driving.	Met
4	Gather opinion regarding the relevance, and likelihood of use of the proposed tool, OMEDA PLUS.	Partially
5	Through examining licence renewal age, begin to address the concept of potential implicit ageism held within the retention of a long-term and unaltered policy despite a changing population and driving environment.	Partially

The aims and objectives will be examined in relation to the relevant research questions that appear in **table 6.2**.

Table 8: Research questions revisited

	Research Questions
1	Can we measure fitness-to-drive in functional rather than chronological terms?
2	Does OMEDA PLUS show the same sensitivity to age, and to accident likelihood?
3	Does OMEDA PLUS show similar results to established fitness-to-drive measures – specifically the Useful Field of View (UFOV) test?
4	Can OMEDA's show links to variables such as driving exposure, time the licence has been held, and self-reported accident history?
5	When on the cusp of driving self-regulation/cessation, is there a perceived relevance for the potential application of OMEDA PLUS?
6	How likely would this group be to engage with the test?

The relationship between aims and research questions to be addressed can be seen in **table 6.3** below which signposts the order in which the following discussion will unfold.

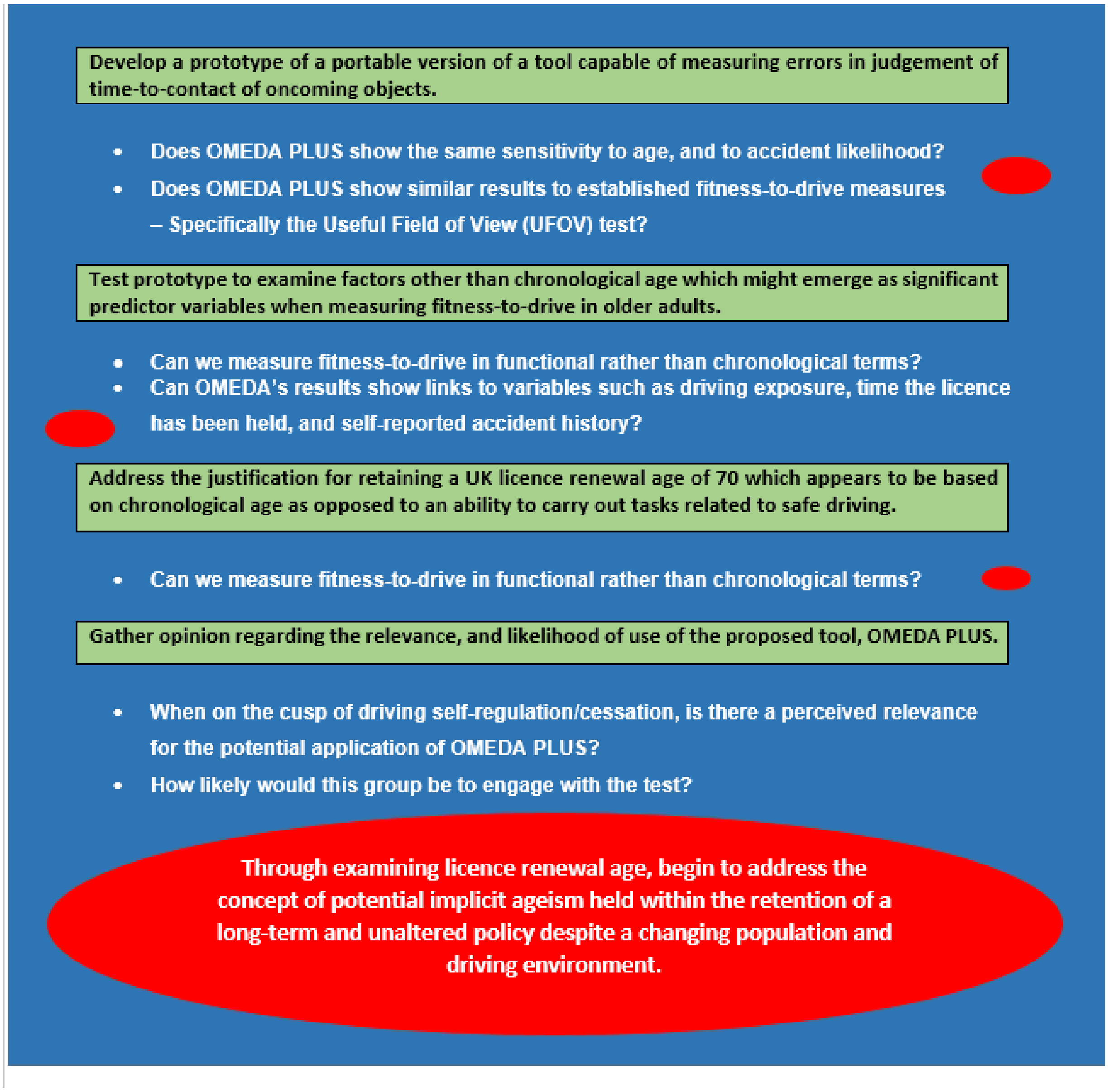

Figure 6. 5 : Flow of discussion

Once these results and aims have been examined, further evaluation will take place regarding the methods used. This will be followed by the concluding section highlighting the recommended future research.

6.3. Revisiting the aims and research questions

As mentioned above, the aims will be revisited in order to examine the results addressing the relevant research questions. These will be taken in turn, and in the order shown in **Figure 6.1**.

6.3.1. Development of a portable tool capable of measuring TTC

Develop a prototype of a portable version of a tool capable of measuring errors in judgement of time-to-contact of oncoming objects.

- **Does OMEDA PLUS show the same sensitivity to age, and to accident likelihood?**
- **Does OMEDA PLUS show similar results to established fitness-to-drive measures – specifically the Useful Field of View (UFOV) test?**

6.3.1.1. Does OMEDA PLUS show the same sensitivity to age, and to accident likelihood?

The results of studies 2 and 3 both show that OMEDA PLUS is capable of measuring differences in TTC. The independent-test in Study 2 was able to show an age-sensitive difference in means when measuring TTC errors. This showed the same relationship between TTC and age as the original Read (2001) study. The Spearman's correlation in Study 2 showed a strong, positive and statistically significant relationship between these two variables. Study 3 suggested a more moderate relationship. In both cases, however the relationship was statistically significant.

Of particular interest are the results regarding the relationship between TTC errors and reported crash experience. When examining accident likelihood and the link with TTC errors, the second and third studies both found the relationship to be negative, weak and non-significant showing a tendency for TTC errors to increase for those who had experienced less accidents. It is questionable as to whether the results may have shown a stronger link if using an on-road rather than a computer-based test.

When examining the link between incidents and age in the third study, a moderate and negative relationship of statistical significance was noted. In this study incidents tended to unexpectedly decline with increasing age. This highlighted the potential for a factor other than age perhaps influencing the relationship whilst being masked by an assumption that age is the dominant variable. Further testing would seek to more closely explore these potential variables.

As mentioned previously in the discussion for Study 2, the results for the t-test mirrored those of the original Read (2001) study. However, when variables were examined more closely alongside factors not explored in the 2001 study, the results showed the opposite relationship. As TTC errors increased, reported crashes appeared to decline.

Arguably, the assumption that age was the main factor affecting safe driving, seemed to be masking something else. This in itself, is potentially an indication of ageism implicit in age-based policy and lends support to the move away from a licence renewal based on age (Box, Gandolfi, and Mitchell 2010).

Crash data was self-reported and may have been inaccurate, or indeed responses may have been affected by what was perceived to be socially acceptable (Lajunen & Summala 2003; Wåhlberg et al 2010).

As a computer-based tool, it might also have been the case that there was a discrepancy between results obtained in this manner as opposed to an on-road test. Read (2001) however, found results gained via a simulated road test to reflect the results gained at the computer version of the original.

OMEDA PLUS is capable of measuring TTC, and is able to be configured for use on different computer and laptop sizes. It has provided results that show the portable version retains the same statistical significance regarding the relationship between age and TTC. A relationship between crash history and TTC exists, but when examined amongst additional factors, shows age to potentially be masking alternative factors to age which may affect safe driving in older adults.

6.3.1.2. Does OMEDA PLUS show similar results to established fitness-to-drive measures – specifically the Useful Field of View (UFOV) test?

It was an expectation that TTC would decline with age as drivers begin to develop UFOV decrements (Read 2001; Rusch et al. 2016).

Study 2 used both parametric and non-parametric tests. The one-way ANOVA was carried out in order to make a clear comparison between the results between this research and the original study (Read 2001). In order to begin to validate OMEDA PLUS it was tested against the UFOV test. The results from the one-way ANOVA for OMEDA PLUS and UFOV2 tests show a matched decrease in performance with increasing age.

The Spearman’s correlation for UFOV2, UFOV3 and UFOV Crash also met TTC scores at a point of statistical significance with the relationship between UFOV2 and TTC errors providing a strong, positive relationship of statistical significance.

Study 3 continued to mirror the expected UFOV2 results with TTC errors of OMEDA PLUS retaining the positive relationship with crash risk results in UFOV.

These results, although in need of further validation, showed a tendency for OMEDA PLUS to reflect the original design indicating a successful rebuild augmented by the addition of the configure function which enabled the tool to become portable. The results showed that the triangulation of results between OMEDA PLUS and UFOV had been effective and beneficial.

6.3.2. Testing OMEDA PLUS to examine factors affecting safe driving in older adults / Questioning age-based policy

Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.

Address the justification for retaining a UK licence renewal age of 70 which appears to be based on chronological age as opposed to an ability to carry out tasks related to safe driving.

- **Can we measure fitness-to-drive in functional rather than chronological terms?**
- **Can OMEDA’s show links to variables such as driving exposure, time the licence has been held, and self-reported accident history?**

6.3.2.1. Can we measure fitness-to-drive in functional rather than chronological terms?

The results from Study 1 and the interviews in Study 4 highlighted peoples’ opinions regarding fitness-to-drive and its link. Individuals discussed issues around health, experience and the environment. Interestingly Donorfio et al. (2008) suggested that age per se is not a reliable predictor of self-regulation of driving, but when taken in conjunction with health, the reliability of the relationship increases. In this way, OMEDA PLUS supports this concept. Testing has shown that whilst age provides a relationship with TTC errors, there is something more complex happening.

The means reported by the results of the one-way ANOVA in Study 2 showed a clear tendency for performance to decrease with increasing age in terms of errors made within each of the OMEDA PLUS subtests and also within the time taken in milliseconds to complete the UFOV subtest 2. However, this research has sought to examine time-to-contact in the aim to provide an alternative factor to age when measuring fitness-to-drive. This strong link between TTC and age was corroborated in Study 3.

Previous research has shown TTC to decline with age as drivers begin to develop UFOV decrements (Rusch et al. 2016). This current research explored alternative variables which might be seen to affect TTC. In order to continue testing for robustness within OMEDA PLUS, the UFOV test was also employed by way of comparison. UFOV2 was chosen on account of its reported reliability.

Study 2 showed strong and statistically significant relationships between TTC errors made and "days driven per week" and "years driving licence has been held". These results show that there is a tendency for TTC errors to increase in drivers that drive more regularly arguably beginning to move away from a measurement based on age. For the group in Study 2, this length of time that the driving licence had been held was closely related to age, in that there were no drivers in the older group who had held their driving licences for a relatively short time, or a length of time equating to that more likely to occur in a younger driver.

Relationships between TTC errors made and "approximate annual mileage" and "confidence" were positive indicating an increase in errors linked to increased annual mileage, and also to confidence. These were however weak relationships and were not found to be significant.

In addition to the relationship indicated between TTC and age, Study 3 also revealed a low, positive and non-significant relationship between the matching errors made in the secondary tasks within OMEDA PLUS for each of the subtests showing a tendency to make more errors in each of these measurements as age increased.

These comments at the very least support the need for research regarding factors separate from age which might contribute to changing fitness-to-drive measurements.

6.3.2.2. Can OMEDA's results show links to variables such as driving exposure, time the licence has been held, and self-reported accident history?

For study 2, statistical significance was met between licence years and TTC errors, TTC distractor errors in the secondary distractor task also provided a statistical relationship with Miles / year. .This latter relationship provides a moderate positive correlation.

Data was collected through the Driving Habits Questionnaire in order to be used towards the creation of a definition of experience by examining driving exposure, and length of driving licence ownership. This would serve as providing a measurable variable that could be used as a counterbalance to age when exploring safe driving in "older adults".

While the length of driving licence ownership was found to provide a statistically significant element towards creating this definition, the figures relating to amount of driving did not. With this in mind, a definition of experience is yet to emerge; and the sensitivity of OMEDA PLUS to accident risk needs to be further explored.

6.3.3. Perceived relevance and likelihood of use of OMEDA PLUS

Gather opinion regarding the relevance, and likelihood of use of the proposed tool, OMEDA PLUS.

- **When on the cusp of driving self-regulation/cessation, is there a perceived relevance for the potential application of OMEDA PLUS?**
- **How likely would this group be to engage with the test?**

6.3.3.1. When on the cusp of driving self-regulation/cessation, is there a perceived relevance for the potential application of OMEDA PLUS?

The participants suggested that there was a degree of relevance for the test to exist, although some felt that it did not have any personal relevance for them at the specific time. They did, however, feel that it would be useful for the test to be either self-administered or administered by GPs and opticians as a tool which might provide a measurement which would support continuation or suggested cessation of driving.

The tool was seen to be a useful test of the collision avoidance ability, but of particular importance was the consideration that OMEDA PLUS could support the concept of the cessation conversation. This supports the intentions for this test, in that it is very much aimed at being a tool which would support an informed choice, and which would provide the individual with an element of agency with this lifestyle change of driving cessation. This proved to be a highly subscribed concept provided by the IAM RoadSmart survey (Hawley 2016).

6.3.3.2. How likely would this group be to engage with the test?

The participants indicated that they would take the test if it was a legal requirement, but “Nick” felt that he would be a little reluctant to take part if it was a required part of the licence renewal process. The majority also claimed that they were more likely to engage with the test if it was being suggested by a medical professional. This mixed response reflected the response to the IAM RoadSmart survey (Hawley 2016) that suggested additional tests becoming part of the driving licence renewal process.

The test however, provided a barrier for some of the participants as it assumed a level of technological ability. “Nick” pointed out that there was still a section of the older generation who had little knowledge of computers (Age UK 2010, Centre for Ageing Better 2020b), and that the study had involved several aspects of technology crossing from email, to following links to YouTube, to the use of online platforms to carry out the interview. He stressed that many people who have not grown up with computers may see the computer itself as a hindrance. He also questioned the fairness of a test that is computer-based being administered to individuals of differing prowess. Which led to a question of whether the results would reflect OMEDA PLUS or the ability of the individual to successfully use the computer itself.

Overall, the feedback was positive. People were willing to engage with the tool. There were however provisos surrounding the validation and administration of the test. These elements will be discussed in the limitations section of the chapter.

6.3.4. Addressing implicit ageism

Through examining licence renewal age, begin to address the concept of potential implicit ageism held within the retention of a long-term and unaltered policy despite a changing population and driving environment.

Central to this research is an aim to acknowledge and counter the implicit ageism (Levy and Banaji 2002; 2018) that appears to remain within society and specifically seems to exist within current licence renewal policy. Despite the illegality of discriminating against an individual because of age (HM Government 2010), UK licence renewal appears to increase scrutiny of drivers at the age of 70.

Regardless of the overall increase in the age of the UK population (ONS 2018), and the changes in lifestyle such as later retirement sometimes leading to the need to extend driving life, UK licence renewal continues to place the emphasis on age as opposed to function in a potentially discriminatory manner (Box, Gandolfi and Mitchell 2010).

In addition, research is being carried out to support the changing demographic and their continued safe relationship with driving (Box, Gandolfi and Mitchell 2010; Parkes 2016; Hawley 2016). This research seeks to lend support to this research by encouraging a move away from the emphasis on age within safe driving research. It questions the potential implicit ageism that lies within the age-based licence renewal policy. This research also considers its own potential for use of arrogance language. This research began with the aim of “supporting older drivers to retain their driving status”. However upon discussing the use of driving, and the importance of identity, and the increased maturity of the approach to research, the aim is now based around providing a situation enabling informed choice by the individual. This slight shift in the language is a hopeful attempt at beginning to influence the shift in ageist language in general.

Stereotypical definitions of the older driver emerged during Study 2 with one younger driver suggesting that drivers of 70 years were not good drivers, and are usually slow. This particular stereotype was debunked by a 73-year-old driver describing her enjoyment of driving on the motorway based on the freedom to drive at a faster speed.

Regarding the overall sense of arrogance and ageism, the licence renewal policy appears to discount the ability and willingness of some individuals to self-regulate their driving when difficulties or changes begin to arise. Admittedly there is also a tendency for some drivers to exaggerate their ability, and for some such as those experiencing dementia to judge accurately any changes, but there is a growing sector of society that is ageing healthily, and is able to independently make these decisions – albeit with the aid of a tool such as OMEDA PLUS.

This research also serves to address the existing digital divide (Matthews et al., 2019; Age UK 2010, Centre for Ageing Better 2020b by seeking to provide a diagnostic tool which is accessible in terms of cost, ease of use and ease of access.

Additionally, this research makes a bid to support the research of Kalache and Gatti (2003) who describe the varied rate of functional decline in adults as age increases, and Antin et al (2012) who present the Safe Driving Criterion that shows a tendency for experienced drivers to retain functional ability beyond their non-driving counterparts as a result of their driving experience.

6.3.5. Section summary: Meeting the aims

The aims will now be revisited in order to establish whether or not they were successfully met throughout the research. **Table 6.3** re-presents the original table**.**

Table 6.9: Meeting the aims

	Aim	Met?
1	**Develop a prototype of a portable version of a tool capable of measuring errors in judgement of time-to-contact of oncoming objects.**	**Met**
2	**Test prototype to examine factors other than chronological age which might emerge as significant predictor variables when measuring fitness-to-drive in older adults.**	**Met**
3	**Address the justification for retaining a UK licence renewal age of 70 which appears to be based on chronological age as opposed to an ability to carry out tasks related to safe driving.**	**Met**
4	**Gather opinion regarding the relevance, and likelihood of use of the proposed tool, OMEDA PLUS.**	**Partially**
5	**Through examining licence renewal age, begin to address the concept of potential implicit ageism held within the retention of a long-term and unaltered policy despite a changing population and driving environment.**	**Partially**

From the table it can be seen that the first three aims have been successfully met. A portable diagnostic tool, OMEDA PLUS has been developed and is able to successfully measure TTC. It has been tested and shown to suggest that variables other than age may well have as important an effect on safe driving.

Throughout, the tool has been tested against the original version (Read 2001) and the UFOV test (Ball & Owsley 1993), and found to work effectively indicating a successful build.

Opinion regarding the relevance of OMEDA PLUS and the likelihood of use has been met from the point of view of the older demographic, but it is yet to be gathered from the point of view of other stakeholders such as medical professionals.

It is difficult to overlay a matrix onto aim 5 and so it is considered to have been partially met. The implicit ageism within age-based licence renewal in the UK has been discussed, with the concept existing as a theme that runs throughout the research.

In conclusion, a prototype of a portable version of a tool capable of measuring errors in judgement of time-to-contact of oncoming objects has been developed, tested and had its relevance and likelihood of use discussed. Factors other than chronological age are beginning to emerge as factors which might be able to be useful factors for measuring fitness-to-drive in older adults. As such, the arguably discriminatory age-based UK licence renewal policy has been brought into question. The following section seeks to evaluate the methods used within the research.

6.3.6. Evaluating the methods used

The design of the studies made use of a mixture of methods and analyses in order to best gather the data required to ensure rich responses primarily regarding the usefulness of OMEDA PLUS and the ability and willingness to engage with it. The mix of methods served to support the requirement to obtain more complex responses (Arcidiacono and De Gregorio 2008) as the research not only sought to test the outcomes from OMEDA PLUS as a tool but also wished to examine its usability. This multi-level approach to the data also served to increase the validity of the data (Bryman 1988 in Todd et al 2004). Despite the time-consuming nature of this approach (Gunbayi 2020; Lopez-Fernandez & Molina-Azorin 2011), the richness of the data was found to be invaluable.

The conversational manner provided by the semi-structured interviews, and the fluidity of the discussion, served to strengthen the rapport between researcher and interviewee, and the process enabled the data to be participant-led (Longhurst 2003).

The DHQs served as an efficient way to gather demographic data from each participant in a condensed and structured manner (Codó 2008). They enabled comparisons to be made at a glance while carrying out field work, and also provided a 5 minute stretch of time to re-set the experiment when participant volumes were high. This also provided time for the participant to settle into the proceedings so that they could begin to feel at ease. The DHQs also provided a self-reported accident count ahead of embarking on the OMEDA PLUS and UFOV tests.

The online management of the survey was advantageous as it served to reach a wider audience (Gail Neely et al. 2011), and the results were collated within the software. The paper version of the survey did not prove to be a success. Despite the low response rate, the overall target of over 100 people was met.

Another advantage of the online format was that it also supported the original aim to provide inclusively-designed survey copies with larger font. With an online survey, the respondent is able to size the screen according to their individual needs. This served also to decrease the overall cost of the distributing the survey, and also helped to make it more environmentally sustainable as less printing of copies was required.

One concern that arose through conversations with participants in later studies was the question of the digital divide which has been discussed in this chapter.

In order to collate a rich level of data based on experience of individuals, Interpretative Phenomenological Analysis (IPA) was employed (Langdridge 2007; Flowers et al., 2009). This enabled the data from the participants to fully direct the research. It provided an in-depth view into the experience of the participant, allowing the opportunity to develop a comparison between the younger and older self amongst the participants. It served to facilitate the exploration of personal and in-depth meanings of these highly subjective topics of ageing and experience. Further discussion regarding the topics that arose appear later on in this chapter.

It had previously been a consideration to create a comparison between younger and older drivers. However the requirement of IPA to engage a homogenous participant group allowed for an improved and more elegant design to be considered. This method of analysis proved time-consuming but beneficial due to the depth of data that was able to be obtained.

Whilst Study 4 was analysed using IPA, the flexibility and lack of attachment to a particular theoretical stance that is offered by Thematic Analysis (Braun and Clarke 2006) was required for the interrogation of the data collected in the first two studies. This was beneficial as it was less time-consuming than the IPA analysis which enabled clear groups of responses to be examined to specific questions regarding issues such as usability where less of an in-depth lived experience was required.

Of the methods used, only one was evaluated as being unnecessary. The Number plate test did not reach significance when examined in Study 3. This was expected as the reliability and efficiency of static visual acuity tests have previously been questioned, with dynamic visual acuity being more highly recommended (Antin et al. 2012), it was decided to omit this test from future phases of the research.

To conclude, each of the methods and methods of analysis were found to be beneficial in supporting the research, with the unsurprising exception of the number plate test which was based on the test for static visual acuity.

6.3.7. Limitations

Study 1 was mainly limited by the small sample of retired drivers recruited which affected data related to the effect of driving cessation. There was also an unfortunate omission to ask respondents how long they had held their driving licences. This would have proved useful for later stages of the research when examining the relationship between length of driving career in relationship to crash experience and judgement of TTC in OMEDA PLUS.

The second study also fell short of the planned sample size which was partially due to an attempt to reflect the cohorts in the original Read (2001) study. This led to an exclusion of potential participants aged between 26 and 59. The small sample was also partially due to the lack of availability or accessibility to potential participants. This did, however serve to strengthen the plan to make OMEDA PLUS portable.

Limitations within Study 3 arose when attempting to create suitable test environments within peoples' homes. The screen needed to be located in an area with minimal glare. This was not always easy to engineer.

Because of the portability, the tool was able to reach a variety of people who may originally have been unable to take part. On occasion, this highlighted the sense of digital divide that might occur with some users. This was, however minimised by the one-to-one setting with the researcher who was able to provide assistance and reassurance (Age UK 2010, Centre for Ageing Better 2020b).

Whilst limitations acknowledged in Study 4 include the potential issues surrounding researcher effects, and the remote method of communication put into place due to coronavirus restrictions, some of the main issues have been provided by the participants themselves. Validation by comparing to results obtained from an on-road test was found to be important by "Clive". This would potentially be a fairer and more effective, if imperfect, way of testing the correct judgement of TTC. On the one hand, it would remove extraneous technology leading to a fairer and clearer measurement of TTC within the actual activity of driving. But on the other hand, it would lead to an increase in time investment from researcher and participant. It would also increase the cost of the research in terms of staffing, equipment and location. Importantly, it would increase the potential risk of accidents for participants with a tendency to misjudge gaps. This current version provides a safer alternative.

OMEDA PLUS can generate scores, but the research has not yet developed a scoring system which would clarify the outcomes for each user. For example, there is not a high, medium and low risk score which is defined within the UFOV risk score. More work needs to be considered regarding algorithms which might enable this to be developed within the context of a research team.

Discussion with participants also highlighted a desire to see more validation carried out in addition to clarifying details regarding the administration and ownership of the test. This will be examined below.

6.3.8. Recommendations for further research

This further research into the reliability of OMEDA PLUS will serve to chart its progress from prototype to product. It aims to provide a robust, reliable, and above all accessible tool that will serve to provide a simple home-based assessment and research tool that is able to measure the likelihood of making erroneous judgement about oncoming traffic. It may enable individuals to become aware of their level of ability to drive safely under divided attention, providing them with an opportunity to independently to opt to self-regulate in order to retain driving status for longer in a safe manner.

Cognitive load has been seen to be affected by the use of language to differing degrees (Freyaldenhoven et al. 2006), inferring a potential for adding distraction to tasks such as driving. Literature also shows that crashes occur as a result of the driver being engaged in conversation with passengers (Amado and Ulupinar 2005) or on mobile phones (Stelling-konczak et al. 2012). As such, in an attempt to increase its relevance to situations on the road, future research will seek to examine these measurements and explore the relationships between the measurements of TTC judgement under visual and auditory conditions; and across the two variables of age and a defined experience level.

However, ahead of this research mentioned above, the three most pertinent steps forward to be taken regarding the current research can be seen below:

1. To carry out semi-structured interviews to gather opinion regarding perceived relevance and likelihood of use with stakeholders such as medical professionals.

2. To continue to validate OMEDA PLUS with further testing by comparing results of the tool with results from an on-road test.

3. To carry out a study inclusive of a sample of older people who have held their driving licences for a short period of time – indicating a group of older people with less experience in driving.

4. To explore any significant differences obtained in results through using different input devices for example keyboard versus hand button and foot pedal. This would begin to support the continued development of OMEDA PLUS into an App for tablet and phone and thus increase its availability and accessibility.

5. Development of an algorithm that serves to provide a simple public facing results display.

6.3.9. Concluding section

This chapter has shown the successful attempt made to fulfil the aims and objectives identified within the Introduction chapter. It has discussed the results within the context of the research questions posed and has suggested avenues for future research.

The evidence within this thesis shows that each of these research gaps has now been addressed. A working version, OMEDA PLUS, has been constructed and augmented. It is now portable and can be configured for different computers or laptops as required, and is able to be easily programmed and transported by researchers. Technically the product is able to be emailed to users. More work needs to be carried out to simplify the package so that the loading of the product and the recovery of results can be made easier. The design needs to provide easier access for computer-users by presenting them with less stages to complete at the point of download. The relevance of OMEDA PLUS as a potential tool has been explored, and it has provided meaningful results. In addition some, though admittedly not all, of the test results have begun to allow factors other than chronological age to begin to emerge as alternative variables when measuring fitness-to-drive in those currently deemed to be older drivers.

Research showed that days driven per week and the length that the driving licence had been held have been seen to hold a strong positive relationship with TTC indicating that these variables may be viable factors with which to begin to create a new “experience” variable.

OMEDA PLUS was found to be a successful build that showed sensitivity to age, and some sensitivity to accident tendency. It has been seen to provide a strong relationship between TTC and UFOV2.

The tool has been seen to have potential relevance within medical/driving professional settings, but also as a tool with which to initiate less formal discussions around potential driving cessation. People showed a willingness to engage with it as a product, but there is the expectation that there will be clear reporting of results. Many issues have been addressed regarding its usability, but more research is required in order to increase its level of robustness.

This research accepts that the deterioration of driving skill is undeniably linked to chronological age, but argues that other factors also have an effect. It proposes that minimally explored factors may actually be masked by results that become attributed to age. Whether this is partially due to implicit ageism, and an accepted stereotype or expectation of result needs to be examined. This raises the question that if age is one of multiple factors affecting fitness-to-drive, then why does policy remain linked to age as opposed to being more closely aligned with alternative factors related to driving ability?

This research supports the suggestion by the Older Driver Task Force (Parkes 2016) that the UK licence renewal could perhaps be increased to 75 years, but goes beyond that to question the justification for an age-based licence renewal process at all. Especially at a time when the population is ageing, with many experiencing good health. It suggests that more factors continue to be researched so as to take into account a broader spectrum of affecting factors on the older driver as an individual in order to allow for informed choices to be made regarding the continuation and / or retirement from driving.

To conclude, a portable version of OMEDA, OMEDA PLUS has been developed and validated, enabling real world testing to be undertaken in the field to better determine fitness-to-drive. This new driver screening tool is easily manipulated by the researcher, and is able to reach a greater volume of people within the comfort of their communities.

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Ensuring Older Adults ’ Needs for Information , Services , and Social Inclusion During COVID-19 When Going Digital Becomes a Necessity : Ensuring Older Adults ’ Needs for Information , Services , and Social’. Journal of Aging & Social Policy [online] 32 (4–5), 460–470 available from <https://doi.org/10.1080/08959420.2020.1771237>

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Appendices

APPENDIX A

Appendix A List

A1	P63990	Certificate of Ethical Approval
A2	P79163	Certificate of Ethical Approval
A3	P89579	Certificate of Ethical Approval
A4	P93731	Certificate of Ethical Approval
A5	P106123	Certificate of Ethical Approval
A6	P63990	Record of Approval (edited to remove extraneous questions)
A7	P79163	Record of Approval (edited to remove extraneous questions)
A8	P89579	Record of Approval (edited to remove extraneous questions)
A9	P93731	Record of Approval (edited to remove extraneous questions)
A10	P106123	Record of Approval (edited to remove extraneous questions)

Appendix A1 – P63990: Certificate of Ethical Approval

Certificate of Ethical Approval

Applicant:

Lara Carballo

Project Title:

Older drivers in a changing traffic environment

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

30 March 2018

Project Reference Number:

P63990

Appendix A2 - P79163: Certificate of Ethical Approval

Certificate of Ethical Approval

Applicant:

Lara Carballo

Project Title:

Survey to examine the experiences of drivers on the road, and their attitudes towards cessation and age.

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

29 November 2018

Project Reference Number:

P79163

Appendix A3 - P89579: Certificate of Ethical Approval

Certificate of Ethical Approval

Applicant:

Lara Carballo

Project Title:

Experimental Study 2

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

29 April 2019

Project Reference Number:

P89579

Appendix A4 - P93731: Certificate of Ethical Approval

Certificate of Ethical Approval

Applicant:

Lara Carballo

Project Title:

Experimental Study Main

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

17 September 2019

Project Reference Number: P93731

Appendix A5 - P106123: Certificate of Ethical Approval

Certificate of Ethical Approval

Applicant:

Lara Carballo

Project Title:

Study 4 - IPA interviews

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

11 June 2020

Project Reference Number:

P106123

Appendix A6 - P63990 Record of Approval (edited to remove extraneous questions)

Medium to High Risk Research Ethics Approval

Project Title

Record of Approval

Principal Investigator

I **request an ethics peer review** and confirm that I have answered all relevant questions in this checklist honestly.	X
I confirm that I will carry out the project in the ways described in this checklist. I will immediately suspend research and request new ethical approval if the project subsequently changes the information I have given in this checklist.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the Code of Research Ethics issued by the relevant national learned society.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the University's Research Ethics, Governance and Integrity Framework.	X

Name: Lara Carballo

Date: 16/11/2017

Student's Supervisor (if applicable)

I have read this checklist and confirm that it covers all the ethical issues raised by this project fully and frankly. I also confirm that these issues have been discussed with the student and will continue to be reviewed in the course of supervision.

Name: Andrew Parkes

Date: 06/02/2018

Reviewer (if applicable)

Date of approval by anonymous reviewer: 30/03/2018

Medium to High Risk Research Ethics Approval Checklist

Project Information

Project Ref	P63990
Full name	Lara Carballo
Faculty	Faculty of Engineering, Environment and Computing
Department	Centre for Mobility & Transport
Supervisor	Andrew Parkes
Module Code	CMT
EFAAF Number	
Project title	Older drivers in a changing traffic environment
Date(s)	25/09/2017 - 25/09/2020
Created	16/11/2017 15:24

Project Summary

An attempt to define the older driver in an attempt to facilitate maintaining and extending driving lifestyle. An attempt to move away from a definition of age in terms of chronology, and a move towards a measurement based on the ability to carry out functional elements of driving.

This thesis focuses on peripheral vision and the Useful Field of View.

Names of Co-Investigators and their organisational affiliation (place of study/employer)	
Is the project self-funded?	YES
Who is funding the project?	Coventry University
Has the funding been confirmed?	YES
Are you required to use a Professional Code of Ethical Practice appropriate to your discipline?	YES
Have you read the Code?	YES

Project Details

What is the purpose of the project?	To examine limitations experienced by drivers as they approach the chronological age of 70. This study aims to examine, using a functional approach, the factors that affect being a good driver.

What are the planned or desired outcomes?	The study hopes to provide some definition of who the "older driver" may be; and hopes to provide evidence that supports older drivers who are able to drive safely, to maintain their driving lifestyle and independence.	
Explain your research design	Mixed - with focus groups, simulated experiments, and hopefully experiments within the real world. The actual design is to be completed.	
Outline the principal methods you will use	focus groups simulated driving experiments	
Are you proposing to use an external research instrument, validated scale or follow a published research method?		YES
If yes, please give details of what you are using	Possibly, some reference to fitness to drive matrices that exist, and Useful Field of View measurements. Also other eye testing methods.	
Are you dealing with Secondary Data? (e.g. sourcing info from websites, historical documents)		YES
Are you dealing with Primary Data involving people? (e.g. interviews, questionnaires, observations)		YES
Are you dealing with personal or sensitive data?		YES
Are there any other ethical issues or risks of harm raised by the study that have not been covered by previous questions?		YES
If yes, please give further details	The potential approach of the end of driving life for an individual can be emotive. I would aim to handle this sensitively, with perhaps this not being the	
	Main focus when carrying out studies. I would need to ensure that professional back up was available should testing prove someone to be unsafe as a driver in any way.	

DBS (Disclosure & Barring Service) formerly CRB (Criminal Records Bureau)

Question			**Yes**	**No**
1	Does the study require DBS (Disclosure & Barring Service) checks?		X	
	If YES, please give details of the serial number, date obtained and expiry date	This is possible depending on my focus groups. I have online dbs. check		

External Ethical Review

Question	**Yes**	**No**

1	Will this study be submitted for ethical review to an external organisation? (e.g. Another University, Social Care, National Health Service, Ministry of Defence, Police Service and Probation Office)	X	
	If YES, name of external organisation	This is a possibility as there me be external links to organisations such as opticians/NHS	

Confidentiality, security and retention of research data

Question		Yes	No
1	Are there any reasons why you cannot guarantee the full security and confidentiality of any personal or confidential data collected for the study?		X
2	Is there a significant possibility that any of your participants, and associated persons, could be directly or indirectly identified in the outputs or findings from this study?		X
3	Is there a significant possibility that a specific organisation or agency or participants could have confidential information identified, as a result of the way you write up the results of the study?		X
4	Will any members of the research team retain any personal of confidential data at the end of the project, other than in fully anonymised form?		X
5	Will you or any member of the team intend to make use of any confidential information, knowledge, trade secrets obtained for any other purpose than the research project?		X
6	Will you be responsible for destroying the data after study completion?	X	

Participant Information and Informed Consent

Question		Yes	No
1	Will all the participants be fully informed BEFORE the project begins why the study is being conducted and what their participation will involve?	X	
2	Will every participant be asked to give written consent to participating in the study, before it begins?	X	
3	Will all participants be fully informed about what data will be collected, and what will be done with this data during and after the study?	X	
4	Will there be audio, video or photographic recording of participants?	X	
	Will explicit consent be sought for recording of participants?	X	
5	Will every participant understand that they have the right not to take part at any time, and/or withdraw themselves and their data from the study if they wish?	X	
6	Will every participant understand that there will be no reasons required or repercussions if they withdraw or remove their data from the study?	X	

7	Does the study involve deceiving, or covert observation of, participants?		X

Risk of harm, potential harm and disclosure of harm

Question			**Yes**	**No**
1	Is there any significant risk that the study may lead to physical harm to participants or researchers?			X
2	Is there any significant risk that the study may lead to psychological or emotional distress to participants?		X	
	If YES, please explain how you will take steps to reduce or address those risks	As mentioned above, the study deals with the potentially emotive topic of the end of driving lifestyle which could cause an impact. It is the aim that the research design should minimise this.		
3	Is there any risk that the study may lead to psychological or emotional distress to researchers?			X
4	Is there any risk that your study may lead or result in harm to the reputation of participants, researchers, or their employees, or any associated persons or organisations?			X
5	Is there a risk that the study will lead to participants to disclose evidence of previous criminal offences, or their intention to commit criminal offences?		X	
	If YES, please explain how you will take steps to reduce or address those risks	only in terms of accident information		
6	Is there a risk that the study will lead participants to disclose evidence that children or vulnerable adults are being harmed, or at risk or harm			X
7	Is there a risk that the study will lead participants to disclose evidence of serious risk of other types of harm?		X	
	If YES, please explain how you will take steps to reduce or address those risks	only within the realm of driving risk and accidents		
8	Are you aware of the CU Disclosure protocol?		X	

Payments to participants

Question			**Yes**	**No**
1	Do you intend to offer participants cash payments or any kind of inducements, or reward for taking part in your study?		X	
	If YES, please explain what kind of payment you will be offering (e.g. prize draw or store vouchers)	I am currently unsure as to whether this will happen. If I do offer any payment, it will be in order to compensate for time taken to carry out experiments or questionnaires.		
2	Is there any possibility that such payments or inducements will cause participants to consent to risks that they might not otherwise find acceptable?			X
3	Is there any possibility that the prospect of payment or inducements will influence the data provided by participants in any way?			X

4	Will you inform participants that accepting payments or inducements does not affect their right to withdraw from the study at any time?	X	

Capacity to give valid consent

Question			**Yes**	**No**
1	Do you propose to recruit any participants who are:			
	a) Children or young people under 18 years of age?			X
	b) Adults who have learning difficulties, mental health condition, brain injury, advanced dementia, degenerative neurological disorders?		X	
	c) Adults who are physically disabled?		X	
	d) Adults who are living in residential care, social care, nursing homes, re-ablement centres, hospitals or hospices?		X	
	e) Adults who are in prison, remanded on bail or in custody?			X
	If you answer YES to any of the questions please explain how you will overcome any challenges to gaining valid consent	I am uncertain as to whether I will invite the members of the groups above. however, I do intend to work with adults in the later stages of their lives so there may potentially be individuals who have experienced mental health conditions or physical disability. They may potentially have undiagnosed dementia status, and may well live in residential care. I will, however, abide by any guidelines given by the university, and will ensure that all protocols are upheld.		
2	Do you propose to recruit any participants with possible communication difficulties, including difficulties arising from limited use of knowledge of the English language?		X	
	If YES, please explain how you will overcome any challenges to gaining valid consent	I will attempt to manage communication difficulties by exploring help with translation, and considering my pace of delivery.		
3	Do you propose to recruit any participants who may not be able to understand fully the nature of the study, research and the implications for them of participating in it or cannot provide consent themselves?			X

Recruiting Participants

Question			**Yes**	**No**
1	Do you propose to recruit any participants who are:			
	a) Students or employees of Coventry University or partnering organisation(s)?		X	
	If YES, please explain if there is any conflict of interest and how this will be addressed	Potentially but unlikely. Permission would be sought via the doctoral college, director of studies and ethics committee.		

b) employees/staff recruited through other businesses, voluntary or public sector organisations?		X	
If YES, please explain how permission will be gained would be sought via the	potentially but unlikely. Permission doctoral college, director of studies and ethics committee.		
d) clients/volunteers/service users recruited through voluntary public services?		X	
If YES, please explain how permission will be gained	Potentially. Permission would be sought via the doctoral college, director of studies and ethics committee. It will be sought in conjunction with the relevant voluntary service.		
e) Participants living in residential care, social care, nursing homes, re-ablement centres hospitals or hospices?		X	
If YES, please explain how permission will be gained	Potentially. Permission would be sought via the doctoral college, director of studies and ethics committee. It will be sought in conjunction with the relevant service.		

Online and Internet Research

Question			Yes	No
1	Will any part of your study involve collecting data by means of electronic media (e.g. the Internet, e-mail, Facebook, Twitter, online forums, etc.)?		X	
	If YES, please explain how you will obtain permission to collect data by this means	Possibly. Permission would be sought via the doctoral college, director of studies and ethics committee. It will be sought in conjunction with the relevant service. It will be open and honest, with additional information about how the data will be stored and destroyed.		
4	Will you be using survey collection software (e.g. BoS, Filemaker)?		X	X
	If YES, please explain which software	Potentially. As yet uncertain. Probably BoS if anything. It will be the aim of the researchers to update ethics committee were this to change.		
5	Have you taken necessary precautions for secure data management, in accordance with data protection and CU Policy?			X
	If NO	please explain why not		
		I currently am seeking information about all of the above and will ensure that no data is collected and held until this has been examined and signed off.		

Languages

Question	Yes	No

1	Are all or some of the consent forms, information leaflets and research instruments associated with this project likely to be used in languages other than English?	X	
	If YES, please specify the language[s] to be used	not necessarily but this is a possibility	
2	Have some or all of the translations been undertaken by you or a member of the research team?		X
	Are these translations in lay language and likely to be clearly understood by the research participants?		X
3	Have some or all of the translations been undertaken by a third party?	X	
	If YES, please specify the name[s] of the persons or agencies performing the translations	More likely to be by 3rd party as members of team may or may not have necessary language skills. Again, the ethics panel will be updated.	
	Please describe the procedures used when undertaking research instrument translation (e.g. forward and back translation), clarifying strategies for ensuring the validity and reliability of the translation	Unsure at this present time as it may or may not be required but thought will be applied to clarity, accuracy and confidentiality.	

Laboratory/Workshops

Question		**Yes**	**No**
1	Does any part of the project involve work in a laboratory or workshop which could pose risks to you, researchers or others?	X	
	If YES: If you have risk assessments for laboratory or workshop activities you can refer to them here & upload them at the end, or explain in the text box how you will manage those risks	There will be some driving simulation which could potentially lead to motion sickness. This will be monitored at all times, and the study will be stopped at the first sign of this being a potential issue. There will then be a follow up to ensure that the participant can be helped home safely and that they continue to be well.	

Research with non-human vertebrates

Question		**Yes**	**No**
1	Will any part of the project involve animal habitats or tissues or nonhuman vertebrates?		X

Question		**Yes**	**No**
1	Does your study involve collecting or use of human tissues or fluids? (e.g. collecting urine, saliva, blood or use of cell lines, 'dead' blood)		X

Travel

Question	**Yes**	**No**

1	Does any part of the project require data collection off campus? (e.g. work in the field or community)	X	
	If YES: You must consider the potential hazards from off campus activities (e.g. working alone, time of data collection, unfamiliar or hazardous locations, using equipment, the terrain, violence or aggression from others). Outline the precautions that will be taken to manage these risks, AS A MINIMUM this must detail how researchers would summon assistance in an emergency when working off campus. For complex or high risk projects you may wish to complete and upload a separate risk assessment	There may be some focus groups and or interviews carried out off campus.	

Appendix A7 - P79163 Record of Approval (edited to remove extraneous questions)

Medium to High Risk Research Ethics Approval

Project Title

Survey to examine the experiences of drivers on the road, and their attitudes towards cessation and age.

Record of Approval

Principal Investigator

I **request an ethics peer review** and confirm that I have answered all relevant questions in this checklist honestly.	X
I confirm that I will carry out the project in the ways described in this checklist. I will immediately suspend research and request new ethical approval if the project subsequently changes the information I have given in this checklist.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the Code of Research Ethics issued by the relevant national learned society.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the University's Research Ethics, Governance and Integrity Framework.	X

Name: Lara Carballo

Date: 21/11/2018

Student's Supervisor (if applicable)

I have read this checklist and confirm that it covers all the ethical issues raised by this project fully and frankly. I also confirm that these issues have been discussed with the student and will continue to be reviewed in the course of supervision.

Name: Andrew Parkes

Date: 26/11/2018

Reviewer (if applicable)

Date of approval by anonymous reviewer: 29/11/2018

Project Ref	P79163
Full name	Lara Carballo
Faculty	Faculty of Engineering, Environment and Computing
Department	Future Transport & Cities

Supervisor	Andrew Parkes
Module Code	FTC
EFAAF Number	
Project title	Survey to examine the experiences of drivers on the road, and their attitudes towards cessation and age.
Date(s)	19/11/2018 - 05/01/2019
Created	21/11/2018 18:14

Project Summary

To examine basic difficulties/attitudes/experiences with driving and ageing

Names of Co-Investigators and their organisational affiliation (place of study/employer)	
Is the project self-funded?	YES
Who is funding the project?	Coventry University
Has the funding been confirmed?	YES
Are you required to use a Professional Code of Ethical Practice appropriate to your discipline?	YES
Have you read the Code?	YES

Project Details

What is the purpose of the project?	To examine behaviours and experiences whilst driving at crossroads, and to discuss the opinions around licensing and driving cessation. The Survey would hope to identify individuals who are willing to take part in interviews.
What are the planned or desired outcomes?	To have information around experience, attitudes and driving behaviour within specific demographics that would enable an interview schedule to be effectively drawn up.
Explain your research design	Overall this would be a mixed research design with survey/interview/tests
Outline the principal methods you will use	Surveys/interviews/tests
Are you dealing with Primary Data involving people? (e.g. interviews, questionnaires, observations)	YES
Are you dealing with personal or sensitive data?	YES
Will the Personal or Sensitive data be shared with a third party?	YES

Will the Personal or Sensitive data be shared outside of the European Economic Area ("EEA")?	NO

DBS (Disclosure & Barring Service) formerly CRB (Criminal Records Bureau)

Question			**Yes**	**No**
1	Does the study require DBS (Disclosure & Barring Service) checks?			X
	c) With adults who are frail or physically disabled?		X	
	d) With adults who are living in residential care, social care, nursing homes, re-ablement centres, hospitals or hospices?		X	
	If you have answered YES to any of the questions above please explain the nature of that contact and what you will be doing	Any contact will be based on an approach via support workers/ families / to ensure that any involvement is fully informed. I hold a DBS certificate for working with vulnerable adults : DBS Certificate number: 001563319718		

External Ethical Review

Question		**Yes**	**No**
1	Will this study be submitted for ethical review to an external organisation?		X

Confidentiality, security and retention of research data

Question			**Yes**	**No**
4	Will any members of the research team retain any personal of confidential data at the end of the project, other than in fully anonymised form?		X	
	If YES, please explain further why this is the case	Only until all of the studies contributing to the PhD have been completed, upon which all non-anonymised data will be destroyed.		
6	Will you be responsible for destroying the data after study completion?		X	

Participant Information and Informed Consent

Question		**Yes**	**No**
1	Will all the participants be fully informed BEFORE the project begins why the study is being conducted and what their participation will involve?	X	
2	Will every participant be asked to give written consent to participating in the study, before it begins?	X	

3	Will all participants be fully informed about what data will be collected, and what will be done with this data during and after the study?	X	
4	Will there be audio, video or photographic recording of participants?	X	
	Will explicit consent be sought for recording of participants?	X	
5	Will every participant understand that they have the right not to take part at any time, and/or withdraw themselves and their data from the study if they wish?	X	
6	Will every participant understand that there will be no reasons required or repercussions if they withdraw or remove their data from the study?	X	
7	Does the study involve deceiving, or covert observation of, participants?		X

Risk of harm, potential harm and disclosure of harm

Question			**Yes**	**No**
1	Is there any significant risk that the study may lead to physical harm to participants or researchers?			X
2	Is there any significant risk that the study may lead to psychological or emotional distress to participants?		X	
	If YES, please explain how you will take steps to reduce or address those risks	In so far as driving cessation and discussion of accidents may be emotive. Questions will be devised in a sensitive manner, and the interviewer will be sensitive and willing to halt proceedings if a participant looks like they are approaching a situation where they may be upset. Participants will be reminded that information and participation are voluntary.		
3	Is there any risk that the study may lead to psychological or emotional distress to researchers?			X
4	Is there any risk that your study may lead or result in harm to the reputation of participants, researchers, or their employees, or any associated persons or organisations?			X
5	Is there a risk that the study will lead to participants to disclose evidence of previous criminal offences, or their intention to commit criminal offences?		X	
	If YES, please explain how you will take steps to reduce or address those risks	This is a minimal risk but may occur if disclosure surrounding accidents occur. The consent forms will remind participants that confidentiality will be upheld unless information is such that the police need to be informed.		

6	Is there a risk that the study will lead participants to disclose evidence that children or vulnerable adults are being harmed, or at risk or harm?		X

7	Is there a risk that the study will lead participants to disclose evidence of serious risk of other types of harm?		X
8	Are you aware of the CU Disclosure protocol?	X	

Payments to participants

Question		**Yes**	**No**
1	Do you intend to offer participants cash payments or any kind of inducements, or reward for taking part in your study?	X	
	If YES, please explain what kind of payment you will be offering (e.g. prize draw or store vouchers)	Prize draw for vouchers as a thanks for involvement	
2	Is there any possibility that such payments or inducements will cause participants to consent to risks that they might not otherwise find acceptable?		X
3	Is there any possibility that the prospect of payment or inducements will influence the data provided by participants in any way?		X
4	Will you inform participants that accepting payments or inducements does not affect their right to withdraw from the study at any time?	X	

Capacity to give valid consent

Question		**Yes**	**No**
1	Do you propose to recruit any participants who are:		
	a) Children or young people under 18 years of age?		X
	b) Adults who have learning difficulties, mental health condition, brain injury, advanced dementia, degenerative neurological disorders?		X
	c) Adults who are physically disabled?	X	
	d) Adults who are living in residential care, social care, nursing homes, re-ablement centres, hospitals or hospices?	X	
	e) Adults who are in prison, remanded on bail or in custody?		X
	If you answer YES to any of the questions please explain how you will overcome any challenges to gaining valid consent	Adults with physical disabilities will have the capacity to understand and consent to participation. Adults within residential services may need to be asked via support staff. Consent will only be sought from those who are seen to have full capacity to make decisions.	

2	Do you propose to recruit any participants with possible communication difficulties, including difficulties arising from limited use of knowledge of the English language?		X
3	Do you propose to recruit any participants who may not be able to understand fully the nature of the study, research and the implications for them of participating in it or cannot provide consent themselves?		X

Recruiting Participants

Question			**Yes**	**No**
1	Do you propose to recruit any participants who are:			
	a) Students or employees of Coventry University or partnering organisation(s)?		X	
	If YES, please explain if there is any conflict of interest and how this will be addressed	No conflict of interest should occur. I will ensure that no participants are linked with the study. I would also ensure, as with any other participant, that all information remained confidential.		
	b) employees/staff recruited through other businesses, voluntary or public sector organisations?		X	
	If YES, please explain how permission will be gained	May need to seek permission from staff at nursing homes		
	c) Pupils or students recruited through educational institutions (e.g. Primary schools, secondary schools, colleges)?			X
	d) clients/volunteers/service users recruited through voluntary public services?		X	
	If YES, please explain how permission will be gained	Uncertain about this, but as hoping for samples from the public, this may happen.		
	e) Participants living in residential care, social care, nursing homes, re-ablement centres hospitals or hospices?		X	
	If YES, please explain how permission will be gained	May need to seek permission from staff at nursing homes, and will ensure that only service users with capacity are asked to participate.		
	f) Recruited by virtue of their employment in the police or armed forces?			X
	g) Adults who are in prison, remanded on bail or in custody?			X
	h) Who may not be able to refuse to participate in the research?			X

Online and Internet Research

Question				Yes	No
1	Will any part of your study involve collecting data by means of electronic media (e.g. the Internet, e-mail, Facebook, Twitter, online forums, etc.)?				X
2	Is there a possibility that the study will encourage children under 18 to access inappropriate websites, or correspond with people who pose risk of harm?				X
3	Will the study incur any other risks that arise specifically from the use of electronic media?				X
4	Will you be using survey collection software (e.g. BoS, Filemaker)?			X	
	If YES, please explain which software		Bristol online		
5	Have you taken necessary precautions for secure data management, in accordance with data protection and CU Policy?			X	
	If YES	Specify location where data will be stored	Sensitive data to be held on OneDrive		
		Planned disposal date	01/03/2021		
		If the research is funded by an external organisation, are there any requirements for storage and disposal?			X

Languages

Question		Yes	No
1	Are all or some of the consent forms, information leaflets and research instruments associated with this project likely to be used in languages other than English?		X

Laboratory/Workshops

Question		Yes	No
1	Does any part of the project involve work in a laboratory or workshop which could pose risks to you, researchers or others?		X

Research with non-human vertebrates

Question		Yes	No
1	Will any part of the project involve animal habitats or tissues or nonhuman vertebrates?		X

Blood Sampling / Human Tissue Analysis

Question		Yes	No
1	Does your study involve collecting or use of human tissues or fluids? (e.g. collecting urine, saliva, blood or use of cell lines, 'dead' blood)		X

Travel

<table>
<tr><th colspan="3">Question</th><th>Yes</th><th>No</th></tr>
<tr><td rowspan="2">1</td><td colspan="2">Does any part of the project require data collection off campus?
(e.g. work in the field or community)</td><td>X</td><td></td></tr>
<tr><td>If YES:
You must consider the potential hazards from off campus activities (e.g. working alone, time of data collection, unfamiliar or hazardous locations, using equipment, the terrain, violence or aggression from others). Outline the precautions that will be taken to manage these risks, AS A MINIMUM this must detail how researchers would summon assistance in an emergency when working off campus.
For complex or high risk projects you may wish to complete and upload a separate risk assessment</td><td colspan="3">I will ensure that research team know when I am due to attend interviews. I will carry a mobile phone, and ensure that I meet people in public places where possible</td></tr>
<tr><td>2</td><td colspan="2">Does any part of the project involve the researcher travelling outside the UK (or to very remote UK locations)?</td><td></td><td>X</td></tr>
</table>

Appendix A8 - P89579 Record of Approval (edited to remove extraneous questions)

Medium to High Risk Research Ethics Approval

Record of Approval

Principal Investigator

I **request an ethics peer review** and confirm that I have answered all relevant questions in this checklist honestly.	X
I confirm that I will carry out the project in the ways described in this checklist. I will immediately suspend research and request new ethical approval if the project subsequently changes the information I have given in this checklist.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the Code of Research Ethics issued by the relevant national learned society.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the University's Research Ethics, Governance and Integrity Framework.	X

Name: Lara Carballo

Date: 25/03/2019

Student's Supervisor (if applicable)

I have read this checklist and confirm that it covers all the ethical issues raised by this project fully and frankly. I also confirm that these issues have been discussed with the student and will continue to be reviewed in the course of supervision.

Name: Andrew Parkes

Date: 11/04/2019

Reviewer (if applicable)

Date of approval by anonymous reviewer: 25/04/2019

Medium to High Risk Research Ethics Approval Checklist

Project Information

Project Ref	P89579
Full name	Lara Carballo
Faculty	University Research Centre
Department	Institute for Future Transport and Cities
Supervisor	Andrew Parkes
Module Code	FTC-PHD
EFAAF Number	
Project title	Experimental Study 2

Date(s)	15/04/2019 - 28/06/2019
Created	25/03/2019 21:42

Project Summary

Participants will be asked to a complete a test where they are asked to read an image of a car number plate - either on a computer screen or in printed form. They will then be asked to complete a short questionnaire about their driving habits before carrying out 2 separate computerised tests - the first developed in-house, and the second the Useful Field of View test that is commercially available. This will be followed by a short interview to discuss driving experience.

Names of Co-Investigators and their organisational affiliation (place of study/employer)	
Is the project self-funded?	YES
Who is funding the project?	Coventry University
Has the funding been confirmed?	YES
Are you required to use a Professional Code of Ethical Practice appropriate to your discipline?	YES
Have you read the Code?	YES

Project Details

What is the purpose of the project?	The purpose of this project is 1. To aim to re-create a study similar to the original study using the in-house system after its rebuild to ensure that it works in a similar way. 2. To compare the in-house system with the Useful Field of View test. 3. To examine the ability of individuals across ages and levels of experience to judge the time to contact of an oncoming vehicle under different circumstances.
What are the planned or desired outcomes?	The study hopes to create a basis from which to develop further tests. An aim is to capture measurements of error within the tests to see whether age is the main predictive variable, or whether perhaps experience may have some influence. It is the hope that where errors are made on the test that further insight into the driving behaviours of each individual gained via the interviews might further validate the test.

Explain your research design	It is a mixed design including qualitative and quantitative methods.	
Outline the principal methods you will use	The mixed methods design will include Computer-based testing, interview and questionnaire to take place within a room on campus. The interviews are designed to be semi structured and so some questions may be omitted if previous answers sufficiently cover the topic. The order may also change in order to ensure conversation flow and comfort of the participant. It should not last more than 1 hour 45 minutes with rest breaks.	
Are you proposing to use an external research instrument, validated scale or follow a published research method?		YES
If yes, please give details of what you are using	I will be using the commercially available Useful Field of View test. It is a computerised test which can only be shown by logging into the website, but by way of explanation I can upload a copy of the manual which outlines the test and what is required.	
Are you dealing with Primary Data involving people? (e.g. interviews, questionnaires, observations)		YES
Are you dealing with personal or sensitive data?		YES

DBS (Disclosure & Barring Service) formerly CRB (Criminal Records Bureau)

Question		**Yes**	**No**
1	Does the study require DBS (Disclosure & Barring Service) checks?		X
2	If NO, does the study involve direct contact by any member of the research team:		
	a) With children or young people under 18 years of age?		X
	b) With adults who have learning difficulties, brain injury, dementia, degenerative neurological disorders?		X
	c) With adults who are frail or physically disabled?		X
	d) With adults who are living in residential care, social care, nursing homes, re-ablement centres, hospitals or hospices?		X
	e) With adults who are in prison, remanded on bail or in custody?		X

External Ethical Review

Question		Yes	No
1	Will this study be submitted for ethical review to an external organisation?		X

Confidentiality, security and retention of research data

Question		Yes	No
1	Are there any reasons why you cannot guarantee the full security and confidentiality of any personal or confidential data collected for the study?		X
2	Is there a significant possibility that any of your participants, and associated persons, could be directly or indirectly identified in the outputs or findings from this study?		X
3	Is there a significant possibility that a specific organisation or agency or participants could have confidential information identified, as a result of the way you write up the results of the study?		X
4	Will any members of the research team retain any personal of confidential data at the end of the project, other than in fully anonymised form?		X
5	Will you or any member of the team intend to make use of any confidential information, knowledge, trade secrets obtained for any other purpose than the research project?		X
6	Will you be responsible for destroying the data after study completion?	X	

Participant Information and Informed Consent

Question		Yes	No
1	Will all the participants be fully informed BEFORE the project begins why the study is being conducted and what their participation will involve?	X	
2	Will every participant be asked to give written consent to participating in the study, before it begins?	X	
3	Will all participants be fully informed about what data will be collected, and what will be done with this data during and after the study?	X	
4	Will there be audio, video or photographic recording of participants?	X	
	Will explicit consent be sought for recording of participants?	X	

5	Will every participant understand that they have the right not to take part at any time, and/or withdraw themselves and their data from the study if they wish?	X	
6	Will every participant understand that there will be no reasons required or repercussions if they withdraw or remove their data from the study?	X	
7	Does the study involve deceiving, or covert observation of, participants?		X

Risk of harm, potential harm and disclosure of harm

Question		**Yes**	**No**
1	Is there any significant risk that the study may lead to physical harm to participants or researchers?		X
2	Is there any significant risk that the study may lead to psychological or emotional distress to participants?	X	
	If YES, please explain how you will take steps to reduce or address those risks	Perhaps not significant risk, but a potential in so far as discussion of accidents may be emotive. Questions will be devised in a sensitive manner, and the interviewer will be sensitive and willing to halt proceedings if a participant looks like they are approaching a situation where they may be upset. Participants will be reminded that information and participation are voluntary.	
3	Is there any risk that the study may lead to psychological or emotional distress to researchers?		X
4	Is there any risk that your study may lead or result in harm to the reputation of participants, researchers, or their employees, or any associated persons or organisations?		X
5	Is there a risk that the study will lead to participants to disclose evidence of previous criminal offences, or their intention to commit criminal offences?	X	
	If YES, please explain how you will take steps to reduce or address those risks	This is a minimal risk but may occur if disclosure surrounding accidents happens. I will immediately inform the participant that we should stop proceedings and explain and explain to the participant that confidentiality cannot be upheld where information is such that the police need to be informed.	

6	Is there a risk that the study will lead participants to disclose evidence that children or vulnerable adults are being harmed, or at risk or harm?		X
7	Is there a risk that the study will lead participants to disclose evidence of serious risk of other types of harm?		X
8	Are you aware of the CU Disclosure protocol?	X	

Payments to participants

Question			**Yes**	**No**
1	Do you intend to offer participants cash payments or any kind of inducements, or reward for taking part in your study?		X	
	If YES, please explain what kind of payment you will be offering (e.g. prize draw or store vouchers)	£10 love2shop voucher		
2	Is there any possibility that such payments or inducements will cause participants to consent to risks that they might not otherwise find acceptable?			X
3	Is there any possibility that the prospect of payment or inducements will influence the data provided by participants in any way?			X
4	Will you inform participants that accepting payments or inducements does not affect their right to withdraw from the study at any time?		X	

Capacity to give valid consent

Question		**Yes**	**No**
1	Do you propose to recruit any participants who are:		
	a) Children or young people under 18 years of age?		X
	b) Adults who have learning difficulties, mental health condition, brain injury, advanced dementia, degenerative neurological disorders?		X
	c) Adults who are physically disabled?		X
	d) Adults who are living in residential care, social care, nursing homes, re-ablement centres, hospitals or hospices?		X
	e) Adults who are in prison, remanded on bail or in custody?		X
2	Do you propose to recruit any participants with possible communication difficulties, including difficulties arising from limited use of knowledge of the English language?		X
3	Do you propose to recruit any participants who may not be able to understand fully the nature of the study, research and the implications for them of participating in it or cannot provide consent themselves?		X

Recruiting Participants

Question			Yes	No
1	Do you propose to recruit any participants who are:			
	a) Students or employees of Coventry University or partnering organisation(s)?		X	
	If YES, please explain if there is any conflict of interest and how this will be addressed	No conflict of interest should occur. I will ensure that no participants are linked with the study. I would also ensure, as with any other participant, that all information remained confidential.		
	b) employees/staff recruited through other businesses, voluntary or public sector organisations?			X
	c) Pupils or students recruited through educational institutions (e.g. Primary schools, secondary schools, colleges)?			X
	d) clients/volunteers/service users recruited through voluntary public services?			X
	e) Participants living in residential care, social care, nursing homes, re-ablement centres hospitals or hospices?		X	
	If YES, please explain how permission will be gained	There is a potential that members of the public who volunteer to take part may be resident in these settings, but they will not be intentionally approached. May need to seek permission From staff at nursing homes, and will ensure that only service users with capacity are asked to participate. As mentioned elsewhere, I have an online DBS certificate. However, this population will not be actively contacted for recruitment at this time.		
	f) Recruited by virtue of their employment in the police or armed forces?			X
	g) Adults who are in prison, remanded on bail or in custody?			X
	h) Who may not be able to refuse to participate in the research?			X

Online and Internet Research

Question		Yes	No
1	Will any part of your study involve collecting data by means of electronic media (e.g. the Internet, e-mail, Facebook, Twitter, online forums, etc.)?		X

2	Is there a possibility that the study will encourage children under 18 to access inappropriate websites, or correspond with people who pose risk of harm?		X
3	Will the study incur any other risks that arise specifically from the use of electronic media?		X
4	Will you be using survey collection software (e.g. BoS, Filemaker)?		X
5	Have you taken necessary precautions for secure data management, in accordance with data protection and CU Policy?	X	
	If YES — Specify location where data will be stored	within the project area on SharePoint	
	Planned disposal date	31/03/2021	
	If the research is funded by an external organisation, are there any requirements for storage and disposal?		X

Languages

Question		**Yes**	**No**
1	Are all or some of the consent forms, information leaflets and research instruments associated with this project likely to be used in languages other than English?		X

Laboratory/Workshops

Question		**Yes**	**No**
1	Does any part of the project involve work in a laboratory or workshop which could pose risks to you, researchers or others?		X

Research with non-human vertebrates

Question		**Yes**	**No**
1	Will any part of the project involve animal habitats or tissues or nonhuman vertebrates?		X

Blood Sampling / Human Tissue Analysis

Question		**Yes**	**No**
1	Does your study involve collecting or use of human tissues or fluids? (e.g. collecting urine, saliva, blood or use of cell lines, 'dead' blood)		X

Travel

Question		**Yes**	**No**
1	Does any part of the project require data collection off campus? (e.g. work in the field or community)		X

Appendix A9 - P93731 Record of Approval (edited to remove extraneous questions)

Medium to High Risk Research Ethics Approval
Record of Approval

Principal Investigator

I **request an ethics peer review** and confirm that I have answered all relevant questions in this checklist honestly.	X
I confirm that I will carry out the project in the ways described in this checklist. I will immediately suspend research and request new ethical approval if the project subsequently changes the information I have given in this checklist.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the Code of Research Ethics issued by the relevant national learned society.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the University's Research Ethics, Governance and Integrity Framework.	X

Name: Lara Carballo

Date: 12/08/2019

Student's Supervisor (if applicable)

I have read this checklist and confirm that it covers all the ethical issues raised by this project fully and frankly. I also confirm that these issues have been discussed with the student and will continue to be reviewed in the course of supervision.

Name: Andrew Parkes

Date: 06/09/2019

Reviewer (if applicable)

Date of approval by anonymous reviewer: 15/09/2019

Medium to High Risk Research Ethics Approval Checklist

Project Information

Project Ref	P93731
Full name	Lara Carballo
Faculty	University Research Centre
Department	Institute for Future Transport and Cities
Supervisor	Andrew Parkes
Module Code	FTC-PHD
EFAAF Number	
Project title	Experimental Study Main
Date(s)	12/08/2019 - 31/03/2021
Created	12/08/2019 11:03

Project Summary

Participants will be asked to a complete a test where they are asked to read an image of a car number plate - either on a computer screen or in printed form. They will then be asked to complete a short questionnaire about their driving habits, and to collect demographic information before carrying out 2 separate computerised tests - the first developed in-house, and the second the Useful Field of View test that is commercially available.

Names of Co-Investigators and their organisational affiliation (place of study/employer)	
Is the project self-funded?	YES
Who is funding the project?	Coventry University
Has the funding been confirmed?	YES
Are you required to use a Professional Code of Ethical Practice appropriate to your discipline?	YES
Have you read the Code?	YES

Project Details

What is the purpose of the project?	The purpose of this project is 1. To aim to continue to test the robustness of the system being developed. 2. To test the portability of the test. I.e. the use of a laptop to travel to participants. 2. To compare the in-house system with the Useful Field of View test. 3. To examine the ability of individuals across ages and levels of experience to judge the time to contact of an oncoming vehicle under different circumstances.

What are the planned or desired outcomes?	The study hopes to create a basis from which to develop further tests. An aim is to capture measurements of error within the tests to see whether age is the main predictive variable, or whether perhaps experience may have some influence. It is the hope that this test will reach a sufficient number of participants so as to test as fully as possible the effect on individuals with different belonging to different demographic groups in terms of location (city/village etc.), illness or medication taken that may affect driving, and age.	
Explain your research design	This will be of quantitative design, and will be analysed using SPSS software. Participants will be aged from 18 upwards, and will be recruited mainly from members of the public who are not seen to be vulnerable. My aim is to continue with the design of the previous "Experimental Study 2", and to aim to achieve at least 10 participants in each age group of 18-27, 28-37, 38-47, 48-57, 58-67, 68-77, 78-87, and 88+. With this in mind, I will be aiming for at least 80 participants. With this in mind, I will be attempting to make the tests completely portable so that I can visit people who may be less mobile.	
Outline the principal methods you will use	The methods will include Computer-based testing, and a short questionnaire which will take place at variable locations.	
Are you proposing to use an external research instrument, validated scale or follow a published research method?		YES
If yes, please give details of what you are using	I will be using the commercially available Useful Field of View test. It is a computerised test which can only be shown by logging into the website, but by way of explanation I can upload a copy of the manual which outlines the test and what is required.	
Will your research involve consulting individuals who support, or literature, websites or similar material which advocates, any of the following: terrorism, armed struggles, or political, religious or other forms of activism considered illegal under UK law?		NO
Are you dealing with Secondary Data? (e.g. sourcing info from websites, historical documents)		NO
Are you dealing with Primary Data involving people? (e.g. interviews, questionnaires, observations)		YES

Are you dealing with personal or sensitive data?	YES
Will the Personal or Sensitive data be shared with a third party?	NO
Will the Personal or Sensitive data be shared outside of the European Economic Area ("EEA")?	NO
Is the project solely desk based? (e.g. involving no laboratory, workshop or off campus work or other activities which pose significant risks to researchers or participants)	NO
Are there any other ethical issues or risks of harm raised by the study that have not been covered by previous questions?	NO

DBS (Disclosure & Barring Service) formerly CRB (Criminal Records Bureau)

Question		**Yes**	**No**
1	Does the study require DBS (Disclosure & Barring Service) checks?	X	
	If YES, please give details of the serial number, date obtained and expiry date	There is a possibility that this might be required. I hold an NVQ3 in Adult Social Care and subscribe to the DBS Update Service. My certificate Number is: 001563319718, and the last certificate obtained was 17/02/2017 with an expiry date of 16/02/2020	

External Ethical Review

Question		**Yes**	**No**
	Will this study be submitted for ethical review to an external organisation?		X

Confidentiality, security and retention of research data

Question		**Yes**	**No**
1	Are there any reasons why you cannot guarantee the full security and confidentiality of any personal or confidential data collected for the study?		X
2	Is there a significant possibility that any of your participants, and associated persons, could be directly or indirectly identified in the outputs or findings from this study?		X
3	Is there a significant possibility that a specific organisation or agency or participants could have confidential information identified, as a result of the way you write up the results of the study?		X
4	Will any members of the research team retain any personal of confidential data at the end of the project, other than in fully anonymised form?		X

5	Will you or any member of the team intend to make use of any confidential information, knowledge, trade secrets obtained for any other purpose than the research project?		X
6	Will you be responsible for destroying the data after study completion?	X	

Participant Information and Informed Consent

Question		**Yes**	**No**
1	Will all the participants be fully informed BEFORE the project begins why the study is being conducted and what their participation will involve?	X	
2	Will every participant be asked to give written consent to participating in the study, before it begins?	X	
3	Will all participants be fully informed about what data will be collected, and what will be done with this data during and after the study?	X	
4	Will there be audio, video or photographic recording of participants?		X
5	Will every participant understand that they have the right not to take part at any time, and/or withdraw themselves and their data from the study if they wish?	X	
6	Will every participant understand that there will be no reasons required or repercussions if they withdraw or remove their data from the study?	X	
7	Does the study involve deceiving, or covert observation of, participants?		X

Risk of harm, potential harm and disclosure of harm

Question		**Yes**	**No**
1	Is there any significant risk that the study may lead to physical harm to participants or researchers?		X
2	Is there any significant risk that the study may lead to psychological or emotional distress to participants?		X
3	Is there any risk that the study may lead to psychological or emotional distress to researchers?		X
4	Is there any risk that your study may lead or result in harm to the reputation of participants, researchers, or their employees, or any associated persons or organisations?		X
5	Is there a risk that the study will lead to participants to disclose evidence of previous criminal offences, or their intention to commit criminal offences?		X

6	Is there a risk that the study will lead participants to disclose evidence that children or vulnerable adults are being harmed, or at risk or harm?		X
7	Is there a risk that the study will lead participants to disclose evidence of serious risk of other types of harm?		X
8	Are you aware of the CU Disclosure protocol?	X	

Payments to participants

Question		**Yes**	**No**
1	Do you intend to offer participants cash payments or any kind of inducements, or reward for taking part in your study?	X	
	If YES, please explain what kind of payment you will be offering (e.g. prize draw or store vouchers)	I intend to offer the chance to win a £50 amazon voucher via a prize draw	
2	Is there any possibility that such payments or inducements will cause participants to consent to risks that they might not otherwise find acceptable?		X
3	Is there any possibility that the prospect of payment or inducements will influence the data provided by participants in any way?		X
4	Will you inform participants that accepting payments or inducements does not affect their right to withdraw from the study at any time?	X	

Capacity to give valid consent

Question		**Yes**	**No**
1	Do you propose to recruit any participants who are:		
	a) Children or young people under 18 years of age?		X
	b) Adults who have learning difficulties, mental health condition, brain injury, advanced dementia, degenerative neurological disorders?	X	
	c) Adults who are physically disabled?	X	
	d) Adults who are living in residential care, social care, nursing homes, re-ablement centres, hospitals or hospices?	X	
	e) Adults who are in prison, remanded on bail or in custody?		X

	If you answer YES to any of the questions please explain how you will overcome any challenges to gaining valid consent	It is not my intention to recruit individuals with dementia or mental health issues without their having support from someone such as a support worker who is able to vouch for their capacity to consent. It may be that future studies choose to focus on this area however. With this in mind, I will fall back on my training and experience of working with Adults with learning disabilities and mental health conditions in order to ensure that the potential participant is able to communicate a knowledge of informed consent. I will hold fast to my training in reading assent and dissent in individuals also. For those who may have a physical disability but who wish to take part in the study, we are able to re-configure the foot pedal and hand button so that their involvement can be carried out without affecting any sense of dignity. I will assume someone with a physical disability, and no sense of obvious cognitive impairment, will have the capability to consent. I have been granted access to Earlsdon Retirement Village that has residents of mixed capability. Once again it is not my intention to recruit individuals with any cognitive or limited ability to consent to participating.		
2	Do you propose to recruit any participants with possible communication difficulties, including difficulties arising from limited use of knowledge of the English language?			X
3	Do you propose to recruit any participants who may not be able to understand fully the nature of the study, research and the implications for them of participating in it or cannot provide consent themselves?			X

Recruiting Participants

Question			**Yes**	**No**
	Do you propose to recruit any participants who are:			
	a) Students or employees of Coventry University or partnering organisation(s)?		X	
	If YES, please explain if there is any conflict of interest and how this will be addressed	No conflict of interest should occur. I will ensure that no participants are linked with the study. I would also ensure, as with any other participant, that all information remained confidential.		

e) Participants living in residential care, social care, nursing homes, re-ablement centres hospitals or hospices?		X	
If YES, please explain how permission will be gained	I have been granted access via face-to face discussion and email discussion. I will enclose the emails.		

Online and Internet Research

Question				Yes	No
1	Will any part of your study involve collecting data by means of electronic media (e.g. the Internet, e-mail, Facebook, Twitter, online forums, etc.)?				X
2	Is there a possibility that the study will encourage children under 18 to access inappropriate websites, or correspond with people who pose risk of harm?				X
3	Will the study incur any other risks that arise specifically from the use of electronic media?				X
4	Will you be using survey collection software (e.g. BoS, Filemaker)?				X
5	Have you taken necessary precautions for secure data management, in accordance with data protection and CU Policy?			X	
	If YES	Specify location where data will be stored	On SharePoint with consent forms stored in a password protected file once uploaded. Paper versions to be destroyed.		
		Planned disposal date	31/03/2021		
		If the research is funded by an external organisation, are there any requirements for storage and disposal?			X

Languages

Question		Yes	No
1	Are all or some of the consent forms, information leaflets and research instruments associated with this project likely to be used in languages other than English?		X

Laboratory/Workshops

Question		Yes	No
1	Does any part of the project involve work in a laboratory or workshop which could pose risks to you, researchers Ͻr others?		X

Research with non-human vertebrates

Question		Yes	No
1	Will any part of the project involve animal habitats or tissues or nonhuman vertebrates?		X

Blood Sampling / Human Tissue Analysis

Question		Yes	No
1	Does your study involve collecting or use of human tissues or fluids? (e.g. collecting urine, saliva, blood or use of cell lines, 'dead' blood)		X

Travel

<table>
<tr><th colspan="3">Question</th><th>Yes</th><th>No</th></tr>
<tr><td rowspan="2">1</td><td colspan="2">Does any part of the project require data collection off campus?
(e.g. work in the field or community)</td><td>X</td><td></td></tr>
<tr><td>If YES:
You must consider the potential hazards from off campus activities (e.g. working alone, time of data collection, unfamiliar or hazardous locations, using equipment, the terrain, violence or aggression from others). Outline the precautions that will be taken to manage these risks, AS A MINIMUM this must detail how researchers would summon assistance in an emergency when working off campus.
For complex or high risk projects you may wish to complete and upload a separate risk assessment</td><td colspan="3">A risk assessment will be drawn up. This document will be attached. I will carry a personal alarm, and will text a "buddy" before and after each session. This text will include my location postcode and the initials of my participant. This "buddy" will have details of my supervisory team should anything appear to have gone wrong. I will carry the phone that I use for work on me at all times.

Whilst on site in buildings, I will adhere to their lone working safety policies.</td></tr>
<tr><td>2</td><td colspan="2">Does any part of the project involve the researcher travelling outside the UK (or to very remote UK locations)?</td><td></td><td>X</td></tr>
</table>

Appendix A10 - P106123 Record of Approval (edited to remove extraneous questions)

Medium to High Risk Research Ethics Approval

Study 4 - IPA interviews

Record of Approval

Principal Investigator

I **request an ethics peer review** and confirm that I have answered all relevant questions in this checklist honestly.	X
I confirm that I will carry out the project in the ways described in this checklist. I will immediately suspend research and request new ethical approval if the project subsequently changes the information I have given in this checklist.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the Code of Research Ethics issued by the relevant national learned society.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the University's Research Ethics, Governance and Integrity Framework.	X

Name: Lara Carballo

Date: 28/04/2020

Student's Supervisor (if applicable)

I have read this checklist and confirm that it covers all the ethical issues raised by this project fully and frankly. I also confirm that these issues have been discussed with the student and will continue to be reviewed in the course of supervision.

Name: Andrew Parkes

Date: 01/05/2020

Reviewer (if applicable)

Date of approval by anonymous reviewer: 09/06/2020

Medium to High Risk Research Ethics Approval Checklist

Project Information

Project Ref	P106123
Full name	Lara Carballo
Faculty	University Research Centre
Department	Institute for Future Transport and Cities
Supervisor	Andrew Parkes
Module Code	FTC-PHD
EFAAF Number	
Project title	Study 4 - IPA interviews
Date(s)	05/05/2020 - 31/03/2021

Created	28/04/2020 18:32

Project Summary

Qualitative study to examine experience of driving cessation, and the perceived usefulness of an online test which is being developed to measure the errors in judgement of time-to contact of an oncoming vehicle, and in turn potentially support safe driving. Skype interviews with volunteering adults aged over 55, who have either stopped driving or are facing imminent driving cessation. Emails will be sent containing short questionnaire and interview schedule - also info including A video showing the look and working example of OMEDA (computer-based test in production) attached, to be followed by "face to face" interview (1hr approx.) over skype or similar platform. Recording (only voice required) of interview will take place. These recordings will be deleted as soon as the interviews have been transcribed, transcriptions will be anonymised. The interviews will be analysed via Interpretative Phenomenological Analysis (IPA). As such in accordance with the accepted conventions of IPA analysis, the sample size will be small - 6 participants. The group of participants will be split equally between male and female. Recruitment will take place via word-of-mouth and social media

Names of Co-Investigators and their organisational affiliation (place of study/employer)	
Is the project self-funded?	YES
Who is funding the project?	Coventry University
Has the funding been confirmed?	YES
Are you required to use a Professional Code of Ethical Practice appropriate to your discipline?	YES
Have you read the Code?	YES

Project Details

What is the purpose of the project?	Firstly, to ascertain a perceived usefulness and relevance for a computer based test in development. Specifically amongst older drivers who are on the cusp of driving cessation. Secondly, to build definitions of "older driver" and "experienced driver" from the point of view of this chosen demographic.

What are the planned or desired outcomes?	1. Discussion of usefulness and relevance of OMEDA to those deemed to be "older drivers" within driving literature. Build towards definitions of "older" and "experienced" within the context of driving. 2. Further examination of experience as an alternative to chronological age within the context of safe driving policy - i.e. should driving renewal be based on age or the ability to carry out driving as a function?
Explain your research design	This will be a qualitative design using a semi-structured interview design. Participants will be emailed the questions prior to Skype (or other platform) interview. Results will be derived from transcribed data.
Outline the principal methods you will use	Semi-structured interview to be analysed by Interpretative Phenomenological analysis (IPA). Preceded by short questionnaire asking about driving experience.

Are you proposing to use an external research instrument, validated scale or follow a published research method?	NO
Will your research involve consulting individuals who support, or literature, websites or similar material which advocates, any of the following: terrorism, armed struggles, or political, religious or other forms of activism considered illegal under UK law?	NO
Are you dealing with Secondary Data? (e.g. sourcing info from websites, historical documents)	NO
Are you dealing with Primary Data involving people? (e.g. interviews, questionnaires, observations)	YES
Are you dealing with personal or sensitive data?	YES
Will the Personal or Sensitive data be shared with a third party?	NO
Will the Personal or Sensitive data be shared outside of the European Economic Area ("EEA")?	NO
Is the project solely desk based? (e.g. involving no laboratory, workshop or off campus work or other activities which pose significant risks to researchers or participants)	NO
Are there any other ethical issues or risks of harm raised by the study that have not been covered by previous questions?	YES

If yes, please give further details	I am aware that I will need to record Skype (or other platform) interviews so that I might be able to transcribe them. I aim to do this in the least invasive way possible, and will ensure that the recordings are destroyed once anonymised transcription has occurred.

DBS (Disclosure & Barring Service) formerly CRB (Criminal Records Bureau)

Question		Yes	No
1	Does the study require DBS (Disclosure & Barring Service) checks?		X
2	If NO, does the study involve direct contact by any member of the research team:		
	a) With children or young people under 18 years of age?		X
	b) With adults who have learning difficulties, brain injury, dementia, degenerative neurological disorders?		X
	c) With adults who are frail or physically disabled?		X
	d) With adults who are living in residential care, social care, nursing homes, re-ablement centres, hospitals or hospices?		X
	e) With adults who are in prison, remanded on bail or in custody?		X

External Ethical Review

Question		Yes	No
1	Will this study be submitted for ethical review to an external organisation? (e.g. Another University, Social Care, National Health Service, Ministry of Defence, Police Service and Probation Office)		X
2	Will this study be reviewed using the IRAS system?		X
3	Has this study previously been reviewed by an external organisation?		X

Confidentiality, security and retention of research data

Question		Yes	No
1	Are there any reasons why you cannot guarantee the full security and confidentiality of any personal or confidential data collected for the study?		X
2	Is there a significant possibility that any of your participants, and associated persons, could be directly or indirectly identified in the outputs or findings from this study?		X
3	Is there a significant possibility that a specific organisation or agency or participants could have confidential information identified, as a result of the way you write up the results of the study?		X

4	Will any members of the research team retain any personal of confidential data at the end of the project, other than in fully anonymised form?		X
5	Will you or any member of the team intend to make use of any confidential information, knowledge, trade secrets obtained for any other purpose than the research project?		X
6	Will you be responsible for destroying the data after study completion?	X	

Participant Information and Informed Consent

Question		**Yes**	**No**
1	Will all the participants be fully informed BEFORE the project begins why the study is being conducted and what their participation will involve?	X	
2	Will every participant be asked to give written consent to participating in the study, before it begins?	X	
3	Will all participants be fully informed about what data will be collected, and what will be done with this data during and after the study?	X	
4	Will there be audio, video or photographic recording of participants?	X	
	Will explicit consent be sought for recording of participants?	X	
5	Will every participant understand that they have the right not to take part at any time, and/or withdraw themselves and their data from the study if they wish?	X	
6	Will every participant understand that there will be no reasons required or repercussions if they withdraw or remove their data from the study?	X	
7	Does the study involve deceiving, or covert observation of, participants?		X

Risk of harm, potential harm and disclosure of harm

Question		**Yes**	**No**
1	Is there any significant risk that the study may lead to physical harm to participants or researchers?		X
2	Is there any significant risk that the study may lead to psychological or emotional distress to participants?		X
3	Is there any risk that the study may lead to psychological or emotional distress to researchers?		X
4	Is there any risk that your study may lead or result in harm to the reputation of participants, researchers, or their employees, or any associated persons or organisations?		X
5	Is there a risk that the study will lead to participants to disclose evidence of previous criminal offences, or their intention to commit criminal offences?		X

6	Is there a risk that the study will lead participants to disclose evidence that children or vulnerable adults are being harmed, or at risk or harm?		X
7	Is there a risk that the study will lead participants to disclose evidence of serious risk of other types of harm?		X
8	Are you aware of the CU Disclosure protocol?	X	

Payments to participants

Question		**Yes**	**No**
1	Do you intend to offer participants cash payments or any kind of inducements, or reward for taking part in your study?		X

Capacity to give valid consent

Question			**Yes**	**No**
1	Do you propose to recruit any participants who are:			
	a) Children or young people under 18 years of age?			X
	b) Adults who have learning difficulties, mental health condition, brain injury, advanced dementia, degenerative neurological disorders?			X
	c) Adults who are physically disabled?		X	
	d) Adults who are living in residential care, social care, nursing homes, re-ablement centres, hospitals or hospices?		X	
	e) Adults who are in prison, remanded on bail or in custody?			X
	If you answer YES to any of the questions please explain how you will overcome any challenges to gaining valid consent	C. it might be that I recruit an individual who may be physically disabled, but feel that this does not affect capacity to give consent to an interview. It is not my intention to seek people within residential care, but should an adult with the capacity to consent reside in one of these settings, I will use the gatekeeper letter and approach the appropriate person within the setting.		
2	Do you propose to recruit any participants with possible communication difficulties, including difficulties arising from limited use of knowledge of the English language?			X
3	Do you propose to recruit any participants who may not be able to understand fully the nature of the study, research and the implications for them of participating in it or cannot provide consent themselves?			X

Recruiting Participants

Question		Yes	No
1	Do you propose to recruit any participants who are:		
	a) Students or employees of Coventry University or partnering organisation(s)?		X
	b) employees/staff recruited through other businesses, voluntary or public sector organisations?		X
	c) Pupils or students recruited through educational institutions (e.g. Primary schools, secondary schools, colleges)?		X
	d) clients/volunteers/service users recruited through voluntary public services?		X
	e) Participants living in residential care, social care, nursing homes, re-ablement centres hospitals or hospices?		X
	f) Recruited by virtue of their employment in the police or armed forces?		X
	g) Adults who are in prison, remanded on bail or in custody?		X
	h) Who may not be able to refuse to participate in the research?		X

Online and Internet Research

Question				Yes	No
1	Will any part of your study involve collecting data by means of electronic media (e.g. the Internet, e-mail, Facebook, Twitter, online forums, etc.)?			X	
	If YES, please explain how you will obtain permission to collect data by this means		I intend to offer the opportunity for individuals to send emailed responses to interview questions separately from their virtual "face-to-face" interviews in order to enrich the data. This permission will be reflected in the consent form sent prior to starting the collection of data by any means.		
2	Is there a possibility that the study will encourage children under 18 to access inappropriate websites, or correspond with people who pose risk of harm?				X
3	Will the study incur any other risks that arise specifically from the use of electronic media?				X
4	Will you be using survey collection software (e.g. BoS, Filemaker)?				X
5	Have you taken necessary precautions for secure data management, in accordance with data protection and CU Policy?			X	
	If YES	Specify location where data will be stored	As a result of Covid-19, storage within university sites is not a possibility. I will upload all stored data to a secure file on Coventry University's OneDrive system.		
		Planned disposal date	31/03/2021		

	If the research is funded by an external organisation, are there any requirements for storage and disposal?		X

Languages

Question		Yes	No
1	Are all or some of the consent forms, information leaflets and research instruments associated with this project likely to be used in languages other than English?		X

Laboratory/Workshops

Question		Yes	No
1	Does any part of the project involve work in a laboratory or workshop which could pose risks to you, researchers or others?		X

Research with non-human vertebrates

Question		Yes	No
1	Will any part of the project involve animal habitats or tissues or nonhuman vertebrates?		X

Blood Sampling / Human Tissue Analysis

Question		Yes	No
1	Does your study involve collecting or use of human tissues or fluids? (e.g. collecting urine, saliva, blood or use of cell lines, 'dead' blood)		X

Travel

Question		Yes	No
1	Does any part of the project require data collection off campus? (e.g. work in the field or community)	X	
	If YES: You must consider the potential hazards from off campus activities (e.g. working alone, time of data collection, unfamiliar or hazardous locations, using equipment, the terrain, violence or aggression from others). Outline the precautions that will be taken to manage these risks, AS A MINIMUM this must detail how researchers would summon assistance in an emergency when working off campus. For complex or high risk projects you may wish to complete and upload a separate risk assessment	Yes, in that I am in lockdown away from campus but there will be no face to face interaction, only virtual.	
2	Does any part of the project involve the researcher travelling outside the UK (or to very remote UK locations)?		X

APPENDIX B

Appendix B List

Appendix B3.1 Code for Study presentations in OMEDA PLUS

Page 1 of 39


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Page 2 of 39


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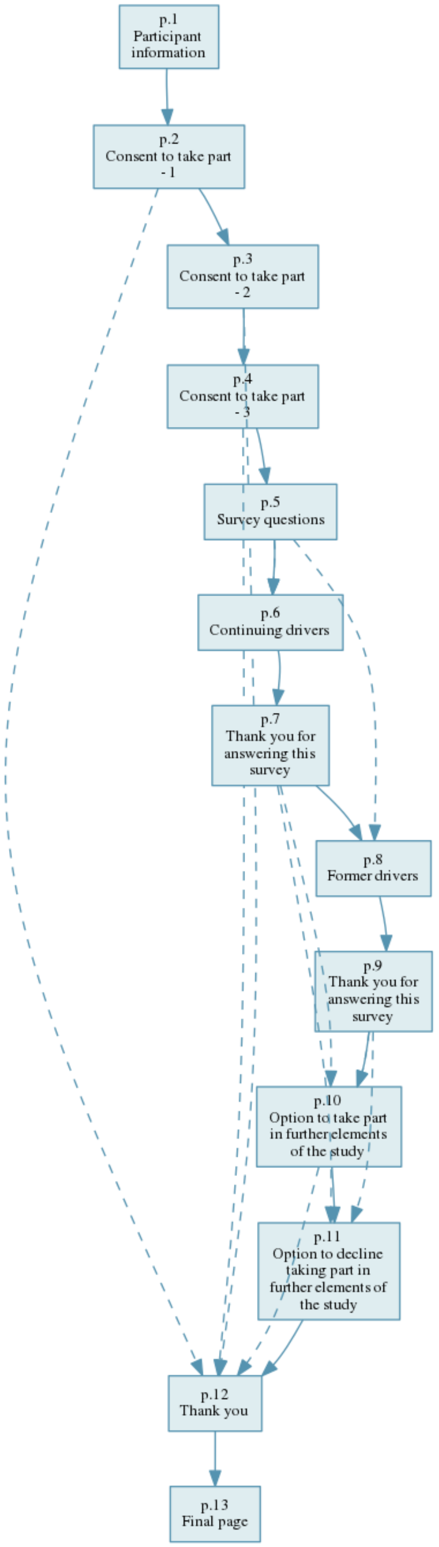
Appendix B3.2 Survey map for Study 1



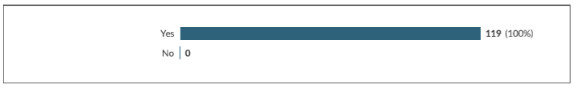
Appendix B3.3 The survey (anonymised)

Jisc Online surveys

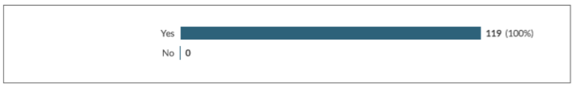
Driving Survey 2018

Showing 119 of 119 responses
With **5 responses excluded**
Hiding **10** questions
Response rate: 119%

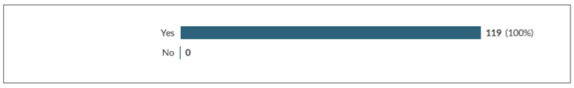
1 I have read and understood the information on the previous page.



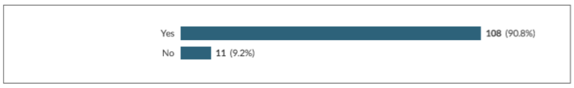
2 I confirm that I am aged 18 or over.



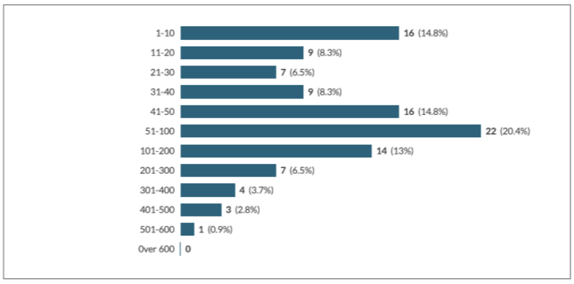
3 I agree to take part in this survey.



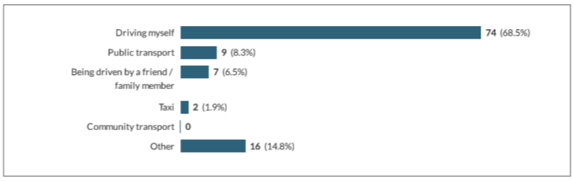
9 Do you still drive?



10 On average how many miles do you drive a week?



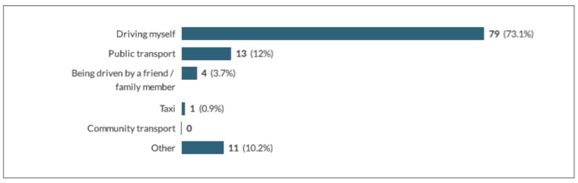
11 What is your preferred method of transport? (Please select the answer that is relevant).



11.a If you selected Other, please specify:

Showing all 16 responses	
Bicycle	420109-420100-41698946
Bicycle	420109-420100-41778161
Walking/Cycling	420109-420100-42010405
Cycling	420109-420100-42062607
Bicycle	420109-420100-42072788
bike	420109-420100-42076441
Walking	420109-420100-42077511
Bike	420109-420100-42081176
Bike - I cannot believe that this was not given as an option	420109-420100-42082749
pedal bike	420109-420100-42085275
Walking where possible	420109-420100-42085350
Walk	420109-420100-42102387
Bicycle	420109-420100-42104402
Walking	420109-420100-42678690
Bicycle	420109-420100-42678937
Cycling	420109-420100-42694771

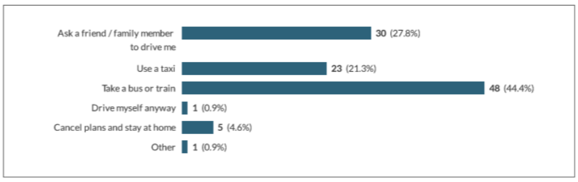
12 Which method of transport do you use most regularly? (Please select the answer that is relevant).



12.a If you selected Other, please specify:

Showing all 11 responses	
Bicycle	420109-420100-41698946
Bicycle	420109-420100-41778161
Bicycle	420109-420100-42072788
bike	420109-420100-42076441
Walking	420109-420100-42077511
As above	420109-420100-42082749
Walking	420109-420100-42085350
Walk	420109-420100-42090397
Bicycle	420109-420100-42104402
Bicycle	420109-420100-42678937
Cycling	420109-420100-42694771

13 If you had to attend an event but felt unsafe to drive yourself, what would you choose to do? (Please select the answer that is relevant).



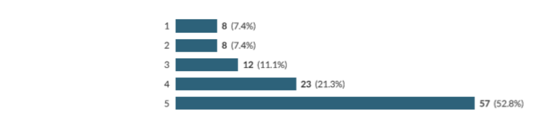
13.a If you selected Other, please specify:

Showing 1 response	
bike	420109-420100-42076441

14 Please rank the following statements from 1 to 5 where 1 is "not at all" and 5 is "a significant amount".

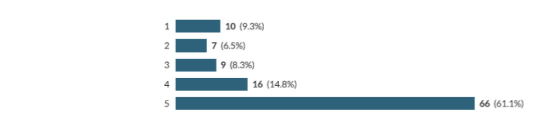
14.1 How important is driving to you in general?

14.1.a How important is driving to you in general?



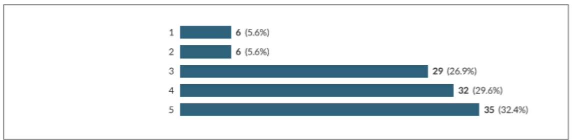
14.2 How important is driving to your independence?

14.2.a How important is driving to your independence?

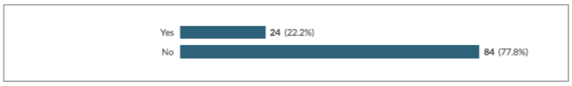


14.3 How much do you enjoy driving?

14.3.a How much do you enjoy driving?



15 Do you consider yourself to be an older driver?



15.a Please explain your answer.

Showing all 108 responses	
Experienced driver but not older	420109-420100-41687346
I'm in my twenties and have only been driving for ten years.	420109-420100-41687312
I don't feel "old"	420109-420100-41687966
I am a capable and confident driver	420109-420100-41689683
Anyone over 50.	420109-420100-41688800
Age	420109-420100-41692839
because I am not an old person	420109-420100-41694632
For insurance purposes, I was a 'young driver' up to about 25-30 yrs old. To consider myself an 'older driver' I'd put myself in the category when I'd need to start taking regular tests to ensure my competence - 70+?	420109-420100-41698946
I have only been driving for 8 years	420109-420100-41726815
I'm 32.	420109-420100-41778161
I'm young and fully capable to drive. I believe that nothing is obstructing my safe driving capabilities.	420109-420100-41794603
"Only" been driving seven years	420109-420100-41848906
As I'm nearly 80!	420109-420100-41867285
I’m 27	420109-420100-41876593
Being in my early 30s along with driving for under 20 years, I don’t consider myself an older driver.	420109-420100-41881174
In my mind, the term "an older driver" is for those around 70 or older, and the term has be coined as they may require additional tests/refreshers in order to maintain a suitable level of safety while driving.	420109-420100-41914190
not old	420109-420100-41918717
I would consider myself an older driver at 60+ years maybe? An age where I might be starting to/have developed long or short term health conditions that could impact my driving	420109-420100-41922563
I am 28	420109-420100-41935360
Compared to 4 grandsons24 to 17	420109-420100-41959476
My style and attitude to driving is the same as when I was in my thirties.	420109-420100-41960241

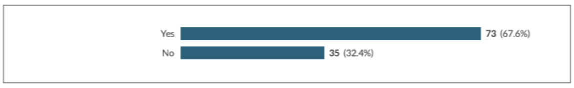
I'm older	420109-420100-41974387
I'm 64	420109-420100-41977782
Due to Age	420109-420100-41982958
26 is very young	420109-420100-41984398
I'm 31	420109-420100-41989414
I'm only 33	420109-420100-41991242
I'm getting older!	420109-420100-41992956
I'm Old	420109-420100-42010405
There are many drivers older than me	420109-420100-42019655
Experienced	420109-420100-42056571
It's kind of a dumb question. I'm just a driver.	420109-420100-42062607
I'm only 37	420109-420100-42072788
I don't consider being a young driver as I've driven over ten years but older makes me think of elderly drivers	420109-420100-42073542
I’m only 32!	420109-420100-42075464
I am 40 and have been driving since I was 17 so would describe myself as an experienced driver.	420109-420100-42075387
I don't feel I'm at a point where my reactions or judgement is impaired	420109-420100-42076441
Having more time, I don’t need to get from A to B as fast as possible, so I can walk or catch the bus instead, or drive more slowly	420109-420100-42076950
Because driving attitudes changed compared to when younger.	420109-420100-42076890
Not yet pension age	420109-420100-42077511
Over 40	420109-420100-42078622
Not yet	420109-420100-42078900
I have been driving for less than a decade.	420109-420100-42080279
I don't think I'm that old.	420109-420100-42081176
I would consider 60+ to be an older driver	420109-420100-42081079
I’m still in my early 40s	420109-420100-42081394
I would consider older drivers to be over 60	420109-420100-42081736
I’m only 62!!	420109-420100-42082644
I am not old	420109-420100-42082749
I do not think my age reflects on my drivingability	420109-420100-42082784
Middle aged i suppose.	420109-420100-42083880
Only 45	420109-420100-42084951

I have been driving for 22 year sand am 39, so don't consider myself old. Experienced though...	420109-420100-42085275
I'm older but no different	420109-420100-42085350
Because of my age	420109-420100-42086730
Only being in my 40’s I would not consider myself an older driver	420109-420100-42086813
I’m only just middle aged	420109-420100-42087131
I’m 36 years old	420109-420100-42087211
I’d consider myself to be an average aged driver.	420109-420100-42087324
I think an older driver might refer to someone who has retired? I think I’m an experienced driver which is a different thing.	420109-420100-42087542
I don’t think I’m older.	420109-420100-42087672
Still use a lot of old driving standards i.e. cars travelling down a hill take precedence over cars going up hill. It appears that current driving does not promote thus	420109-420100-42088236
I consider an "older driver" to be of retirement or later age	420109-420100-42090397
I think "older" refers to retirement age or older	420109-420100-42090569
I’m only 54!	420109-420100-42090743
I'm older than a younger driver but younger than an older driver. Never thought about it really.	420109-420100-42090887
I'm only 41!	420109-420100-42091716
I'm only 39 :)	420109-420100-42091719
I have been driving for nearly 40 years	420109-420100-42091465
I'm young - see above	420109-420100-42091906
Drive on a daily basis & consider myself competent not older	420109-420100-42092313
I have been driving for over 40years and have basically seen it all when it comes to car drivers/motorbikes/HGV drivers/cyclists/pedestrians-the good, the bad and the downright stupid ones.	420109-420100-42092279
I feel I'm still new to driving and the highway code, whereas older drivers, in my opinion, have dated knowledge of the road, driving slowly and badly.	420109-420100-42092455
I don't consider myself as old.	420109-420100-42094303
My licence permits me to drive more than a modern one does.	420109-420100-42095414
Getting there, but not older yet!	420109-420100-42099543
Recently passed my test, new driver.	420109-420100-42099769
I consider myself to be a very confident driver and had have taken an assessment with 90% pass	420109-420100-42101419
I’ve been driving 33 years, I have a lot of experience at urban and long distance travel I suppose I have more experience than the average driver.	420109-420100-42102387

I would say70 + to be older	420109-420100-42103202
I've been taught the new techniques for driving	420109-420100-42103700
At 48 I consider myself a middle aged driver.	420109-420100-42103917
I'm 34	420109-420100-42104402
I'm only 61!	420109-420100-42107619
I hope to still be driving in 50 years time!	420109-420100-42156941
I'm 34.	420109-420100-42208953
Not yet - maybe soon!	420109-420100-42678690
I'm middle aged, and have only been driving for 30 years, so I have 30 more to go, I hope. I'd consider older to be over retirement age.	420109-420100-42678937
I've only been driving for under a year so would say I am a fairly new driver.	420109-420100-42679230
I'm only 37! Experienced maybe, not old	420109-420100-42679471
Silly question? I am 79! Why is this answer a problem? If i did not consider myself to be an older driver, I would be delusional!	420109-420100-42679431
I drive every day . Over 65/70 would be an older driver	420109-420100-42680098
I am still working full time so don't consider myself to be an older driver	420109-420100-42681110
At just 48 I don't think I'm even close to halfway through my driving lifetime	420109-420100-42682386
Only passed 8 years ago, and there are drivers 50 years older than me on the road.	420109-420100-42682896
I'm 50 years old and there so many younger drivers on the road.	420109-420100-42682743
Been driving for 10 years, and been doing far more miles per year than anyone I've met who doesn't drive for a living.	420109-420100-42682815
I'm only 45 !	420109-420100-42684667
Need a definition of what 'older' constitutes...	420109-420100-42684893
I only really have four years experience of drivings so I consider that quite a young driver	420109-420100-42685098
I'm only 36 I consider older drivers to be 70+	420109-420100-42685189
Not old	420109-420100-42687463
No	420109-420100-42688423
Just my age!	420109-420100-42689612
Under the age of 65	420109-420100-42689892
I have been driving approximately 20 years, I often have my son in the car too. Which I think contributes to a more mature attitude and less risk-taking.	420109-420100-42690057

I do not feel that my age has yet produced significant enough deficits to affect my driving safety.	420109-420100-42693347
I would consider older drivers to be drivers over the retirement age.	420109-420100-42694771

16 Do you think that your driving style has changed as you have got older?



16.a Please explain how you feel it has changed.

Showing all 108 responses	
it hasnt changed	420109-420100-41687346
Become more experienced.	420109-420100-41687312
It has become less "impatient"	420109-420100-41687966
More aware of safety issues	420109-420100-41689683
Safer - not as mad. More considerate.	420109-420100-41688800
No	420109-420100-41692839
more confident, more careful	420109-420100-41694632
Less aggressive, more aware of the risks, more cautious. Also, I try not to 'let the car drive me'.	420109-420100-41698946
I have become more confident and able to read the road and other drivers much better.	420109-420100-41726815
With experience, I have become more relaxed.	420109-420100-41778161
more cautious	420109-420100-41794603
Smoother and more confident	420109-420100-41848906
It hasn't changed hence I said no!	420109-420100-41867285
Confident	420109-420100-41876593
Over the years realised the driving style of being more considerate is beneficial to all. In addition speeding just does not save enough time.	420109-420100-41881174
I'm far smoother as a driver	420109-420100-41914190
no	420109-420100-41918717
I have only been driving for 6 years	420109-420100-41922563
N/a	420109-420100-41935360

More wary	420109-420100-41959476
My driving style has not changed	420109-420100-41960241
I don't think it's changed	420109-420100-41974387
Longer reaction times. Dislike of modern traffic.	420109-420100-41977782
Feel the years of experience have made me a safer driver.	420109-420100-41982958
Less aggressive	420109-420100-41984398
Confident in my ability but aware I can always learn and improve	420109-420100-41989414
N/a	420109-420100-41991242
I'm more cautious.	420109-420100-41992956
Generally safer and slower	420109-420100-42010405
I don't feel it has changed	420109-420100-42019655
More experience	420109-420100-42056571
I got better at it. More experience, better able to anticipate situations. Also slowed down a bit, but that's about fuel economy and the environment	420109-420100-42062607
More careful, less speed, would never change CD / check phone anymore	420109-420100-42072788
I drive more slowly and safely now	420109-420100-42073542
N/a	420109-420100-42075464
I am slightly more cautious and aware of other drivers	420109-420100-42075387
better judgement	420109-420100-42076441
I drive more slowly	420109-420100-42076950
More careful, slower	420109-420100-42076890
I am more confident in driving in certain conditions. I also limit myself to driving I like.	420109-420100-42077511
No	420109-420100-42078622
Drive safer and more aware of dangers	420109-420100-42078900
I have got some bad habits that if I did during my test would mean that I would fail e.g. not always having both hands on the steering wheel.	420109-420100-42080279
Not sure if it's age or having children, but you become more aware of the dangers of driving, and generally are less concerned about getting to places in a hurry.	420109-420100-42081176
More considered	420109-420100-42081079
I have more experience of driving in other countries	420109-420100-42081394
More aware and alot more cautious	420109-420100-42081736
It has not changed	420109-420100-42082644
It has not!	420109-420100-42082749

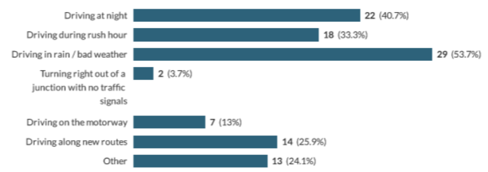
It has not changed really	420109-420100-42082784
More aware of other drivers and how they are driving.	420109-420100-42083880
More conscious of having to think for other drivers and anticipate their actions	420109-420100-42084951
it hasn't changed	420109-420100-42085275
It has not	420109-420100-42085350
I don't	420109-420100-42086730
I have become more confident on the roads and in difficult conditions, for example frosty weather.	420109-420100-42086813
More relaxed, calmer	420109-420100-42087131
I'm more cautious	420109-420100-42087211
I'm more aware of the dangerous on the road, other road users, pedestrians etc I think I've become more cautious.	420109-420100-42087324
I'm safer	420109-420100-42087542
I am more cautious, less aggressive.	420109-420100-42087672
Learnt how to parallel park properly, not taught when learning to drive	420109-420100-42088236
I am more patient	420109-420100-42090397
More cautious	420109-420100-42090569
Hasnt	420109-420100-42090743
I don't	420109-420100-42090887
It hasn't	420109-420100-42091716
Confidence diminished due to other drivers not obeying road rules so Im more anxious than when I first passed my test	420109-420100-42091719
I ride a Vespa 125 Scooter & I'm much more aware of road safety & other road users	420109-420100-42091465
Not changed	420109-420100-42091906
Safer	420109-420100-42092313
More observant and wary of my surroundings	420109-420100-42092279
I have improved and am more tolerant of other drivers.	420109-420100-42092455
I feel it is more or less the same, bit more confident, but that's only natural.	420109-420100-42094303
Less wreckless. Less powerful car. Own car so more careful.	420109-420100-42095414
Less hurried, more patient	420109-420100-42099543
It hasn't, only been driving months	420109-420100-42099769
Am still confident	420109-420100-42101419
Slowed down	420109-420100-42102387

I don't feel it has changed.. other than my confidence has grown..	420109-420100-42103202
I was quite aggressive when I started driving. I'm now more relaxed	420109-420100-42103700
I don't feel that it has changed.	420109-420100-42103917
More patient.	420109-420100-42104402
Less li,ely to break the speed limit and there afe mofe cameras around.	420109-420100-42107619
Perhaps I'm a bit more lax with treating the mechanics of the car well (grinding gears etc), less concerned by warning lights. But now I have a young baby so my driving has changed again - less laissez-faire!	420109-420100-42156941
Not sure - a bit more carefully.	420109-420100-42208953
No real change. Perhaps slightly more risk aware	420109-420100-42678690
Experience of near misses with careless drivers when cycling has made me particularly cautious to the point of driving such that others cannot put cyclists in danger near me.	420109-420100-42678937
New driver so still not much experience	420109-420100-42679230
More conscious of my speed	420109-420100-42679471
There is more traffic on the roads now, and i am more aware of the bad driving of people on mobile phones	420109-420100-42679431
More considered	420109-420100-42680098
It hasn't	420109-420100-42681110
Slower and safer	420109-420100-42682386
Less risky, less speed	420109-420100-42682896
I'm now very much more aware of what is going on around me while driving. I'm also better at foreseeing problems ahead.	420109-420100-42682743
More mindful, slower driving.	420109-420100-42682815
it hasn't	420109-420100-42684667
Having a child has made me more conscientious.	420109-420100-42684893
I am more conscious of other drivers and try to be more aware	420109-420100-42685098
It hasn't	420109-420100-42685189
More cautious	420109-420100-42687463
No	420109-420100-42688423
I am much more aware of other road users and speed limits.	420109-420100-42689612
I've always been cautious	420109-420100-42689892
More consideration for other road users, significantly more patience for cars being driven slowly	420109-420100-42690057
More defensive. Happier to hold back when other drivers are competitive or erratic.	420109-420100-42693347

More aware and more cautious	420109-420100-42694771

17 Sometimes people temporarily change their driving behaviour due to factors such as coping with a cold or being tired. Have you ever altered your driving in this way?

17.a Please select any driving situations from the following that you avoided as part of changing your driving behaviour.

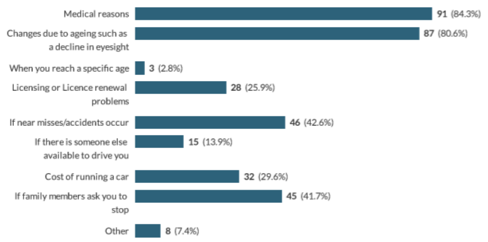


Multi answer: Percentage of respondents who selected each answer option (e.g. 100% would represent that all this question's respondents chose that option)

17.a.i If you selected Other, please specify:

Showing all 13 responses	
Dont change conditions - change approach	420109-420100-41687966
Wouldn't avoid driving - just take more care.	420109-420100-41688800
Following incidents, such as accidents witnessed or experienced, or fines for speeding, or immediately after seeing something like that happen to another driver.	420109-420100-41698946
Opening windows	420109-420100-41876593
Resting if tired or pulling over in downpours or high wind. Not driving if too much snow	420109-420100-42081394
Driving in snow	420109-420100-42082749
Stop for a rest or drink break on longer journey	420109-420100-42099543
None	420109-420100-42102387
I would drive more slowly rather than avoid	420109-420100-42103202
Cold, tiredness, other people in the car	420109-420100-42208953
I haven't avoided any driving situations, just drive slower at night or in rain and stop and rest when tired.	420109-420100-42682386
I'm aware of getting tired and will pull over for a sleep even if running late.	420109-420100-42682743
None	420109-420100-42684893

18 If you were to choose to retire from / stop driving, what factors might lead you to come to that decision? (Please select any from the following answers below that apply).



Multi answer: Percentage of respondents who selected each answer option (e.g. 100% would represent that all this question's respondents chose that option)

18.a If you selected Other, please specify:

Showing all 8 responses	
Access to good (quicker and cheaper) alternative transport	420109-420100-41689683
Political/environmental issues (which is why I cycle and no longer own my own car).	420109-420100-41698946
Envrionmental reasons	420109-420100-41778161
N/a	420109-420100-42102387
If I worked in my town and/or the trains were better, I would consider not driving now.	420109-420100-42208953
Lack of need.	420109-420100-42678937
If public transport were frequent/ comfortable/ reliable enough to mean I had no need to drive	420109-420100-42679471
Free public transport options were available with frequent and reliable service	420109-420100-42694771

18.b If you selected "when you reach a specific age", what age would this be?

Showing all 3 responses	
Depends. When my age negatively affects my driving ability.	420109-420100-41687312
60+	420109-420100-42010405
I think you should re take your test or a refresher lesson or two at 75	420109-420100-42087324

19 Have you ever thought about retiring from / stopping driving?

19.a Please explain why?

Showing all 11 responses	
Driving is boring/stressful, I would prefer to be doing something else	420109-420100-41689683
I thought of moving to another area when I am unable to drive, so I could walk to different places	420109-420100-41694632
Environmental reasons, and personal health. I did switch, but hire cars to drive on holiday/to special events with poor transport.	420109-420100-41698946
Environmental reasons.	420109-420100-41778161
I have stopped driving before as I lived in London for a few years	420109-420100-41935360
Dislike of modern driving conditions	420109-420100-41977782
Didn't need to travel much	420109-420100-42010405
I find it boring	420109-420100-42076890
I've thought about what I might do in the future when I become too old to drive safely.	420109-420100-42103917
It would be cheaper, it would be better for the environment.	420109-420100-42208953
Not to stop right now but being aware that the time will come to stop. I would not want to be a danger to others on the road	420109-420100-42689612

20 Do you wear glasses / contact lenses when you drive?

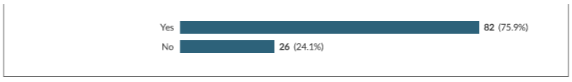
20.a What type of glasses do you wear when you drive? (e.g. sunglasses, standard presciption glasses, night vision glasses).

Showing all 67 responses	
dont wear glasses	420109-420100-41687346
Standard prescription glasses	420109-420100-41687312
none	420109-420100-41687966
Standard prescription glasses	420109-420100-41689683
Prescription contact lenses	420109-420100-41688800
Prescription only in the dark though	420109-420100-41692839
Standard prescription glasses / prescription sunglasses, depending on the weather.	420109-420100-41698946

standard prescription glasses; sometimes contact lenses	420109-420100-41778161
standard prescription glasses (short sighted)	420109-420100-41794603
Varifocals	420109-420100-41867285
Prescription & sunglasses	420109-420100-41876593
Standard prescription glasses	420109-420100-41914190
standard presciption	420109-420100-41918717
Standard prescription glasses	420109-420100-41922563
Varifocal	420109-420100-41959476
Varifocal prescription glasses	420109-420100-41960241
Standard prescription glasses	420109-420100-41974387
vari-focals standard prescription	420109-420100-41977782
standard prescription	420109-420100-41982958
prescription glasses	420109-420100-41984398
Standard Prescription	420109-420100-41992956
Sunglasses when it's sunny and driving into sun. Standard prescription at night in the rain (my uncorrected vision is OK for driving, but in certain conditions I feel happy with the slight correction of my glasses).	420109-420100-42062607
standard prescription anti glare	420109-420100-42073542
standard prescription glasses	420109-420100-42076441
Prescription varifocals	420109-420100-42076950
Prescription glasses	420109-420100-42076890
Standard prescription glasses	420109-420100-42078900
Prescription glasses and sunglasses.	420109-420100-42080279
standard perscription glasses	420109-420100-42081176
Standard varifocal glasses	420109-420100-42082644
standard presciption glasses or presciption sunglasses	420109-420100-42082749
Prescription glasses	420109-420100-42082784
Prescription glasses.	420109-420100-42083880
Prescription	420109-420100-42084951
Presciption	420109-420100-42085350
Standard prescription glasses	420109-420100-42087131
Prescription glasses	420109-420100-42087324
Standard prescription glasses	420109-420100-42087542

Standard prescription.	420109-420100-42087672
Varifocal prescription	420109-420100-42088236
Standard prescription (glasses or contact lenses)	420109-420100-42090569
Glasses or contact lenses	420109-420100-42091716
Prescription glasses	420109-420100-42091906
Prescription sunglasses	420109-420100-42092313
Varifocals and prescription sunglasses.	420109-420100-42092279
Prescription	420109-420100-42095414
Standard prescription glasses, prescription sunglasses if the weather requires me to.	420109-420100-42099543
Prescription	420109-420100-42099769
Standard prescription glasses	420109-420100-42101419
Lenses for short sight	420109-420100-42103202
Standard Prescription glasses/contact lenses.	420109-420100-42103917
Prescription glasses	420109-420100-42104402
Varifocals with reactolite and anti-glare	420109-420100-42107619
Standard prescription glasses	420109-420100-42156941
standard presciption glasses	420109-420100-42208953
Standard prescription	420109-420100-42678690
Standard Prescription glasses	420109-420100-42679230
Standard prescription varifocals	420109-420100-42679431
Contact lenses	420109-420100-42681110
Standard prescription	420109-420100-42682896
Standard contact lenses.	420109-420100-42682743
Prescription glasses or contacts.	420109-420100-42682815
my standard glasses	420109-420100-42684667
Standard prescription	420109-420100-42684893
Prescription Normal and Sunglasses	420109-420100-42687463
Standard prescription glasses	420109-420100-42688423
Standard prescription	420109-420100-42690057

21 Have you had an eye test within the last 12 months?



22 Have you been diagnosed as having a specific eye condition? (e.g. Astigmatism, short or long sightedness, cataracts).

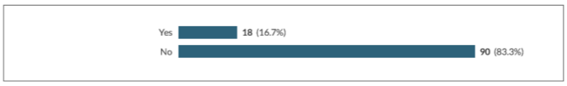
22.a If yes, please specify:

Showing all 57 responses	
Eye strain	420109-420100-41687312
Astigmatism, short sightedness	420109-420100-41689683
Short-sight	420109-420100-41688800
Minor astigmatism in left eye, myopia.	420109-420100-41698946
short sightedness	420109-420100-41778161
short sighted	420109-420100-41794603
Astigmatism, myopia, cataracts	420109-420100-41867285
Myopia	420109-420100-41914190
short	420109-420100-41918717
short-sightedness, astigmatism	420109-420100-41922563
Cataracts	420109-420100-41959476
Short sightedness	420109-420100-41974387
Astigmatism	420109-420100-41977782
Astigmatism	420109-420100-41989414
Cataracts	420109-420100-41992956
Astigmatism	420109-420100-42056571
Slightly long, slighly short, slight astigmatism	420109-420100-42062607
Long sighted	420109-420100-42072788
slightly short sited	420109-420100-42076441

Shirt sighted	420109-420100-42076890
Short sight	420109-420100-42078900
short sighted	420109-420100-42080279
Astigmatism, shortsightedness	420109-420100-42082644
Astigmatism & short sightdness.	420109-420100-42083880
Astigmatism, long and short sight (eyes are different) + developing cataract	420109-420100-42085350
Long sightedness	420109-420100-42086813
All of the above, recently prescribed varifocals	420109-420100-42087131
Astigmatism & long sightedness	420109-420100-42087324
Shirt sighted	420109-420100-42087542
Short sighted.	420109-420100-42087672
Short sighted	420109-420100-42088236
Astigmatism, short and long sightedness	420109-420100-42090569
Short sighted	420109-420100-42091716
Astigmatism corrected by operation	420109-420100-42091906
Both long and short sighted.	420109-420100-42092279
Short sight	420109-420100-42095414
Short sighted, astigmatism	420109-420100-42099543
Short sighted	420109-420100-42099769
Beginning of cataracts	420109-420100-42101419
Astigmatism	420109-420100-42103202
Short sighted	420109-420100-42103917
Astigmatism	420109-420100-42104402
Short sightedness and astigmatism	420109-420100-42107619
Short sightedness	420109-420100-42156941
Astigmatism and both long and short sightedness. (Eyes are different)	420109-420100-42678690
Astigmatism	420109-420100-42678937
Short Sightedness	420109-420100-42679230
AMD, one eye, checked by DVLA and passed fit to drive	420109-420100-42679431
Short sighted	420109-420100-42681110
Short sightedness	420109-420100-42682896
Short sighted	420109-420100-42682815
Astigmatism, short and long sighted	420109-420100-42684893

Astigmatism and short sighted	420109-420100-42685098
Astigmatism	420109-420100-42685189
Astigmatism and Short sighted	420109-420100-42687463
Astigmatism, short sighted	420109-420100-42688423
Astigmatism, long sightedness	420109-420100-42690057

23 Over the past year, have you had any near misses whilst driving? (e.g. Have you been in a position where you nearly had an accident but managed to avoid it?).



23.a Please describe what happened.

Showing all 18 responses	
Nearly hit a road traffic cone I had misjudged distance to as I looked at other road traffic	420109-420100-41687966
A vehicle pulled into the lane I was travelling in, forcing me off the road	420109-420100-41689683
Lordy got too close	420109-420100-41692839
I almost didn't see someone opening their car door in front of me because of foggy windows.	420109-420100-41778161
Car in front breaking hard. Had to slam on breaks	420109-420100-41876593
Car swung around roundabout without signally	420109-420100-41959476
I was driving in the night and talking with friends next to me. At a roundabout, a car suddenly stopped in front of me. I was alert by one of the passenger. Then I did emergency stop to avoid accident happen.	420109-420100-41984398
Black ice	420109-420100-42056571
Someone pulled out in front on me but managed to stop in time	420109-420100-42078900
Someone was honking their horn at me at a roundabout because I hadn't moved quick enough for them. Once we were off the roundabout, the driver swerved into me to try and scare me. I had to move over to avoid being hit.	420109-420100-42080279
Someone driving too fast in a 30. I pulled out when safe to do so and the other driver drove faster in the 30 zone and overtook me while I was doing 30!	420109-420100-42081736
Nearly hit by another car which was turning the wrong way (when there was a no right turn sign) at a junction.	420109-420100-42085275
Car pulled out in front of me	420109-420100-42088236
I frequently avoid accidents by applying my brake. I drive in the city every day and it's a bit mad	420109-420100-42090887
Car pulled out quickly from parked position onto a 30 road in front of me without looking or indicating but I managed to	420109-420100-42091719
Another driver pulled out in front of me on a motorway without indicating	420109-420100-42092313
Was in Lane 1 on the motorway and a lorry moved into my lane when he was alongside me so I was forced to run into the hard shoulder to avoid him hitting me	420109-420100-42104402
Other road user went to change lane without looking in driver-side blind spot. Used horn to audibly notify driver of my presence and I safely changed lane (it didn't feel possible to safely apply the brakes in my car)	420109-420100-42690057

24 Over the past year, have you been involved in an accident whilst driving?

24.a Were you seen to be at fault by police or other parties?

25 During your driving career, have you had any near misses or accidents that have affected your attitude to driving?

25.a If yes, please describe how your attitude has changed:

Showing all 50 responses	
I've bought cars with clearer blind spots.	420109-420100-41687312
I hit a stationary car in front of me at a junction when I was anticipating they would exit the junction and they did not move. Now I don't anticipate movement even when I judge that the individual should/would move	420109-420100-41687966
More aware of speed and stopping distances	420109-420100-41689683
Stopped talking on loudspeaker as didn't realise it was so distracting	420109-420100-41692839
diesel on the road	420109-420100-41694632
I became far more cautious, giving longer lead times to manoeuvres and leaving more space between my vehicle and others'.	420109-420100-41698946
I have become more careful.	420109-420100-41778161
Other road users are idiots & make experience unsafe	420109-420100-41876593
Caution when icy	420109-420100-41959476
Dislike of modern driving conditions	420109-420100-41977782
Keep more distance	420109-420100-41984398
I live down a lane next to an A-road with poor visibility, pulled out and there	420109-420100-41989414

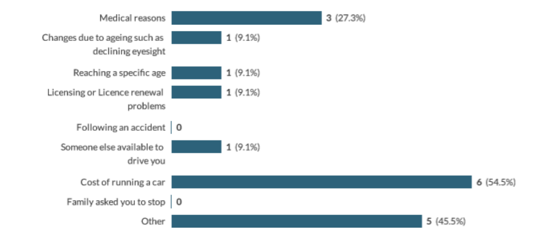
was a car that I hadn't seen, they braked hard and I accelerated so no harm, but I now wait longer to be certain - sometimes too long - when pulling out	[illegible]
Honestly, Can't really remember but Ice affected my driving	420109-420100-42010405
A near miss has made me more cautious and vigilant	420109-420100-42019655
More cautious	420109-420100-42056571
Motorway crash, my fault. Do not do things like change CDs anymore	420109-420100-42072788
Made me drive slower on motorways	420109-420100-42073542
somethings made me concentrate more	420109-420100-42076441
I realised how tiredness can affect my driving	420109-420100-42076950
Taking less risks with speed and overtaking	420109-420100-42076890
Be more aware, drive slower	420109-420100-42078900
Attitude didn't change as much as it was a reminder to be more vigilant and aware of potential hazards.	420109-420100-42081079
Too much rain on the motorway causing me to aquaplane. If the rain is heavy I'll pull over. Also I won't drive a small car on a motorway as I did this once and nearly had an accident due to lorries passing me.	420109-420100-42081394
I drove into the back of someone at slow speed but it was at fault.	420109-420100-42081736
More aware of other drivers on the road, and what how they are driving.	420109-420100-42083880
I skidded on ice when I was 18 and slowed down and drove more carefully	420109-420100-42085275
As a young driver I was shunted from behind at traffic lights. Ever since I have ensured I slow down in plenty of time to give other drivers warning of my intention to stop	420109-420100-42086813
Being more aware of the risks of other motorists bad driving as a result of having my car written off due to a lorry driver not considering how far his trailer would swing into my lane whilst turning.	420109-420100-42087131
More cautious when driving in the rain as rain was a contributing factor in my only accident in nearly 20 years of driving	420109-420100-42087211
I've been in a car driven by someone else that was involved in an accident, barely any contact made between vehicles but other driver claimed whiplash etc, I'm very cautious about breaking/stopping distances.	420109-420100-42087324
I became much more cautious. Left more space between me and the cars in front	420109-420100-42087542
An articulated lorry misjudged a roundabout and drove up my near side wing I now am very aware of large lorries and how they are turning	420109-420100-42088236
More cautious, allow more braking room, and I expect other people to be less predictable. I drive much slower in wet conditions and wont drive at all in the snow.	420109-420100-42090569
A cyclist at a roundabout that I didn't see until last second has made me look harder for cyclists.	420109-420100-42090743

I am even more aware of other drivers taking unnecessary risks	420109-420100-42091716
Other people who don't look, signal, go through red lights or are aggressive when driving make me anxious and spoiled the joy of driving :(	420109-420100-42091719
Riding a motorcycle I'm much more aware of road safety. I complete a 3 hour CBT practical test every 2 years which is good revision & made more aware of driving safely. Also when I drive the works car I believe I'm now more aware of other drivers on the road especially motor cyclists	420109-420100-42091465
More cautious now	420109-420100-42092313
Another driver was in the wrong lane when approaching traffic lights & cut in front of me from the right hand side & bumped my car (which was in fact the 2nd day I had my very 1st car & I was out driving to get a feel to it. Wasn't pleasant).	420109-420100-42094303
Always take note of bend signs and other drivers' unpredictability	420109-420100-42095414
Tired on the motorway and lost concentration resulting in a near miss. Will now stop for more breaks.	420109-420100-42099543
I am much more careful when overtaking on single carriageway roads	420109-420100-42104402
Sometimes not, sometimes made me drive more carefully at least for a while.	420109-420100-42208953
Temporary, brief caution	420109-420100-42678690
I cycle a lot, so I meet a lot of idiots who have nearly killed me on many occasions.	420109-420100-42678937
Near misses in the past, particularly on motorways/ fast roads have led me to decrease my own speed and increase the distance I leave between car in front	420109-420100-42679471
Become more aware of the potential of other drivers making unexpected manoeuvres	420109-420100-42684893
I am more vigilant about other drivers and tend to drive slower in certain conditions	420109-420100-42685098
Received a 12 Month ban for dangerous driving when I was 22. I didn't drive for 5 years, when I felt ready to drive again, I felt more mature and ready to be behind the wheel again.	420109-420100-42690057
Aware of how fast things can get out of control when driving at the wrong speed for the situation	420109-420100-42694771

27 At what age did you stop / retire from driving?

Showing all 11 responses	
22	420109-420100-42081735
0	420109-420100-42082597
67	420109-420100-42084405
19	420109-420100-42091674
19	420109-420100-42093826
48	420109-420100-42097202
60	420109-420100-42106673
50	420109-420100-42540389
22	420109-420100-42675616
31	420109-420100-42681939
90	420109-420100-42685214

28 What factors led to you choosing to stop / retire from driving? (Select all relevant answers)



Multi answer: Percentage of respondents who selected each answer option (e.g. 100% would represent that all this question's respondents chose that option)

28.a If you selected Other, please specify:

Showing all 5 responses	
Not needed in central London	420109-420100-42081735
Never been able to afford a car.	420109-420100-42091674
No longer needed a car, living very centrally.	420109-420100-42540389
Gone out of practice + fear	420109-420100-42675616
Lack of practice has made me nervous about my abilities	420109-420100-42681939

29 When you stopped / retired from driving, did you consider yourself to be an older driver?

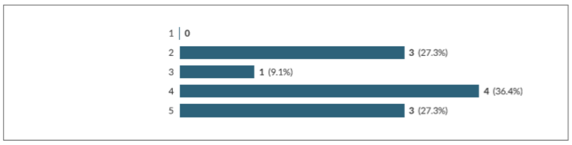
29.a Please explain your answer.

Showing all 11 responses	
Don't consider an 'older driver' until retirement age	420109-420100-42081735
N/a	420109-420100-42082597
I think 67yrs would be considered old.	420109-420100-42084405
At 19, you're not an old driver.	420109-420100-42091674
I was still a teenager	420109-420100-42093826
It was a voluntary decision	420109-420100-42097202
because I was in my 60s. now you get people driving in 80s and 90s so you can't really forsee who is young/old. If I had better eyesight, I would like to drive as its easier to get to places if I want to go out. Also If you don't tell the insurance company, it makes your licence invalid.	420109-420100-42106673
I am still young.	420109-420100-42540389
I am not old.	420109-420100-42675616
I was in my early 30s	420109-420100-42681939
Felt it was time to stop, vision and hearing not as good any more, and physical effects of aging reducing response times.	420109-420100-42685214

30 Please rank the following from 1 to 5 where 1 is the least and 5 is the most.

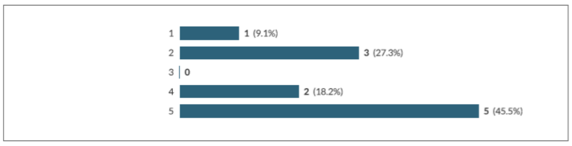
30.1 How important was driving to you in general?

30.1.a How important was driving to you in general?



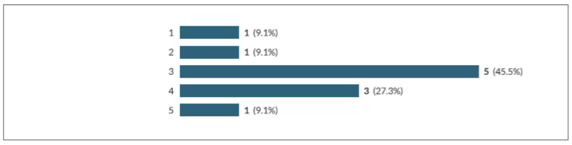
30.2 How important was driving to your independence?

30.2.a How important was driving to your independence?

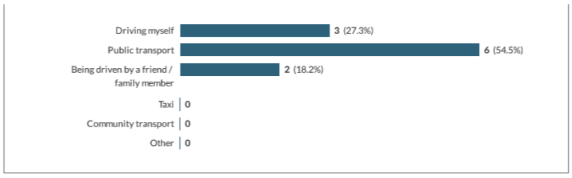


30.3 How much did you enjoy driving?

30.3.a How much did you enjoy driving?



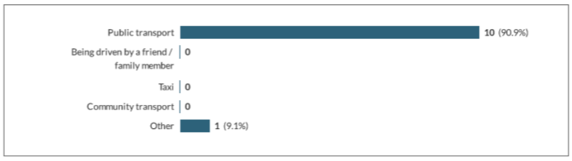
31 Before retiring from / stopping driving, which method of transport did you use most regularly? (Please select the relevant answer).



31.a If you selected Other, please specify:

No responses

32 What is your preferred method of transport now? (Please select the relevant answer).

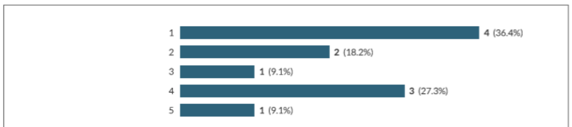


32.a If you selected Other, please specify:

Showing 1 response	
Walking.	420109-420100-42540389

33 On a scale of 1 to 5, with 1 being "Not affected at all" to 5 being "Very significantly affected", how has retiring from driving affected your lifestyle?

33.1 How big an impact has retiring from driving had on your lifestyle?

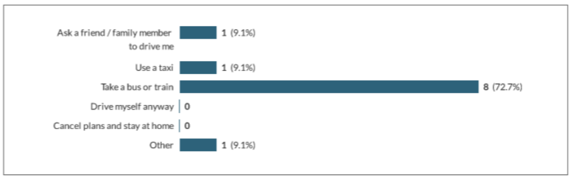


Multi answer: Percentage of respondents who selected each answer option (e.g. 100% would represent that all this question's respondents chose that option)

33.a Please explain your answer:

Showing all 11 responses	
Wouldn't be able to drive to work in London due to traffic and parking, wouldn't drive to socialise often as then I wouldn't be able to drink	420109-420100-42081735
N/a	420109-420100-42082597
Lose of independence having to ask to go to done places.	420109-420100-42084405
I can still get around, I live in a metropolitan area with good public transport. Also, my wife drives, so there is that option when required.	420109-420100-42091674
incredibly pleased with the local transport links in my local area	420109-420100-42093826
Has restricted my freedom to travel to new places away from population centres.	420109-420100-42097202
tied us down a lot as to go for a day out it has to be a holiday coach. Don't go out as much as we did when we we had a car. i do miss a car very much as it gives you the independence to do something. we used to go out to Wanstead and Woodford to the club. We got about because we had wheels.	420109-420100-42106673
I now live within walking distance of almost everywhere I want to be (living in centre of town)	420109-420100-42540389
I lost a lot of independence.	420109-420100-42675616
There are some things which would be made easier by driving but not driving doesn't stop me from doing anything completely. I'm lucky to live in a city with very good public transport so can get where I need to go.	420109-420100-42681939
Restricted in where I can go and when, due to rural bus timetables, or reliant on family member to take me on a day off or weekend.	420109-420100-42685214

34 Prior to stopping / retiring from driving, if you needed to travel somewhere but felt unsafe to drive yourself, what would you have chosen to do? (Please select the relevant answer).

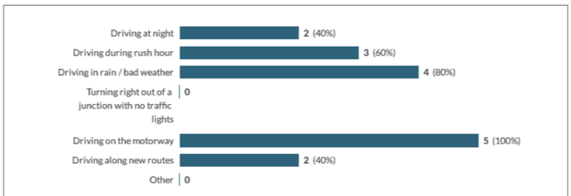


34.a If you selected Other, please specify:

Showing 1 response	
Never felt unsafe. Taxi or public transport good alternatives.	420109-420100-42540389

35 Before you decided to stop / retire from driving, were there any specific driving situations you chose to avoid?

35.a Below are a list of driving situations. Please select all relevant situations that you would have chosen to avoid.



Multi answer: Percentage of respondents who selected each answer option (e.g. 100% would represent that all this question's respondents chose that option)

35.a.i If you selected Other, please specify:

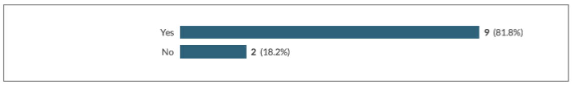
No responses

36 Did you wear glasses / contact lenses when you drove?

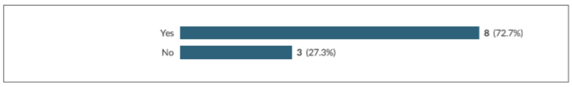
36.a What type of glasses did you wear when you drove? (e.g. sunglasses, standard prescription glasses, night vision glasses).

Showing all 6 responses	
Standard prescription	420109-420100-42081735
Standard prescription glasses.	420109-420100-42084405
standard prescription	420109-420100-42093826
Standard prescription glasses	420109-420100-42675616
Standard prescription glasses / contacts	420109-420100-42681939
Standard prescription, reactolite rapides	420109-420100-42685214

37 Have you had an eye test within the last 12 months?



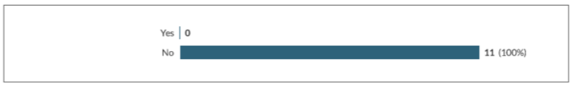
38 Have you been diagnosed as having a specific eye condition? (e.g Astigmatism, short or long sightedness, cataracts).



38.a If yes, please specify:

Showing all 8 responses	
Astigmatism	420109-420100-42081735
Just the beginning of a cataract.	420109-420100-42084405
Eye pressure above average in my right eye.	420109-420100-42091674
astigmatism, short sighted	420109-420100-42093826
told about cataracts about a year ago. Had a check up, and doing ok. get eye strain. Have glasses now.	420109-420100-42106673
Long sight.	420109-420100-42540389
Short sighted	420109-420100-42681939
Long sighted, macular degeneration	420109-420100-42685214

39 During your last year of driving did you have any near misses whilst driving? (e.g. a time where you nearly had an accident but managed to avoid it).

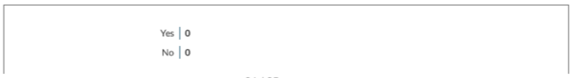


39.a Please describe what happened.

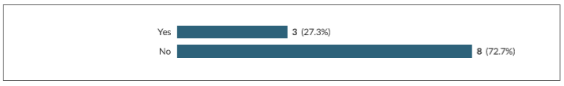
No responses

40 During your last year of driving did you experience any accidents where you were the driver?

40.a Were you seen to be at fault by police or other parties?



41 During your driving career, did you have any near misses or accidents that affected your attitude to driving?



41.a If yes, please describe how your attitude changed:

Showing all 3 responses	
Driver opened his door without looking and damaged bonnet and passenger door.	420109-420100-42084405
Minor car dings and maintenance costs made me reassess whether I still needed the bother and expense of a car.	420109-420100-42097202
I became more scared and less confident of driving alone.	420109-420100-42675616

Appendix B3.4 DHQA

Driving habits questionnaire **Participant No:**

Date **Date of birth**

Time **Are you left or right handed?**

1. When did you get your driving licence?
2. How many drivers are there in your household?
3. Are you the main driver in your household?
4. When was the last time you drove?
5. How many miles on average do you drive a year?
6. How many accidents or small bumps have you been involved in over the last 2 years? (Whether you were seen to be at fault or not):

Small bumps (Total cost of repairs below £500. Backing into posts etc.)

Accidents – (Total cost of repairs above £500)

7. Please describe the **last bump** or accident you were involved in (even if it was more than two years ago and even if you were not at fault):
8. What was the incident you described above? (Please tick as appropriate)

A small bump ☐ An Accident ☐

9. When did the incident you described above take place? (Be as accurate as you can)

Year Month

(Please turn over the page)

10. How fast do you usually drive compared to the general flow of traffic? (Please tick one answer)

☐ Much faster
☐ Somewhat faster
☐ About the same
☐ Somewhat slower
☐ Much slower

11. Compared to all other drivers you see on the road, how safe a driver are you? (Please circle one number):

Much worse				*The Same*			*Much better*	
1	2	3	4	5	6	7	8	9

12. Compared to all other drivers, how good are you at driving to an unfamiliar destination without getting lost? (Please circle one

Much worse				*The Same*			*Much better*	
1	2	3	4	5	6	7	8	9

Appendix B3.5 DHQB

Participant No:

Driving habits questionnaire

Date

TimeA t or right handed?

1. When did you get your full driving licence?

2. Do you still drive? Yes ☐ No ☐

3. How many miles on average do / did you drive a year?

4. On average, how many days a week do you / did you drive? Please circle a number **1 234567**

4b. If less, please state how often:

5. How many accidents or minor bumps have you been involved in over the last 2 years? Or if you no longer drive, in your last 2 years of driving? (Whether you were seen to be at fault or not):

Minor bumps - (Backing into posts etc.)

Accidents

6. Please describe the last minor bump or accident you were involved in (even if it was more than 2 years ago).

7. When did the incident you described above take place? (Be as accurate as you can)

8. How confident a driver to you feel you are? (1= not confident at all, 5 = extremely confident)

The following questions may appear personal but we are asking them so that we can see if there is an effect upon the OMEDA test when people have illnesses or take medication that might affect driving from time to time. This information will remain confidential, and will not be shared with any other bodies in such a way that you will be identified. Once completed, this form will be uploaded to a securely protected file, and the paper copy will be destroyed.

Please ignore these questions if they do not apply to you.

9. Please list any illnesses that you experience:

10: Please list any medication that you take:

Appendix B3.6 DHQC

Thank you for showing interest in taking part in this research. Once you have read through the Participant Information sheet and the consent form (stating your agreement to participate within your return email will represent your consent), it would be helpful if you would complete and return this short questionnaire.

It just asks questions to understand a little about your driving experience, and about who you are. Please only share information that you are happy to share, but please try to be as accurate as you can.

The easiest way to respond to this questionnaire would be to:

1. Click reply on this email
2. Make deletions and responses within the text before you
3. Click send.

Thank you for your support.

Introductory Questionnaire

Thank you for agreeing to take part in this research. Once you have acknowledged the Participant Information sheet and the consent form, it would be helpful if you would complete and return this short questionnaire.

It asks questions to understand a little about your driving experience, and about who you are. Please only share information that you are happy to share.

INFORMATION ABOUT YOU

Please answer the following questions about yourself. Please delete any answers that are not relevant to you.

1. Gender (Please delete as appropriate):
· Female
· Male
· Other

2. Date of birth:

CAR DRIVING EXPERIENCE

3. Do you have a UK driving licence?
· Yes
· No

4. Do you still drive?
· Yes
· No

2. How many years have you had your driving licence?

3. On average, how many hours do/did you spend driving in a day?

4. How many days per week do/did you drive per week?

5. How often do you typically drive on the following types of roads? (**A=Daily, B=2/3 times a week, C=once a week, D=Monthly, E=Rarely**)
Urban/city roads - A B C D E
Suburban/rural - A B C D E

Single carriageways - A B C D E
Motorways/highways - A B C D E

6. Have you been involved in any crashes whilst being the driver?

7. What age(s) were you when these occurred?

8. Did you require any support from emergency services?

9. Were you considered to be at fault?

Driving Ability and Confidence
7. Please rank your driving ability (from 1 “less skilled” to 5 “more skilled”) in comparison to the 'average' driver you would see every day (skill does not just include physical driving ability; it also includes factors like road awareness and following the road rules).

1 2 3 4 5

8. On a scale ranging from 1 to 5, (1 being very unconfident, 5 being very confident), how confident do you feel while driving in your local area and any other areas you frequently drive in?

1 2 3 4 5

Consent decision
*I Agree to take part in the study / I would prefer to not take part in the study (*Please delete as appropriate - Due to Covid-19, your agreement within this email will be taken as the equivalent of you signing the consent form).

Thank you for completing the above questionnaire. If you are interested in continuing to take part, I will send you some more details in advance of our arranging an interview over Skype at a time that is convenient to you.

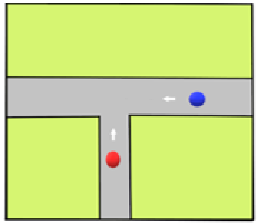
Please return this with your consent decision to:

Appendix B3.7 Interview Schedule drivers Study 2

INTERVIEW SCHEDULE – Drivers

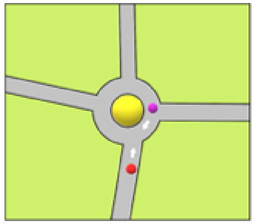
1. **How did you find the tests on the computer?**
2. **According to the questionnaire you have had your driving licence for X years, on a scale of 1 to 5 where 1 is not confident at all and 5 is extremely confident, how confident a driver would you say you are?**

3. **What do you think contributes to that level of confidence?**
    - (Years driving / amount of driving each week / age?)
4. **What sort of trips do you generally use the car for?**
5. **Can you describe your favourite driving trip?**
    - What is it that you like about it?
    - Are there any difficult parts of the journey?
6. **What is the least favourite journey that you have to drive?**
    - What do you not like about it?
7. **Are there any conditions that you choose to avoid driving in?**
    - (Weather, times of day etc.)
8. **Does this change if you feel unwell or tired?**
9. **Do you have any specific difficulties when you drive now that you didn't have when you first started to drive?**
    - Are there any changes in mobility or vision that have developed since you first started driving?
10. **Look at this image of a junction.**



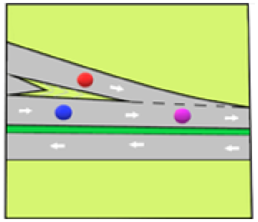
- Have you ever had any accidents or near misses at a junction? What happened?
- If yes, why do you think it happened?

11. **Look at this image of a roundabout.**



- Have you ever had any accidents or near misses at a roundabout?
- What happened?
- If yes, why do you think it happened?

12. **Here is an image of the same red car merging onto the motorway.**



- Have you ever had any accidents or near misses when merging onto the motorway?
- What happened?
- If yes, why do you think that it might have happened?

Appendix B3.8 Interview Schedule Study 4

Interview Schedule

Driving status

1. Are you still driving at the moment?
   If no - what is it that led to you deciding to stop driving?
   If yes – you mentioned that you were thinking of stopping.
   What sort of things have led to you thinking about doing this?

2. Do you feel that your driving has changed since you first started?
   Skills
   Confidence
   Enjoyment
   Use of the car

3. How do you feel that stopping driving will / has affected you?
   Lifestyle
   Sense of identity
   Sense of independence

4. Would you consider yourself to be an “older driver”?
   What is it that makes someone an older driver?

5. Would you consider yourself to be an “experienced driver”?
   What is it that makes one person a more experienced driver than another?

6. What is your understanding of the term “Fitness-to-drive”?
   What is it that makes one person more fit to drive than another?

OMEDA

Don’t worry if not, as we can take some time to look at it now, but have you had much time to look at the fact sheet on OMEDA?
Did you get a chance to look at the recording?

7. What were your first thoughts about it as a test of safe driving ability?

8. Would you consider taking this test to see if you were safe to drive?
   Please explain your answer.

9. How physically comfortable would you be using the computer set up as shown in the image on the fact sheet?
Please explain your answer
Pedal / hand button

10. If the test gave you a score that represented your fitness-to-drive would you trust the score?

11. Would this score change the way in which you drove?

12. Would you give up driving if it claimed that you were unsafe?

13. Would you say that this test has a relevance to your situation, or the situation you were in before you decided to give up driving?

14. If this test was available, would you recommend this to a friend who was considering ending their driving career?

15. Would you take it yourself?

16. How would you feel if a member of the family suggested you take it?

17. How would you feel if your doctor suggested it?

18. How would you feel if it were part the licence renewal process?

19. Is there anything about the existence of a test like this that worries you?

20. Do you see any advantages to the existence of a test like this?

Appendix B3.9 OMEDA (PLUS) Factsheet

OMEDA Fact Sheet

OMEDA is designed to represent the complex environment of an intersection in a simple 2-dimensional form. The test is presented on a computer or laptop screen, and responses made using a hand button and a foot.

The OMEDA test is divided into 2 parts and examines the fitness to drive of users. It measures:

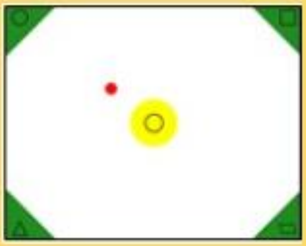
- **The ability to judge when an object reaches the centre of the screen.**
- **The ability to judge when two objects will collide should no aversive action be taken.**
- **The test takes approximately 20 minutes to complete, and each test is preceded by a practice session.**

Part 1:

The first thing that the participant is asked to do is to press the foot pedal at the **exact** time at which the red object reaches the centre of the screen (whether it can be seen or not).

At the same time, the outline of a shape appears in the centre of the screen, and around each of the green edges of the screen.

If the shape in the centre matches at least one of those around the edge, the participant is asked to press the hand button.

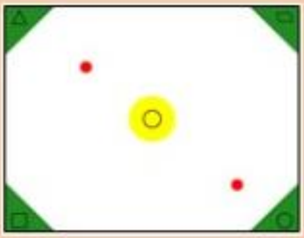


Part 2:

Here the participant is asked to press the foot pedal at the **exact** time at which the red objects are judged to crash (again whether the crash can be seen or not).

At the same time, the outline of a shape appears in the centre of the screen, and around each of the green edges of the screen.

If the shape in the centre matches at least one of those around the edge, the participant is asked to press the hand button.



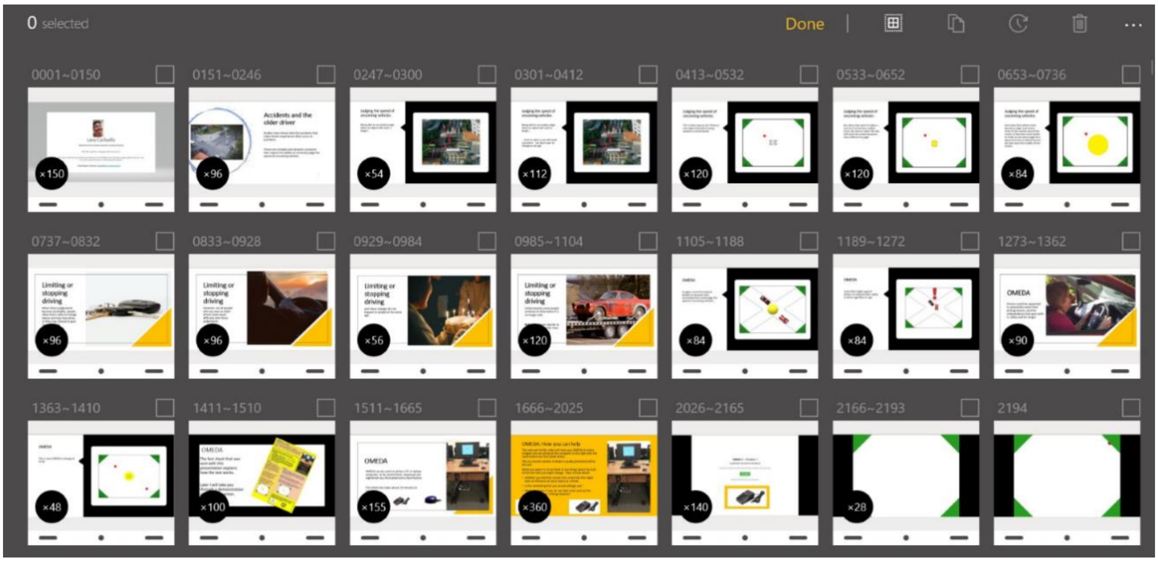
Please click on the link below to view a working video showing the two parts of the test in action:

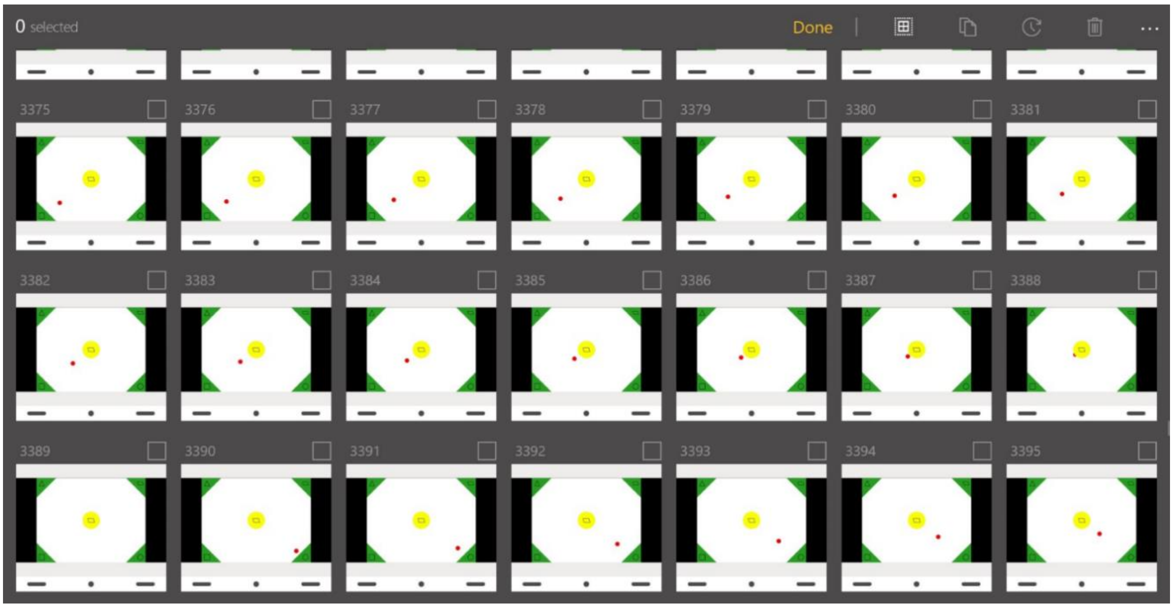
Appendix B3.10 Script for video Study 4

	Hello. I'm Lara. I just wanted to take the time to introduce myself, and to thank you for showing an interest in my research. This video has been put together in preparation for our interview should you wish to take part.
0141	Studies have shown that older drivers experience a high proportion of accidents at complex road junctions.
0237	Being able to judge when an object will reach a specific target.
0291	Such as a car reaching a junction, has been seen to change as we age.
0403	This judgement is fairly easy to estimate if we are looking at one object moving towards a central point As in the case of the red dot here
0523	But when that central point is hidden by a yellow circle, the judgement becomes more difficult to make.
0643	Increase the size of that circle, and an accurate judgement becomes even harder.
0727	When these judgements become unreliable, people often begin to change how they drive, with some choosing to give up completely.
0823	Not all people who are seen to be older drivers experience the same changes in their judgements of oncoming vehicles.
0919	And changes don't happen to all individuals at an identical age.
0975	Arguably because of this, some people continue to drive when it is no longer safe, whilst others stop earlier than they may perhaps need to.
1095	But, imagine a test that helped people to measure how accurately they could judge the speed of an oncoming vehicle.
	A test that might support drivers to measure their safety to drive – regardless of chronological age.
1263	Drivers could potentially be supported to retain their driving licence, and the independence that goes with it, safely and for longer.
1353	This is what OMEDA is designed to do
1401	The fact sheet that was sent with this video describes how OMEDA works. But here, I can show you what it looks like in action.
1501	OMEDA can be used on either a desktop or laptop computer. Responses are made by pressing a foot pedal and a hand button, and the test usually takes about 15 minutes to complete.
1656	Whilst watching OMEDA in action, please keep a few things in mind. For instance, is there anything about the way that the test looks that you might change?
1656b	But more importantly, think about whether or not you feel that the results of a test such as this might have either influence or relevance to your current driving status. Is this a test that you might have considered using to support your decision to either continue or stop driving?
2016	The test starts with a series of practices. This first one helps the participant to get used to the foot pedal. At this point, and during OMEDA Test 1, the participant is asked to press the foot pedal at the exact moment the red object reaches the centre of the screen.

	This central point is sometimes, but not always, hidden by a yellow circle of variable size. The participant is asked to make a judgement about the object's arrival to the centre of the screen.
2375	The second practice introduces the hand button. This is pressed when the black shape in the centre of the screen matches at least one of those around the edge. This represents an additional layer of complexity reflecting the divided attention experienced whilst driving. There is not always a match, meaning the hand button is not always pressed.
2704	Here we see OMEDA TEST 1. Again it asks the participant to carry out each of the tasks mentioned in the practices – but here…they are presented at the same time. We see the red dot move towards the centre of the screen at which point the foot pedal is to be pressed – whether it is hidden or not. In addition we see the shape appear at the centre and around the green edges. The hand button is pressed as soon as a match is noticed. There is not always a match.
3116	This is followed by OMEDA TEST 2. This introduces a second object. Here the food pedal is pressed at the exact moment that the objects are judged to collide – again whether they can be seen or not. The objects move at constant speeds but at different speeds to each other. The objects do not always collide, meaning that the foot pedal does not need to be pressed. The second matching task, identical to that in OMEDA TEST 1, remains.
Thank you	Thank you for taking the time to watch this video. I hope that it has given you an idea of what the research includes. If you have any questions, please email me at the address below. If you are happy to join me in an interview, please complete the questionnaire and consent form sent with this video within the next 4 days. We can then arrange a time that would be convenient. Thank you for your time today. I look forward to chatting with you.

Appendix B3.11 Screenshots for video Study 4

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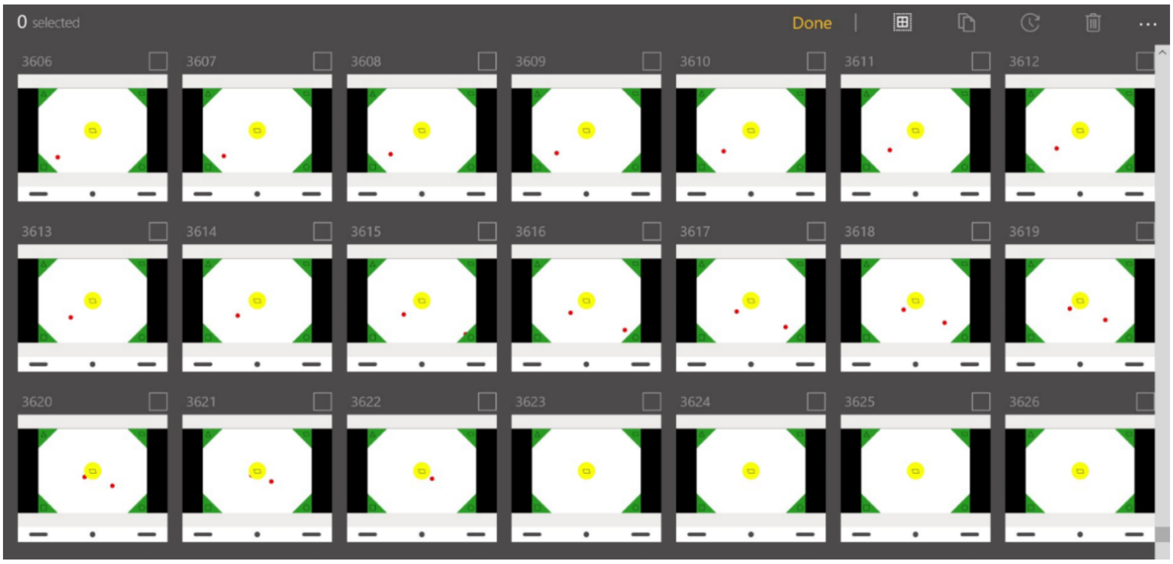
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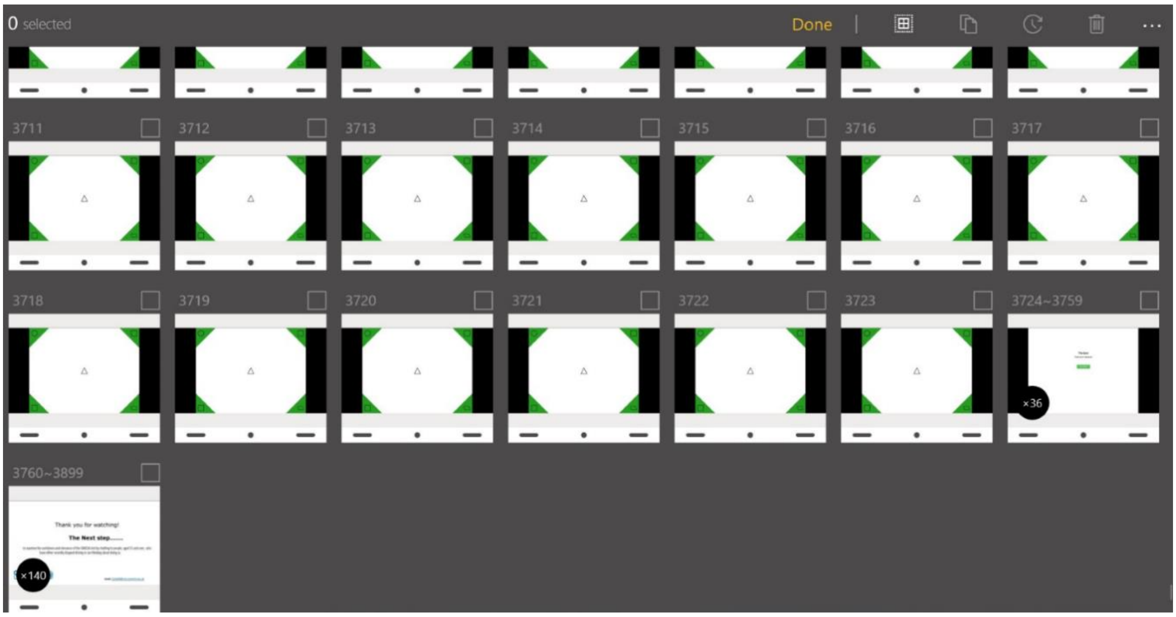
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3760~3899
×140

Appendix B4.1 Themes emerging from Study 4 interviews

Codes retained	Subordinate codes
Accidents	Causes and effects
Ageing	Attitudes and descriptions
Cessation	Points of view
	Conversation with others
	GP Reverence
	Alternative transport
Chronological versus functional age	as a measurement of fitness-to-drive
Confidence	Changes over time
Covid-19	Changes experienced
	Technology factor
Definitions	The Experienced Driver
Definition	Fitness-to-Drive
Definition	The Older Driver
Driving	Skills and training
	Testing
	Car use
	Emotive topic
	Level of importance
	Responsibility
	Enjoyment
Driving environment	Opinions and Changes
	Car industry
Driving licence Renewal	Opinions and the process
Health	Physical
	Visual
	cognitive
	Auditory
OMEDA PLUS	Licence renewal
	A test of fitness-to-drive
	perceived purpose
	Relevance
	Willingness and ability to engage
	Opinions
	Concerns

Appendix B4.2 Summary of themes across interviews

Codes	Subordinate code	Linked Transcript from each interview						
		Catherine	Christine	Clive	Mark	Nick	Peter	Sean
Accidents					77-79	391-393	63, 143, 179-182	
age versus function		106-109, 137-138	48-49	51-56	131-135, 140-154			
Ageing				177-179	341-343	216	140-141	
Alternative transport				110-114	52-57; 107-116	70		
car industry awareness of older demographic						328-334; 339-347; 353-354		
Car use		12		11-12	31-43; 45-57	17-21; 23-24; 35; 37-39; 340-351	26-28; 60-62	
	convenience				45-48			
Cessation	opinion			118-122				
	consideration	19-21	41; 78-79	184-189	93-95; 100-107; 107-116	110-112; 118		
	conversation							100-101; 146-157; 163-167 ;199-201; 211-212
changing traffic environment								38; 41-42; 195-196
Confidence			11-14		26-29	47	39-44	19-20; 28-31
Covid-19				29-30; 32; 34-37	23; 100-103	11-14	176-178	
	technology					161-165; 171-173; 180-185		

Codes	Subordinate code	Linked Transcript from each interview						
		Catherine	Christine	Clive	Mark	Nick	Peter	Sean
Definition: Experienced driver		37-39; 41-43; 69-73	44-47	59-63	157-167	91-93	76-77; 80-83	72; 74-78
definition: fitness-to-drive		45		65-71	171-183	96-99; 120-122	87; 91-100	82-83
Definition: older driver		29; 31-35; 41-43; 69-73		46-49; 51-56	129-154	79-82	70; 72-74	64-68
	Relative age	129-154						
Disability and driving		23-26	50-51					
Driving	testing							189-192
	emotive topic			124-126				169-171; 183
	Level of importance					44-50		
	responsibility		21-23					
Driving environment					86-90		195-198	
Driving licence	Renewal							153-157; 185-192
Driving skills and training								23-24; 29-33; 134-138; 140-141
Enjoyment		14			86-90	398-401	46; 48-49; 51-53; 55-57	38-42

Codes	Subordinate code	Linked Transcript from each interview						
		Catherine	Christine	Clive	Mark	Nick	Peter	Sean
family vs GP recommendation						233-235		
GP responsibility				198-200				
GP reverence		113	94-96	191-196; 198		243-245		186
Health	physical						8-10; 22-23; 176-178	19-20
	physical fitness				13			4
	eyesight		6-9		19-21; 26-29; 71-74		89-91	
	cognitive					387		23-24
	hearing	2						
History of driving							33-37; 48-49	
OMEDA PLUS	Licence renewal					260		
	test effect					212-213		
	a test of fitness to drive						111; 112-116; 121; 121-124	
	ability to engage	76	66-67	129-133; 137-143	251			110
	concerns	54-55; 59. 118-120		202-203			202; 222-228	116-119; 199-201; 206-207
	Licence renewal					253-255		
	need for validation			161-165				

Codes	Subordinate code	Linked Transcript from each interview						
		Catherine	Christine	Clive	Mark	Nick	Peter	Sean
	opinion			75-76; 78-84	188-192; 220-233; 239-247; 273-275; 278-284; 299-311		123-124	90; 98
	perceived purpose	53-55				126		
	relevance							100-101; 144; 146-157; 162-167; 199-201; 211-212
	real world relevance		82-85	171; 173-179; 181-182	198-216 ; 226-228; 262-268; 270-271	522		163-167; 178-179; 200
	recommendation	95-97; 99-100	90					169-171
	Relevance	66-67; 88; 90-93; 116	75-76	97-100	192-198; 363-381		189; 191-193; 204-207; 222-228	
	suggestions	78-80		135; 137-138; 205-206		224; 314-318		162-163
	technology		67	137-143		504-506; 508		
	Test: Licencing				314; 322-326			
	willingness to engage	103	63; 92; 101-107	86-91	186; 218; 236-238; 286	141	111-112; 118-119; 132; 138-140; 154-159; 164; 189; 195-197	92-94
other driver story		31-35; 61-64	33-39			99-112		148-157
other drivers		19-21					55-57; 72-74; 143; 178; 185-187	

Codes	Subordinate code	Linked Transcript from each interview						
		Catherine	Christine	Clive	Mark	Nick	Peter	Sean
Policy					326-338; 343-356			
Regulation by others	Friends and family	106-109						
	DVLA		109-111					
Responsibility as driver			21-23		23-24		183	
Retirement					52-57	30-32		
Self as driver		10; 108-109	11-14; 21-23	8-9; 23-25; 44		61-63	25-28; 31; 33-37; 39-44; 60-62; 132-138; 147-152; 176-178	28-31; 51; 57-58; 62; 70; 72; 74-78
	confidence				74-86; 80-81	84; 391-393		
	new driver					51-56		
	experience		42		163-16760-71		201-202	
	skill				81-86			
	advanced driver			17-21; 147-158				
self as older driver			30-32		118-126:	77-82	70	
	Relative age						185-187	
Self: role as driver within household		15-16; 24-26; 104-106			93-100		177-178	

Codes	Subordinate code	Linked Transcript from each interview						
		Catherine	Christine	Clive	Mark	Nick	Peter	Sean
Self-regulation / Cessation		103-106	6-9:		19-21; 37-39		17-18; 20; 22; 28; 176-182	15; 20; 22; 25; 42; 44-45; 47-51; 72; 148-152
	avoided scenarios					67-68		
	familiar routes		12-14			37-39		
	due to health		6-9:					
Technology				129-133		150-165	48-49; 201-202	8; 214-216; 218; 227-232
	advantage					283-287		
	generation differences					517-520		
	in car			39				
technology and ageing						168-173		
	assumed access					168-171; 177		
	assumed knowledge					187-200; 204-205		
	loneliness					169-173; 175		
	generation differences			129-131				
terminology						357-360		
Value of self-opinion							168-169; 204-207	