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What passengers really want: Assessing the value of rail innovation to improve experiences

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ABSTRACT

Technology has the potential to provide more up-to-date information and customised services to train passengers and therefore improve the rail journey experience. However, there is a lack knowledge about which innovations and services are preferred by the travelling public. The purpose of this study was to understand the value which passengers placed on technological innovations to improve the overall passenger journey experience. A conjoint analysis survey based on the best-worst scale of preference was developed to evaluate how passengers ($N = 398$) value different system features proposed to improve passenger experience in the UK. Results show that the automatic compensation for delayed or cancelled trains was valued the highest, and the ability to pre-order special services ranked as least value from a set of ten features. Additional results include the segmentation of responses according to passenger type (commuters, business and leisure) and the similarities and differences in responses from the public versus those working directly in the rail industry. The insights gained from this study suggest which features should be prioritised to improve rail passenger journey experiences.

1. Introduction

Public transport systems such as rail provide benefits including less traffic congestion, less pollution, safer travels, lower expenditures, less effort and better predictability in comparison to road transport (Litman, 2015; Wener and Evans, 2011). However, there are diverse barriers preventing or limiting the use of public transport, from hard barriers such as travel time or financial cost to soft barriers such as information provision or perceived comfort (Blainey et al., 2012).

Bus and train riders experience the most negative emotions in comparison with other transport modes such as private car, walking and cycling (Morris and Guerra, 2015). Public transport use has a negative effect on travel satisfaction, and it is necessary to turn public transport to an attractive alternative and therefore improve passenger's wellbeing (Friman et al., 2017). Cost-effective ways to improve the quality of public transport and increase ridership may involve comfort and convenience improvements, which are relatively inexpensive (Litman, 2008).

Technology has the potential to bring about the changes needed to increase efficiency of rail transport (Oliveira et al., 2019) and improve customers' experience (Oliveira et al., 2017). Encouraging society to use public transport more often requires the implementation of measures to make the journey more pleasurable. Examples include strategies to increase information provision and communication, enhance convenience, improve control and facilitate journey planning (Camacho et al., 2013; Foth and Schroeter, 2010; Islam et al., 2017). The following section describes a number of technological features that have the potential to improve rail transport, and it leads to the definition of a study to test which features are most and least valued by passengers.

2. Literature review

The travelling public in the UK would appreciate the provision of more information both at stations and on board trains, particularly in case of disruptions (Transport Focus, 2014a). Focus groups and interviews with passengers indicate that there is an appetite for the use of more technology and provision of sophisticated information, "especially given the growing use of apps on smart phones" (Transport Focus, 2014b). The importance of automated traveller information systems and electronic fare payment and collection are well documented, with clear operational and financial benefits. One extensive report (Goeddel, 1996) indicates that passenger information systems can increase ridership, revenues and customer convenience. Real time information has been available for a few years in public

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transport systems (Dziekan and Kottenhoff, 2007), and passengers look for this information in different interfaces, from localised displays installed on platforms to smartphone applications (Islam et al., 2017; ORR, 2012).

Technology can also improve fare collection and management, which, if made manually, can be prone to errors and time consuming (Camacho et al., 2013; Foth and Schroeter, 2010). Unified cards or smartphones can make it easier for passengers to obtain tickets, with the potential to increase the user satisfaction with the rail system (van Lierop et al., 2018).

Passengers demand not only pre-trip information for planning their travels, but also information during journeys such as punctuality, connections and platform allocation (Blainey et al., 2012). One extensive review indicates that accurate communication, for example giving effective wayfinding information, can optimise passengers' experience with public transport (van Lierop et al., 2018).

Technology can facilitate the process of finding free seats on trains, which is a current demand from passengers (Transport Focus, 2016) and cause of stress during the boarding process (Oliveira et al., 2017). Passengers have specific preferences regarding seats (Wardman and Murphy, 2015) and would appreciate having control of where to sit (Cox et al., 2006). Navigation and wayfinding information can be delivered directly to passengers to inform where they could stand aiming to board less busy carriages (Peña Miñano et al., 2017). Reports show that passengers are willing to change behaviours, for example choosing to travel on a less crowded train, or spreading themselves out on the platform before boarding, in response to crowding information (Pritchard and Preston, 2017; Pritchard, 2018).

Innovative technology could improve people's perceptions of rail transport and improve the overall user experience of passengers in the UK. Smartphones are frequently used by passengers of public transport (Lyons et al., 2016) and can make waiting times seem shorter (Oliveira et al., 2016). Furthermore, specific system features designed for train passengers have the potential do improve the journey experience of the travelling public. However, to design the correct technologies and to increase its acceptance and adoption, it is necessary to evaluate what customers value (Goodman et al., 2012).

3. Transport service quality analysis

Transit service quality evaluation methods can indicate the improvement strategies to make public transport a more attractive means of travel (Litman, 2008). Results from these studies have the potential to be incorporated into transport planning and inform the design of infrastructure. Attitudinal research in the public transport industry has heavily relied on the use of psychometric 5 or 7-point scales. These scales evaluate customers' levels of agreement/disagreement or satisfaction/dissatisfaction with different attitudes, perceptions or experiences. These psychometric scales are commonly used in industry, where the results then go on to inform important policy and business decisions (Transport Focus, 2016; Beck and Rose, 2016). Passenger's perceptions of journeys had been evaluated via the recent Satisfaction with Travel Scale (Friman et al., 2017; Ettema et al., 2011; Olsson et al., 2013; De Vos et al., 2015). This scale takes in consideration the affective states of mind during events and cognitive evaluations of experiences. Affective questions are designed with rating scales ranging from tired to energetic or stressed to calm. Cognitive questions use comparative rating scales such as “the worse I can think of” to “the best I can think of”. These methodologies can provide a large amount of data for statistical analysis, which gives a good picture of evaluation of services such as transport. These instruments are generally set to evaluate experiences after passengers used existing transport systems. However, these rating scales make it difficult to understand customer desires for future improvements, and do not help defining how much certain characteristics are valued in comparison to others (Spitz et al., 2007).

More recently, the use of alternative approaches to measuring attitudes surrounding public transport are recommended, specifically, those that offer more robust, useful and actionable attitudinal data that can be used by managers and practitioners in the public transport industry (Beck and Rose, 2016). Best-Worst Scaling (BWS) (Finn and Louviere, 1992) has risen in popularity as a choice-based measurement approach. BWS experiments collect both “best” and “worst” information from a set of statements about the product or service offering. These could include attributes, features or product benefits. As such, more information is gathered about the top ranked and bottom ranked items in a set, which allows for a more complete understanding of customer preferences (Louviere et al., 2013).

A typical BWS experiment will ask participants to trade off attributes, selecting only one best option and one worst option in a given choice set, from textual descriptions, pictures or both (Mielby et al., 2012). By asking for the best and worst, BWS alleviates the problem of respondents rating all attributes highly (Beck and Rose, 2016). It also prevents respondents from consistently selecting the middle options of a scale, and avoid extreme response bias, when respondents only select the extreme options of a scale (Beck and Rose, 2016; Paulhus, 1991). Since BWS experiments do not use verbal measurement scales (or category scales), it means that respondents are less likely to misinterpret a question and instead select options that are easy to understand and can be made quickly, with less individual subjectivity (Cardello et al., 2003; Hinz et al., 2015). Therefore, it can be assured that respondents have interpreted the choice tasks consistently, which cannot be guaranteed for a rating scale task (Hinz et al., 2015). Avoiding these response biases, the final results may be more representative of the respondents' true feelings and attitudes and have more likely been identified as a major issue within values research (Lee et al., 2008). BWS is able to handle considerably large number of attributes (usually up to 30). Despite this, fatigue is relatively low, which means that a BWS experiment is simple for the respondent but gathers rich data for the researcher (Lancsar et al., 2013).

As BWS requires respondents to make a trade-off, it is considered to be another form of discrete choice experiment (DCE) (Louviere et al., 2013). Statements are matched in sets to be compared and confronted, resulting in a utility score for each statement versus all other statements. This method is also labelled “conjoint analysis” because it forces respondents to evaluate attributes conjointly, in the same context (Spitz et al., 2007). Usually, four attributes are presented at each time, since four seem to be “adequate to allow respondents to trade between the best and the worst with sufficient accuracy” (Beck and Rose, 2016).

BWS has been applied to the transportation industry in a number of cases. Hinz et al. (2015) used BWS to determine the most preferred complimentary mobility services that could potentially be offered by electric vehicles (e.g. intelligent charging stations, IT-based parking and payment and remote diagnostics). The Syracuse Metropolitan Transportation Council (NY, USA) used BWS to understand residents' priorities regarding improvements to their I-81 highway system. A list of 20 benefits potentially resulting from these improvements were drawn up and included in the BWS survey. The analysis showed the relative importance of each benefit, which helped to prioritise which improvements to take forward (SMTC, 2011). Conjoint analysis have also included monetary measures to identify how much people would pay to use specific technology such as shared autonomous vehicles (Krueger et al., 2016).

In the rail industry, Spitz et al. (2007) used BWS to explore customer perceptions to define priorities for New York City Transit's subway stations. Participants were asked to work through a number of trade-off scenarios related to existent or proposed station improvements. Results helped the researchers to understand whether renovations served the needs of passengers, and determined what other renovations customers appreciated “for stations scheduled for renovation and stations yet to be constructed” (Spitz et al., 2007). BWS had been also used to evaluate infrastructure improvements in and around metro stations in Kolkata, India (Sadhukhan et al., 2016). Respondents ranked a number of improvements such as pedestrian crossings, level change and better visual communication, and the corresponding willingness-to-pay for these facilities.

From this overview of the literature we demonstrated that some studies have been set to test individual system features for the rail industry and evaluate their usefulness and acceptance [e.g. Pritchard and Preston, 2017]. Others asked users about existing infrastructure and service quality (Beck and Rose, 2016) or evaluated proposed station improvements (Spitz et al., 2007). However, no research was found aiming at assessing how different technological features compare against each other in the attempt to improve rail transport.

3.1. Aims

We designed this current study aiming to provide an understanding of which proposed system features are most important and most valued to rail passengers. A large-scale customer research survey was administered to two groups of people: the general population and people working for the rail industry. From a list of potential innovation to be implemented for train journeys, we tested how these different features compare in terms of user preference. We used the BWS method to produce quantitative rankings demonstrating the perceived value of each system feature to indicate what passengers really want. The usefulness of these results is in prioritising design and investment decisions for new system features, which aim to improve the overall passenger journey experience of rail travellers.

4. Methods

4.1. Tested system features

The current study proposed a list of technological innovations, which was based on the literature review and previous research conducted to map passengers' journey experiences (Oliveira et al., 2017). Key touchpoints and pain points regarding British rail transport were identified, and this knowledge informed ways in which technology can improve the passenger experience. The potential system features to improve user experience were shortlisted as ten system features to be ranked using the BWS method.

The ten potential system features were identified as follows:

	System feature	*Explanation*
1	Ability to search for, reserve and/or change your seat before and during your journey	Passengers would be able to choose a preferred seat (e.g. forward facing, with a table, plug socket, away from the toilet, close to the door) using a carriage map displayed on smartphones. This seat can then be changed or reserved up until the last minute.
2	Directions displayed on your phone to help you find your platform and your seat on the train	Navigational information, which will include the train composition in relation to the direction of travel, the number of coaches and the carriage ordering, so passengers can anticipate how to better get to their seats by standing at the right place on the platform.
3	Access to live information showing the occupancy levels of current and future trains	Passengers will be able to access information regarding the occupancy levels of current and future trains, in real time.
4	Ability to validate your ticket electronically at your seat, so you don't need to present your ticket for inspection	The ability to automatically validate a ticket using a sensor located on the seat. This reduces the disturbances and removes the need for a train manager manually checking tickets on board the train.
5	Information on facilities at your destination station (e.g. details of bus connections, phone number of taxis)	Individualised information for specific passengers and their journeys, so they can anticipate what to find at the final station and plan how to proceed on the 'last mile'.
6	Ability to earn rewards through a loyalty scheme and redeem points for rail or non-rail purchases	Passengers will be able to collect points (similar to air miles and retail points) for each journey they take. These points can then be exchanged for rewards (e.g. a free cup of tea, reduced fare price, upgrades).
7	Ability to pre-order special services (e.g. refreshments, train manager assistance)	Passengers will be able to use the system to pre-order services prior to boarding the train, which will alert the train provider.
8	Automatic compensation for late or cancelled trains	Automatic reimbursement offered to passengers of delayed or cancelled trains, instead of the current procedure in which a request has to be made via post or email.
9	Access to live journey information (e.g. ETA, alternative travel routes in the event of disruptions)	Access to real-time information regarding journeys and alternative travel in case of disruptions. This will remove the reliance that passengers have on checking information boards at stations and make it easier for passengers to check the platform number for their connecting train.
10	A diagram of free and reserved seats on your phone or on screens on the train and platform	Passengers will be able to see the occupancy level of carriages, and check which individual seats are available. Users will not need to be there and check each seat or displays visually.

4.2. Sample description

Participant recruitment was managed via the opt-in market research panel Qualtrics, which invites respondents from its database to complete a screener via email. Respondents were screened against the criteria of being based in the UK and who have taken a train in the past 12 months. A link was sent to targeted respondents, inviting them to complete the online survey in return for a small incentive in the form of cash honorarium, compatible with the length of the survey.

In addition to these members of the public, the survey also obtained responses from individuals working directly in the rail industry. The survey was disseminated across two major UK rail corporations by email and via a link on the companies' staff intranet. People completing the survey were not directly involved in the project.

Data had been cleaned to remove partially completed responses or those finished in under 3 min, since this was the time required to read all statements. Responses were also limited to people that had taken the train at least two times a year. In total, 398 survey responses were collected.

This research segmented the travelling public in three different types of passenger: commuters, business travellers or leisure travellers, as commonly used by the rail industry in the UK (Transport Focus, 2014b; Wardman and Murphy, 2015; Lyons et al., 2013). The definition for each segment used in the survey can be referred to below:

- Commuting (You travel by train very regularly, almost daily and probably for work reasons)
- Business (Your professional employment necessitates you to travel from time to time)
- Leisure (You travel for social reasons other than work)

The final distribution obtained for this research was 50%, 35% and 15% for commuters, business and leisure travellers respectively. These figures turned out to be comparable to the distribution of rail trips by mode in England (57%, 33% and 10%) (DfT, 2015). Our sample had more males than females (52 and 48% respectively) and the age of participants peak on young adults. These figures are similar to the general UK statistics for number of trips per age and gender (DfT, 2016). A breakdown of the samples can be referred to below in terms of age and gender (Table 1), travel purpose (Table 2), frequency of rail travel (Table 3) and origin of sample, if from Qualtrics general population database or rail industry internal contacts (Table 4).

4.3. Survey description and setup

There were three sections to the survey: a brief introduction, demographic questions, questions relating to the frequency at which the respondent travelled by rail and the reasons for doing so, and lastly the BWS choice sets. The survey was implemented using an internet market research panel provider (Qualtrics).

The ten system features were presented using fifteen BWS choice sets. An example is shown in Fig. 1 - respondents were presented with the same journey scenario each time: a train journey lasting approximately 2 h. This duration was selected to be longer than the average rail commute in the UK, which is/about 1 h (DfT, 2018b). Participants were asked to select their most preferred and least preferred feature out of four options.

A pilot study was conducted to determine whether participants were comfortable with the four-feature setup for each question and whether the wording of the statements needed further clarification. Each feature appeared six times randomly throughout the four-choice sets. Fifteen sets were selected to present a reasonable number of combinations, following a balanced incomplete block design (BIBD), as suggested in the literature (Beck and Rose, 2016).

4.4. Data analysis

The data were assessed to determine how many times each statement appeared as the "most preferred" and "least preferred" option. The best-worst scale is obtained by subtracting the number of least preferred selections from the number of most preferred selections. This gives a ranking where negative numbers indicate the lesser preferred features and the positive numbers show the more preferred features. This method derives a hierarchy of preferences but also gathers enough information that can be used to estimate parameters for a statistical regression model. For example, a multinomial logit model can be developed if prediction of behaviour is required (Louviere et al., 2013). Hinz et al. (2015) compared the simple counting technique against a more sophisticated Maximum Likelihood estimation method and found that both sets of estimation results were highly proportional. This provided evidence to suggest that a simple count analysis is sufficient when evaluating BWS data to provide practical implications and recommendations when assessing preference information.

IBM SPSS 25 was used during the analysis of the significance of differences between the different groups of respondents. For the segmentation based on the purpose of the trip, Initial tests were comprised of ten 1×3 Kruskal-Wallis tests comparing how each technological feature scored across the three groups of people (business, commuters and leisure travellers). Additional post-hoc Mann-Whitney *U* tests were performed to check for the direct comparisons focused on the significant effects obtained from the Kruskal-Wallis tests. For the segmentation based on the origin of the respondents, Mann-Whitney U tests were performed to explore the difference between the scores of the general public and the personnel affiliated with the rail industry.

5. Results

The graph displayed in Fig. 2 shows the results across all participants, aggregating responses from the public survey and the rail industry professionals. Since each feature was presented to participants six times, the maximum and minimum possible scores are six, if chosen as the best or worse every time. The bar graphs present the average ranking of each feature, as stated by all participants. For visualisation purposes, the x axis bounds were set to +3 and −3 in all figures.

Table 1
Age and gender of participants.

Age\gender	Female	%	Male	%	Total	%
18–24	31	16	8	4	39	10
25–34	80	42	56	27	136	34
35–44	35	18	59	29	94	24
45–54	30	16	44	21	74	19
55–64	12	6	38	18	50	13
65–74	3	2	2	1	5	1
Total	191	48	207	52	398	100

Table 2
Segmentation of sample by travel purpose.

Type	Total	%
Business	61	15
Commuting	199	50
Leisure	138	35
Grand total	398	100

Table 3
Travel frequency.

Frequency	Total	%
5 times a week or more often	199	50
Once a week or more often	46	12
2–3 times a month	66	17
Every 2–3 months	44	11
Once a month	43	11
Total	398	100

Table 4
Segmentation of sample origin.

Segment	Quantity	%
General public	304	76
Rail staff	94	24
Total	398	100

Automatic compensation of late or cancelled trains was the most preferred feature by far, with an average score 2.6 times larger than the following feature. The second most-preferred feature was the ability to access real-time journey information such as the estimated time of arrival (ETA) and alternative travel routes in the event of disruptions. Next, there are two features related to finding seats: the ability to search for, reserve and/or change a seat up until the last minute, and access to live information showing the occupancy levels of current and future trains.

The following features achieved negative scores on average. The least preferred option by far was the ability to pre-order special services, with an average score three times larger than the penultimate feature, which was the ability to have directions displayed on a passenger's phone. The third least preferred feature was information about station facilities, followed by the ability to electronically validate a ticket. The features with a slightly negative score on average were a diagram of free and reserved seats, followed by the ability to earn rewards through a loyalty scheme.

5.1. Segmentation

5.1.1. Travel purpose

The comparisons presented in this section are shown in Fig. 3 below, and involved assessing the average rankings from the three main groups of passengers: commuters, business and leisure travellers. Again, the automatic compensation feature was by far the most preferred across all segments, while the ability to pre-order services was the least preferred. Business travellers placed a high value on the ability to search for, reserve or change a seat up until the last minute, resulting in a statistically significant difference between the scores from business and both commuters and leisure travellers. Similarly, business travellers were more enthusiastic about a diagram of free and reserved seats than other passengers were, with significant differences between business and commuters. Interestingly, the

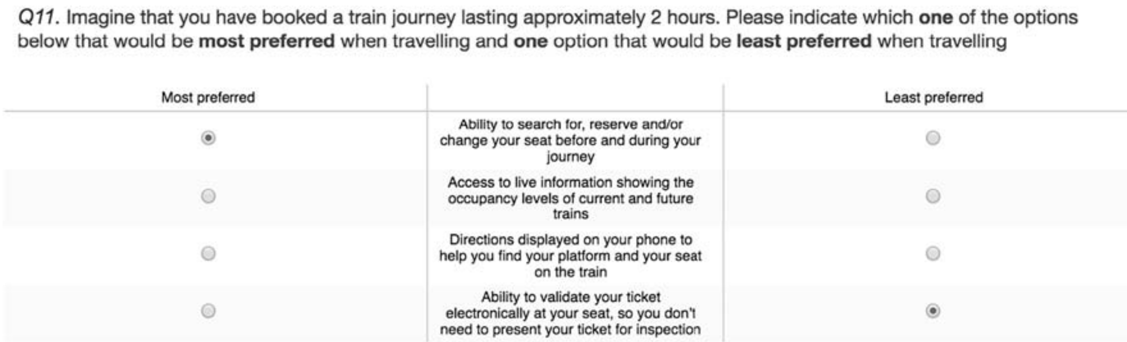

Fig. 1. Example BWS survey question.

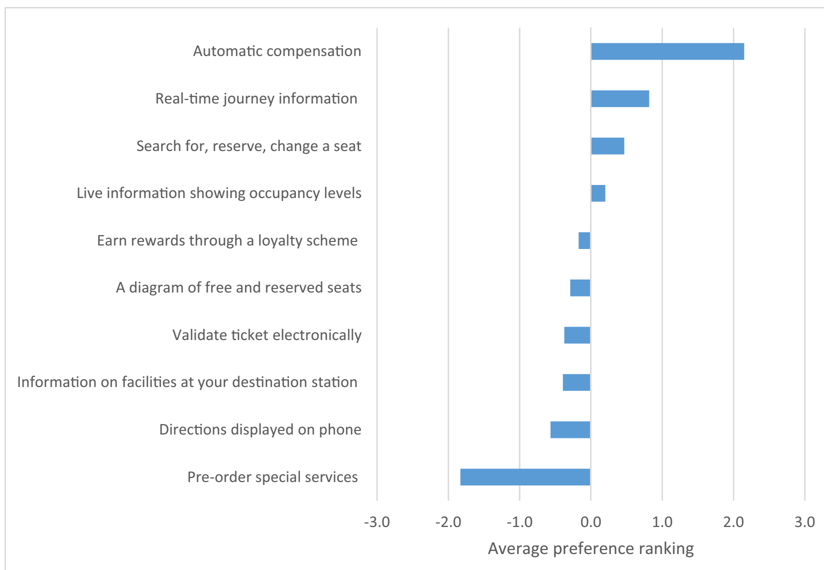

Fig. 2. Average preference ranking for all participants.

ability to earn rewards through a loyalty scheme was rated positively only by commuters, on average. Respondents travelling mainly for business appeared to give less value to electronic ticket validation and information about facilities at the destination station in comparison to commuters or people travelling for leisure. The same pattern emerged from the ability to obtain information about facilities at the destination station.

5.1.2. General public and rail staff

Fig. 4 below shows the comparison between respondents working directly in the rail industry and the results from the general public survey. What is immediately noticeable is the fact that the results from the rail industry personnel were much more extreme for almost all of the features, expressed by the statistically significant difference in most scores. For example, the results show that those in the rail industry were decidedly positive about seeing real-time journey information, and searching, reserving and changing seats up to the last minute, whereas the general public opinions were mildly positive in comparison. Additionally, the general public appears to be fairly neutral or slightly negative towards three features: the self-validation of tickets, information about the destination station and directions displayed on phones. Conversely, those in the rail industry responded very negatively towards these same features. One position of clear disagreement was the access to a diagram of free and reserved seats: rail personnel were very positive, and the general public showed negative preference towards this feature.

6. Discussion

Automatic compensation of late or cancelled trains was the most preferred feature by far, across all segments. Government statistics show that 61.88% of trains run on time (arriving within 59 s of its scheduled time), 89.77% arrive within 5 min, and 98.13% within 30 min (ORR, 2018). For most areas in the UK, passengers are currently entitled for a delay repay only if the train is more than 30 minute late (for a 50% refund) or one hour late (for a full refund). Although the number of passengers entitled for a refund seems small, a recent survey with over 10.000 rail passengers shows that 41% of them experienced a delay lasting over 30 min in the last 6 months (DfT, 2018a).

Even though the process of compensations is going through reviews (ORR, 2016), passengers affected by delays or cancelations currently have to fill a form and submit the claim to the train operating company in order to obtain a refund of part of the value paid. The compensation is then usually sent via post to the claimant. Although the forms may be easy to complete, taking around 20 min to do so each time, passengers receive a voucher “two or three weeks after making the claim” (Transport Focus, 2014b). The Office of Rail and Road estimates that

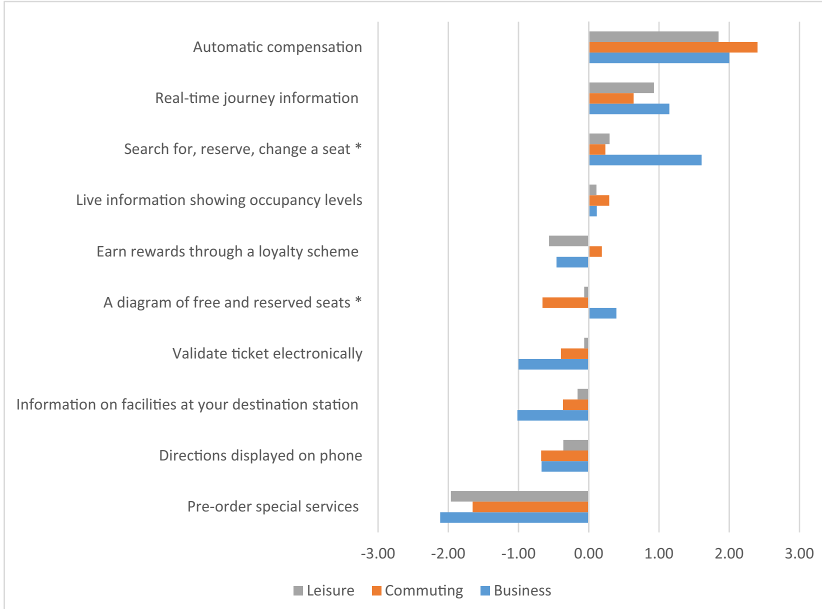

Fig. 3. Average preference ranking segmented by main passenger type, based on their main purpose of travels. Statistically significant differences ($P < .01$) are marked with a *.

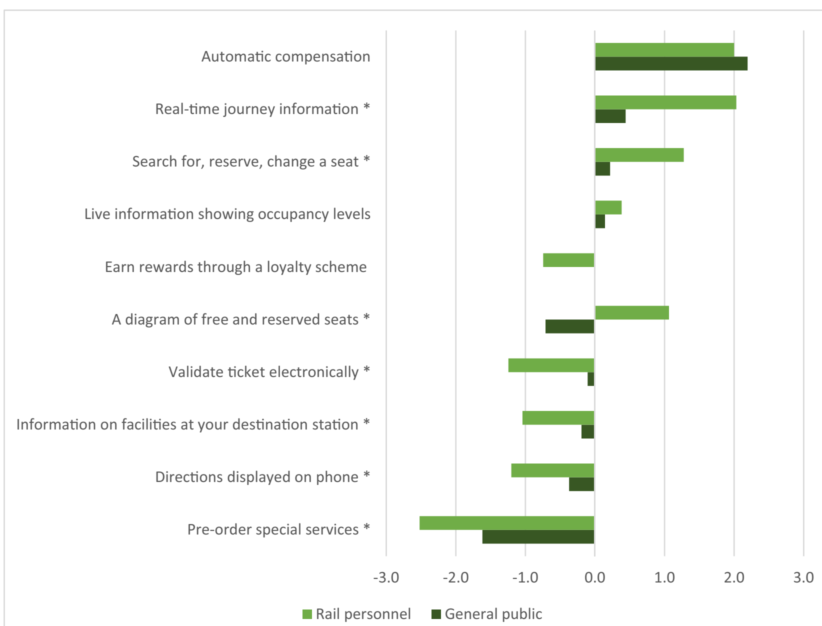

Fig. 4. Average preference ranking segmented by sampling strategy, from general public and rail personnel. Statistically significant difference ($P < .005$) marked with a *.

"around 80% or more of potential claims go unclaimed" (ORR, 2016). Among the explanations is that, given that it is a time consuming process, passengers are less likely to submit a claim for relatively low-value tickets. In a recent report, passengers declared that "it was not worth the effort for the amount they would get back", especially if they paid £5 or less for their tickets (DfT, 2018a) This may explain why the possibility to automate this process was highly appreciated by the survey participants. However, making it easier for passengers to obtain compensation will incur in expenses to operators, since it certainly increase the number of claims. There is evidence that the claim process is time consuming and discourages those wishing to seek compensation (ORR, 2016).

The following most highly valued feature was real-time journey information such as ETA and alternative travel routes in the event of disruptions. This is a frequent demand from the travelling public, who would like to have more information readily available (Transport Focus, 2014a) preferably on mobile phones and not on station screens and public address system announcements (Transport Focus, 2014b).

Innovations that may increase the likelihood of passengers finding a seat were highly valued by participants. According to annual surveys, passengers are not very satisfied with their current ability to find a seat (Transport Focus, 2016). Another research indicates that the availability of seats is the second most important priority for improvement for rail passengers in the UK, after a better value of money (Transport Focus, 2014a). Recent user research indicated that the most negative aspect on board of trains was the process of finding a seat (Oliveira et al., 2017). Often, current system allocates seats that passengers do not like, but people place different values to different seats (Wardman and Murphy, 2015). Cox et al. (2006) describes that "the ability to choose seats and control proximity to others appear to be key factors in reducing passenger stress".

The least valued option across all segments was the ability to pre-order special services. This result resonates previous reports on passenger priorities, which tends to focus on practical aspects and basic service requirements such as price, availability of seats, frequency and punctuality (Transport Focus, 2014a; Cavana et al., 2007). The statement for this item exemplified refreshments or train manager assistance. These special services could be seen as perks not needed by the majority of the travelling public, and could also increase the fare.

It was a surprise to see the low value given to a diagram of free and reserved seats by passengers, since it overlaps with the ability to search for, reserve and change a seat up to the last minute, which was the third most preferred feature overall. Although similar, the main difference between these two is the fact that the latter implies the ability to dynamically reserve and search for seats in real time rather than just seeing an image of free and reserved seats.

A slightly different picture emerged when the sample was segmented. For the segmentation on the three different purposes of travel, the most striking difference was that business travellers valued highly the features that could help them to find a seat. One possible explanation could be that if they intend to work during the train journey they will need a seat. The ability to earn rewards through a loyalty scheme was valued only by commuters, presumably because they travel so often so they would benefit from some sort of compensation for their expenses. Similarly, loyalty schemes for the airlines industry are most beneficial for members who are frequent flyers (Reales et al., 2017).

The automatic validation of tickets was ranked poorly by business travellers, contradicting the belief is that they would appreciate an undisturbed journey. One possible explanation is that passengers often see the process of ticket validation by the train managers as positive due to the presence of a figure of authority on board (Oliveira et al., 2017). Also, previous research on barriers to rail use shown that "some passengers find the presence of staff to provide information very important, particularly during interchange" (Blainey et al., 2012). There may be the suspicion that an electronic ticket validation could potentially reduce safety on board and eliminate the chance to ask questions or have a friendly chat.

Commuters placed a low value on a diagram of the free and reserved seats. This may be explained by the fact that commuters are more likely to squeeze in the first train that arrives, while other travellers tend to let the crowded train go and wait to take the next one, if they know that there will be places available (Kattan and Bai, 2018). Commuters also already have their own strategies including where to stand on platforms to find seats, therefore this information would be of low value (Pritchard, 2018).

For the segmentation between the general public and rail industry staff, the latter presented more extreme preferences towards most system features. That can be explained by the fact that they are a more homogeneous group, having a similar knowledge of the limitations of the industry and the long promised and needed features. It is understandable that their results would likely to follow a similar trend in relation to their choices, therefore skewing the results towards the same features. Rail industry staff were more positive towards real time information about journeys in the event of disruption. It can be explained by the fact that they are more knowledgeable about the disorder caused when things go wrong in the railways. They may also know that timely and accurate information can minimise the effects of disruption, for example, when it provides alternative routes for the travelling public.

Rail personnel valued features related to seat reservations, such as the ability to search, reserve and change seats up to the last minute, or the diagram of free and reserved seats. This has been a potential improvement for a long time, but of difficult implementation. Due to limitations on the current national reservations system, the implementation of real time seat reservations would require a new retail system for the whole rail industry at high financial costs (ATOC, 2015).

Rail industry personnel were negative towards the possibility of passengers validating their own tickets. That may be caused by the concern that this feature will reduce the role of train managers, as they will not need to check tickets anymore. A greater proportion of trains could be running without a train manager aboard. This could be seen as a contentious feature similar to the introduction of the driver-only operation of train doors, which caused protests by train crew (Transport Committe, 2016).

Finally, rail industry personnel placed very low value to information on facilities at the destination station, and to directions displayed on phones to help find platforms and seats. Passengers already consume large amounts of transit information online, usually via social networks (Cottrill et al., 2017). Furthermore, transit agencies customarily leverage on stablished social media platforms as the mechanism for reaching out to passengers (Camacho et al., 2013). Therefore, it is unclear if this information would be appreciated or needed if embedded in an operator's mobile application.

Differences between user groups indicate that passenger preferences should be accounted for during the design of innovation for the rail industry, in the attempt to contemplate the items valued by the largest number of users. Features that are appreciated by certain users may have low value to others (Blythe et al., 2006), thus developers should allow enough adaptation and customisation so the system is able to "bend and stretch and adapt to the user's needs" (Cooper, 1999).

6.1. Limitations and future work

This study asked participants to make trade-off decisions of their most-preferred and least-preferred benefits of a dynamic seat reservation system. Through analysis, it was then possible to rank the list of proposed features that could be implemented to enhance the user experience of train journeys. This is, however, prone to the methodological caveat of *hypothetical bias*. When evaluating customer desires for future improvements, "individuals might behave inconsistently, when they do not have to back up their choices with real commitments" (Hensher, 2010). This is particularly problematic with behaviours involving money, which can differ remarkably from actual revealed behaviour (Brownstone and Small, 2005). This current study avoided this bias by presenting system features that could be implemented on journeys free of charge, to which participants had to select their preferred items.

Most user research is subject to self-selection bias, as volunteers may have a personal interest in the topic under study. Our survey invitation did not include specific details about the contents of the survey, and instead shared only very general and minimum information about the study. Our participants received financial incentive to take part in this study, which can remove the intrinsic, altruistic desire to contribute to the research. However, it can make users behave in certain ways just to obtain the reward (Metcalfe and Dolan, 2012), for example disregarding the questions. To eliminate these participants we performed data quality checks to replace respondents who finished the survey in less than 3 min.

The BWS, as many other research methods, may also motivate respondents to alter their behaviours to comply with the researcher's aims (Smith et al., 2017). When participants have a suspicion of the hypothesis of the study, they may strive to be good subjects and purposely try to contribute to confirm the expected results (Nichols and Maner, 2008). This intention to be the 'good subject' is stronger for socially desired behaviours, for example those involving environment protection (Smith et al., 2017). The design of the current study avoided the measurement of attitudes and perceptions on desirable behaviours, focusing instead on technical features directly related to train journeys. Participants ranked the features that could directly improve their next personal journeys, hence avoiding value judgment.

The results presented here are focused on the specific proposed features that can be implemented within British long distance trains. Other rail systems have different demands and limitations. For example, most suburban commuter trains do not allow seat reservations, and with certain systems, there is no need to validate your ticket on the train (van den Heuvel, 2016). The state of technology in other countries will be at different points on the roadmap, therefore present different requirements. Innovations destined to improve train journeys of other populations will require different features and present different results. Nevertheless, this study indicated that participants tend to have a pragmatic vision of what they value, focusing on ways to solve problems that they encounter, such as the wish to obtain compensation for late trains, or the desire to find a seat.

Future research should take the proposed features and explore them in more detail, matching the system design against the user tasks and needs (Stickdorn and Schneider, 2010). In-context interviews and usability studies can provide valuable information for developers such as the detailed requirements that could improve user experience at specific touch points with the rail system (Oliveira et al., 2017). Further studies can implement the selected features as working prototypes to be tested with users in realistic settings, providing further data about the ease of use, usefulness and relevance of the technology (Goodman et al., 2012). Next steps towards real-world implementation of new technology for the rail industry could include reprioritising the features based on business benefits and technical feasibility. That way, we would have a view on the desirability, viability and feasibility of the system, which could be used to create a more holistic feature roadmap.

7. Conclusions

In this paper, we presented results from a best-worst scaling survey exploring how passengers value each item of a list of new system features, which could be introduced by the UK rail industry to enhance journey experiences. The BWS used during this study proved to be an effective tool to understand people's values in relation to rail innovation of customer-facing technologies, and gave further indication of how some technological advancements could be used to enhance the experience of rail transport.

It was found that the same three features were ranked highest across the whole sample and within the segmentations (commuters, business and leisure travellers, and general travelling public versus rail personnel). The provision of these features could help to encourage society to use public transport more often and improve the overall user experience of travelling by train:

1. Automatic compensation for late or cancelled trains
2. Real-time journey information, especially during disruption
3. The ability to search for, reserve or change a seat up until the last minute.

This research also indicated that some features were often selected as the least preferred by our participants. The implementation of these features should be made with care, as it can face resistance from the travelling public. The lowest ranked features include:

1. Pre-order special services such as refreshments or train manager assistance
2. Directions displayed on phones to help find platforms and seats on trains
3. Information on facilities at the destination station, for example details of bus connections and phone number of taxis
4. Ability to validate your ticket electronically at the seat, so there is no need to present the ticket for inspection

The results presented here provide valuable information for train operators, designers, planners and policy makers to more effectively address user needs and preferences. As important would be not to invest in features that would require substantial investments for little or no improvement in the journey experience. Resources should be better applied to make sure innovative technology improve rail journey experiences according to what passengers really want.

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