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# Analytical reasoning reduces internet fraud susceptibility☆,☆☆,☆☆☆

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ABSTRACT

Fake websites extract an enormous financial and psychological toll on consumers across the globe, with some estimates reaching billions of dollars each year. Yet, there is a paucity of empirical data on why some consumers respond to fake websites while others remain immune. In nine studies (6 in the main text, 3 in Supplemental Materials) we tested the hypothesis that analytical reasoning promotes the ability to discriminate real from fake versions of popular consumer websites. We found evidence in support of this hypothesis in individual difference studies using both convenience (Supplemental Studies 1–2) and representative samples (Study 1) with expertise as a boundary condition of this effect (Study 2). We also found evidence for this hypothesis experimentally by inducing time pressure (Study 3) and priming participants to engage System 2 (analytic) versus System 1 (intuitive) processes (Study 4). This latter experimental effect was bounded by expertise (Study 5). Finally, we showed that the link between analytical reasoning and discriminability is mechanistically driven by memory recall (Study 6). Collectively, these studies provide convergent evidence that analytical reasoning may protect individuals from Internet fraud by helping them detect fraudulent websites.

## 1. Introduction

The Internet has become an indispensable part of daily life and a driver of consumer behavior – a trend which has been amplified by the COVID-19 pandemic (Baicu et al., 2020; Bhatti et al., 2020; Favale et al., 2020; Seetharaman, 2020). Given this indispensability, scammers have used a range of techniques to deceive people online. One of the most common techniques has been the creation of fake websites that mimic popular consumer websites. These nefarious facades are designed to steal personal information, money, and banking details from well-intentioned consumers. In 2020 alone, spoofing attacks like this cost U.S. consumers well over 200 million dollars (Federal Bureau of Investigation, 2020). With financial scammers working overtime, there is a paucity of research on the underlying psychological processes leading people to fall victim to these spoofing attacks, or how to harness behavioural science to protect consumers. In the current research, we systematically investigate the extent to which one psychological process – analytical reasoning – influences the ability to discriminate real from fake versions of popular consumer websites in the United Kingdom.

### 1.1. Psychological processes and fraud

Despite structural changes and improvements like firewalls and antivirus protection designed to make the Internet safer, as well as a wealth of information on safe online behavior, the choices individuals make when engaging with the Internet continue to confer risk for Internet fraud. This highlights the importance of understanding psychological processes that may increase risk or foster resilience against Internet fraud. However, previous studies examining psychological processes are limited and have often focused on phishing emails and mass marketing scams rather than fraudulent websites (Hanoch & Wood, 2021; Norris et al., 2019). Furthermore, these studies have focused on demographics and a narrow bandwidth of personality traits and individual differences. In terms of demographic differences in fraud susceptibility, greater chronological age has been linked to greater susceptibility in some studies (e.g., Deliema et al., 2020; Gavett et al.,

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2017; Langenderfer & Shimp, 2001) and lower susceptibility in others (e.g., Mueller et al., 2020). Markers of lower socioeconomic status such as lower income (e.g., James et al., 2014; Langenderfer & Shimp, 2001), and lower education (e.g., Wood et al., 2018) have been associated with increased fraud susceptibility. Studies of gender differences have been ambiguous with some research suggesting that women report greater victimization by mass marketing scams (e.g., Anderson, 2019) and other studies suggesting that males report greater victimization via investment scams (e.g., Deliema et al., 2020).

In terms of personality traits, Big Five traits like openness to experience and extraversion have been found to be associated with reduced susceptibility to phishing emails (Hong et al., 2013; Pattinson et al., 2011). Furthermore, higher levels of conscientiousness are associated with lower levels of fraud victimization in older adults (Judges et al., 2017) and more conscientious individuals are better able to dissociate real from fake phishing emails (Hong et al., 2013). Another study observed that agreeableness decreased perceived risk of phishing attacks while increasing perceived trust in phishing emails with neuroticism showing an opposite pattern (Cho et al., 2016). Beyond the Big Five, higher levels of cognitive ability are associated with lower self-reported fraud susceptibility in older adults, above and beyond participant demographics (James et al., 2014). Similarly, another study of older adults (Judges et al., 2017) found that fraud victims (compared to non-victims) scored lower on cognitive ability measured via the Multiple Ability Self-report Questionnaire (MASQ; Seidenberg, Haltiner, Taylor, Hermann, & Wyler, 1994). Moreover, susceptibility to persuasion in higher in victims of fraud compared to non-victims (Fischer et al., 2013, Study 1). In an experimental manipulation of scam content, Fischer and colleagues (Study 2) found that previous fraud victims (vs. non-victims) were more likely to response to respond to highly lucrative prizes embedded in scams. This latter finding is consistent with other work showing that higher risk-taking tendencies (Moody et al., 2017) and lower self-control (Holtfreter et al., 2008) predict higher levels of phishing susceptibility and likelihood of fraud victimization respectively.

Internet knowledge and experience also predict fraud susceptibility. First, inattention to browser and address bar cues predicted vulnerability to phishing attacks in a usability study (Dhamija et al., 2006). Greater Internet knowledge, operationalized as knowledge of browser and address bar cues, is associated with less vulnerability to phishing attacks (Downs et al., 2007). Finally, an integrated, information processing model of phishing susceptibility (Vishwanath et al., 2011) proposes that greater domain-specific knowledge about email and email-based scams leads to a lower likelihood of responding to phishing scams via deeper, elaborative processing. Though additional support for this model is needed. Much of this research is inspired, at least in part, by the Elaboration Likelihood Model (ELM; Petty & Cacioppo, 1986) of persuasion. The ELM is a dual process theory of persuasion which hypothesizes that individuals are likely to be persuaded either through a central route or a peripheral route. Whereas the central route involves a deep level of analytical reasoning about the stimulus, the peripheral route involves more superficial judgements. The ELM represents the application of dual process theories of human cognition to the domain of persuasion. Even though the research above has been informed by the ELM (e.g., Vishwanath et al., 2011) research examining the role dual process theories of human cognition play in Internet fraud susceptibility is limited.

### 1.2. Dual-process theories of human cognition and Internet fraud susceptibility

Dual-process theories of human cognition make a distinction between automatic, intuitive (System 1) processes and deliberative, analytic (System 2) processes (De Neys, 2006, 2021; Epstein, 2003; Kahneman, 2011; Stanovich & West, 2000). Despite a relative preference for the intuitive system, engagement of the analytic system is robustly related to a tendency to reject misleading, potentially harmful information. For example, the tendency to think analytically is associated with disbelief in conspiracy theories and experimental manipulations that induce analytical thinking decrease belief in conspiracy theories (e.g., Alsuhibani et al., 2022; Swami et al., 2014). Similarly, others have shown that the tendency to think analytically is associated with reduced paranormal beliefs above and beyond the effects of sex, age, political ideology, and education (e.g., Pennycook et al., 2012).

Researchers have also examined how analytical reasoning influences the ability to detect "pseudo-profound bullshit" (Pennycook et al., 2015). Pseudo-profound bullshit refers to buzzwords and nonsense crafted into seemingly deep and intellectual statements that are actually meaningless (e.g., "Conscientiousness is the growth of coherence, and of us"). Across four studies Pennycook et al. (2015) observed that analytical reasoning was associated with a greater ability to detect and a reduced receptivity to pseudo-profound bullshit. These results bear directly on the current research as pseudo-profound bullshit, like fraudulent websites, appear true and genuine on the surface, but are in reality are neither true nor genuine. Whereas pseudo-profound bullshit and fake websites may share the same underlying mechanistic explanation (analytical reasoning) the consequences of being hoodwinked by fake websites are potentially much more financially and psychologically costly. More recently researchers have extended this work to explore the consequences of analytical reasoning for more costly outcomes like fake news. This research has observed that greater analytical reasoning ability is associated with the ability to distinguish between real and fabricated news (Pehlivanoglu et al., 2021; Pennycook & Rand, 2019, 2021). Collectively this research suggest that analytical reasoning enables individuals to discern fact from fiction.

More central to the aims of the current study, others have observed that analytical reasoning predicts the ability to detect phishing emails. One study examined the causal role analytical reasoning plays in making decisions about potentially fraudulent emails (Yan & Gozu, 2012). They asked participants to evaluate emails quickly (presumably engaging System 1) or carefully (presumably engaging System 2) and found that those who reviewed emails carefully were better able to detect fraudulent emails. Similarly, time spent deliberating on each email also predicts phishing email detection (Bayl-Smith et al., 2020). In another study, participants completed the CRT and an email judgement task where participants made decisions about the veracity of a series 18 phishing and 18 legitimate E-mails (Jones et al., 2019). Using signal detection analysis, they observed that higher CRT scores were associated with better ability to discriminate legitimate from phishing emails. Similar results were obtained in two other studies. First, (Butavicius et al. 2016) found that participants with higher CRT scores were better able to detect fraudulent links in spear-phishing emails. Second, Ackerley et al. (2022) reported that higher CRT scores predicted better detection of phishing emails particularly for those who utilize fewer phishing cues in making veracity judgements. In summary, research linking analytical reasoning to phishing email detection suggests that it may also predict fraudulent website detection.

While analytical reasoning and by extension System 2 thinking, is often associated with "correct", rule-based responses, this is not always the case. In contrast to this perfect-alignment dual-process view (for a review see De Neys, 2021) System 2 thinking can produce "incorrect" responses commonly associated with System 1 thinking. For example, research on rationalization finds that participants process will spend high levels of deliberation and cognitive effort justifying incorrect responses (Evans & Wason, 1976; De Neys, 2020). Consistent with this view, initial decisions may be driven by automatic, heuristic (System 1) processes and later analytic (System 2) processes rationalize the earlier heuristic choice (Shynkaruk & Thompson, 2006). In line with the rationalization literature and motivated reasoning accounts, goal motivation rather than accuracy motivation can also lead to misinformation sharing (Osmundsen et al., 2021). Due to these mapping issues it is important to consider *why* people are engaging in analytic (System 2) thinking. Motivated reasoning offers a theoretical framework for understanding how both goals and accuracy may underlie the proclivity for engaging System 2 (Kunda, 1990). In particular, motivated reasoning distinguishes between goal-oriented and accuracy-oriented motivated reasoning. When reasoning about an issue, people may be motivated by their goals, desires, or attitudes (i.e., goal-oriented motivated reasoning) to build a well-reasoned argument. Consistent with this viewpoint, researchers have found that analytical reasoning can increase *partisan* motivated reasoning about politically charged topics (e.g., Kahan et al., 2012; Kahan et al., 2017) which in turn can lead to belief in fake news. This is consistent with goal-oriented motivated reasoning because political affiliation (Michael & Breaux, 2021) and group memberships like political affiliation are an integral part of identity (Tajfel & Turner, 1986; Van Bavel & Pereira, 2018). Rather than being driven by partisan, goal-oriented motivated reasoning, reactions to fake websites may instead be driven by accuracy-oriented motivated reasoning. People are likely to engage in accuracy-oriented motivated reasoning when the stakes of being wrong are high (Kunda, 1990). Consistent with this view, mistaking a fake website as real can have immediate (e.g., paying for products that will never arrive) and enduring (e.g. identity theft) financial costs to individuals. Given these potential costs, accuracy-oriented rather than goal-oriented motivated reasoning may explain the link between cognitive reflection and susceptibility to fake information in the context of Internet fraud (i.e., fake websites).

### 1.3. Overview

In the current research we systematically investigate the role of analytical reasoning in Internet fraud susceptibility. This investigation connects one literature examining psychological processes underlying Internet fraud susceptibility with another examining the role of analytical reasoning in promoting the rejection of misleading, potentially harmful information. In nine studies (6 in the main text, 3 in Supplemental Materials) we examine how analytical reasoning influences the ability to discriminate real from fake versions of popular websites. Because the costs of engaging with fake websites are high, we predict (in line with accuracy-oriented motivated reasoning) that higher levels of analytical reasoning promote the ability to discriminate real from fake versions of popular websites. We tested this hypothesis from an individual differences perspective and utilized convenience (Supplemental Study 1), age-stratified (Supplemental Study 2), and representative (Study 1) samples. Then we tested a boundary condition (i.e., expertise; Study 2) and generalizability (Supplemental Study 3) of the hypothesis. Next, we show that analytical reasoning experimentally influences the ability to discriminate real from fake websites (Studies 3–4) and identify expertise as a boundary condition of this experimental effect (Study 5). Finally, Study 6 examines the extent to which analytical reasoning promotes the ability to discriminate real from fake websites via memory recall. All Studies were approved by the University of Southampton Psychology Ethics Committee.

## 2. Study 1

In Study 1, we tested the hypothesis that analytical reasoning is associated with greater success at discriminating real from fake websites. A representative sample (in terms of age, sex, and ethnicity) of UK adults viewed and evaluated real and fake versions of six popular websites in a randomised order. Afterward, they completed a measure of individual differences in analytical reasoning and an Internet knowledge measure

### 2.1. Method

#### 2.1.1. Participants and procedure

We sought to sample at least 200 participants in order to detect small-to-medium effects ($r = 0.20$) with 80% power according to a power analysis conducted in G*Power 3.1 (Faul et al., 2009). We oversampled and recruited 301 participants completed our study entitled "Reactions to websites" via the online platform Prolific (https://www.prolific.co). We oversampled because 300 participants is the minimum sample size for using Prolific' s representative sample tool (https://researcher-help.prolific.co/hc/en-gb/articles/360019236753-Representative-samples). Two participants were excluded because they indicated at the end of the that their data should not be used in our analyses leaving 299 participants. This sample allows us to detect a small association ($r = 0.16$) between analytical reasoning and discriminability with 80% power. Participants were 20–82 years old ($M_{\text{years}} = 45.98$, $SD_{\text{years}} = 14.98$) UK residents ($N_{female} = 144$, 48.16%; $N_{male} = 136$, 45.48%). Participants completed the website discrimination task, CRT, and the Internet knowledge measure.

#### 2.1.2. Website discrimination task

After the consent process participants viewed screenshots depicting real and fake versions of the following six websites in a randomised order: Amazon.co.uk, ASOS.com, Lloyds Bank, the World Health Organization COVID-19 donation website, PayPal, and HMRC (GOV.UK Verify). These websites were selected because they are among the most visited websites in the UK. Fake websites were developed based on well-known 'red-flag' features for identifying fake websites (Which?, 2020; The SSL Store™, 2018). An example real and fake website is illustrated in Fig. 1. Participants were instructed to view each website free of time constraints. After viewing each website, participants were asked to rate the authenticity of each website on a 7-point scale from 1 (*definitely real*) to 7 (*definitely fake*). Finally, participants were asked to rate their confidence in their response on a 7-point scale from 1 (*not at all confident*) to 7 (*very confident*). After the website discrimination task participants were asked about their Internet use in the last 6 months as well as their familiarity with the websites used in the study.

#### 2.1.3. Analytical reasoning

The Cognitive Reflection Test (CRT; Frederick, 2005) is a measure of the propensity to engage in analytical reasoning. The CRT asks participants to answer three questions each of which has an intuitive (System 1) response and a correct (System 2) response. Specifically, the CRT asks the following.

1. A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?
2. If it takes 5 machines 5 min to make 5 widgets, how long would it take 100 machines to make 100 widgets?
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

The intuitive responses to these three questions are 10 cents, 100 min, and 24 days respectively. The correct responses which engage analytical reasoning are 5 cents, 5 min, and 47 days respectively. The total number of correct responses (0–3) was our index of analytical reasoning.

#### 2.1.4. Internet Knowledge

Finally as past research has highlighted how Internet knowledge/experience shapes responses to phishing attempts (e.g., Dhamija et al., 2006; Downs et al., 2007; Vishwanath et al., 2011) we included a measure of Internet knowledge (Potosky, 2007). Internet knowledge is defined as "what people know about the Internet as well as the various kinds of things people are able to do using the Internet" (Potosky, 2007, p. 2761). On the Internet knowledge measure participants rate their level of agreement on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*) with 14 statements related to general knowledge (e.g., "I understand most computer terms that have to do with the Internet"') and problem solving (e.g., "I know some good ways to avoid computer

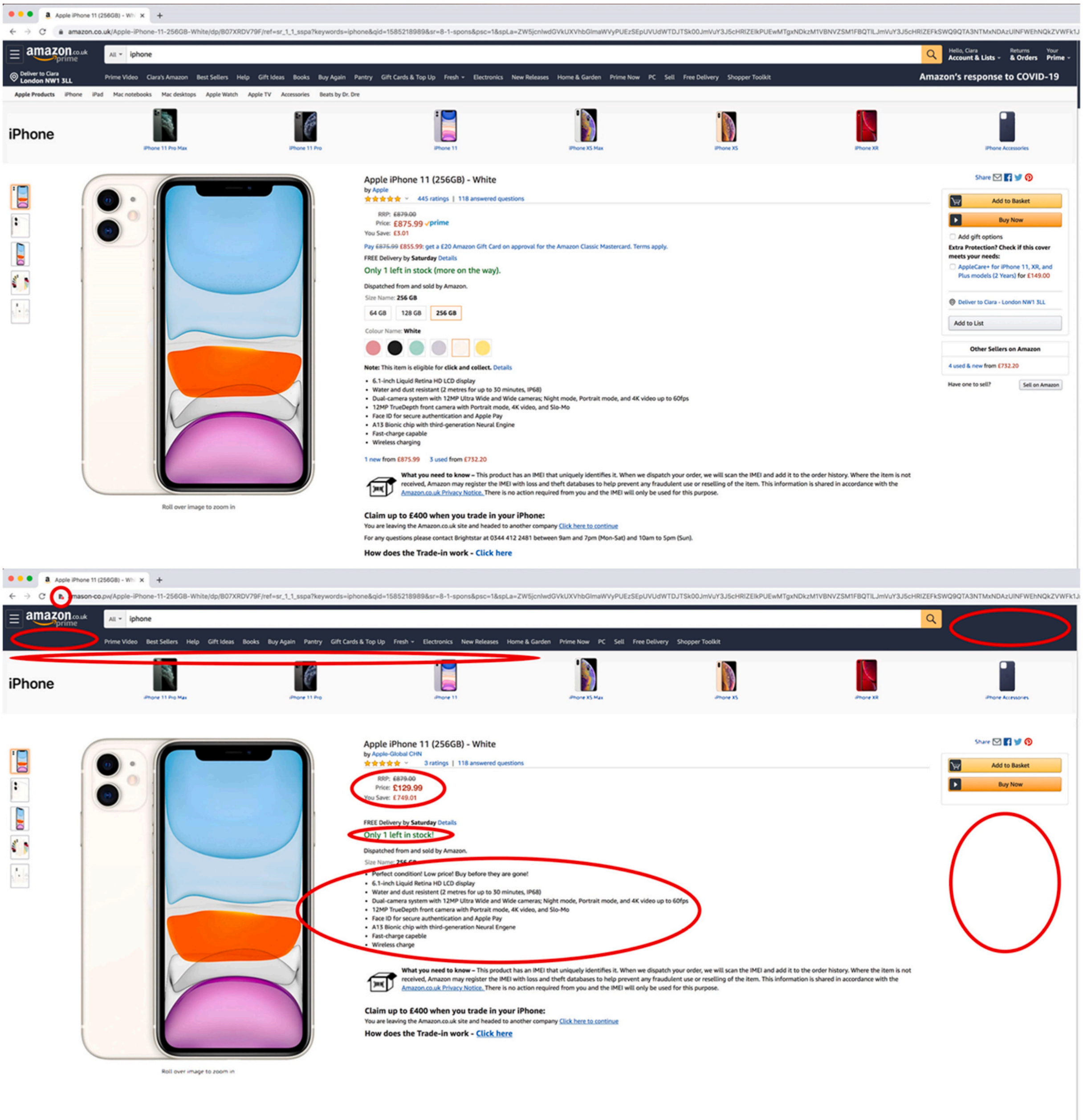


**Fig. 1.** Example real (top) and fake (bottom) screenshots used in the current research.
Note. Red-flag features for identifying fake websites (Which?, 2020; The SSL,Store™, 2018) are circled in red.

viruses"). In this study, Internet knowledge was assessed on scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Average scores ranged from 1.29 to 7.00 ($M = 5.04$, $SD = 1.10$, $\alpha = 0.92$).

## 2.2. Results

### 2.2.1. Discriminability index

The average inauthenticity rating of fake websites ($M = 5.48$, $SD = 1.14$) was higher than real websites ($M = 2.78$, $SD = 1.13$), $F(1, 298) = 797.52$, $p < .001$, partial $\eta^2 = 0.728$. We then computed the discriminability index (fake – real) for each participant with larger values reflecting better discriminability. In this study, discriminability scores ranged from −1.00 to 6.00 and the average score was 2.70 ($SD = 1.65$).

### 2.2.2. Covariates

Males ($M = 2.91$, $SD = 1.65$) discriminability scores were higher than females ($M = 2.51$, $SD = 1.65$), $F(1, 205) = 4.08$, $p = .044$, partial $\eta^2 = 0.014$. Age was associated with worse discriminability ($r = -0.27$, $p < .001$). Internet knowledge ($r = 0.40$, $p < .001$) was associated with better discriminability. See Table 1.

**Table 1**
Descriptive statistics and bivariate correlations (Study 1).

| | Variable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **1.** | Discriminability | – | | | | |
| **2.** | Real | −.73*** | – | | | |
| **3.** | Fake | .73*** | −.06 | – | | |
| **4.** | CRT | .18** | −.10† | .16** | – | |
| **5.** | iKNOW | .40*** | −.34*** | .23*** | .09 | – |

Note. – Discriminability = Real – Fake; CRT = Cognitive Reflection Task; iKNOW = Internet Knowledge. We used the following schema to indicate significance: †p < .10; *p < .05; **p < .01; ***p < .001.

#### 2.2.3. Main analyses

Consistent with our hypothesis, higher levels of analytical reasoning (as measured by the CRT) was associated with better discriminability, $r$ (293) = 0.18 $p$ = .002. Next, we conducted a hierarchical multiple regression to examine whether analytical reasoning continues to predict discriminability above and beyond the significant covariates above. In the first step, Internet knowledge ($\beta = 0.33$, $t = 5.35$, $p < .001$, partial $r$ = .32) predicted better discriminability whereas age ($\beta = -0.19$, $t = -3.25$, $p = .001$, partial $r = -0.20$) predicted worse discriminability. Sex ($\beta = 0.02$, $t = 0.34$, $p = .736$, partial $r = .02$) was not significantly associated with discriminability. Overall, the model was significant, $F$ (3, 260) = 20.01, $p < .001$ and predicted approximately 18% of the variance in discriminability (adjusted R2 = 0.178). In the second step analytical reasoning was entered. It was a significant predictor of discriminability ($\beta = .14$, $t = 2.46$, $p = .014$, partial $r = .15$). The second model was significant, $F$ (4, 259) = 16.81, $p < .001$ and predicted approximately 19% of the variance in discriminability (adjusted R2 = 0.194). Crucially, the second model fit significantly better and including analytical reasoning in the model explained approximately 2% more variance in discriminability, $F$change (1, 259) = 16.31, $p$ = .014, R2 change = 0.019).

### 2.3. Discussion

Taken together with Supplemental Studies 1–2 we show that greater analytical reasoning is associated with better discriminability, this time in a representative of the UK population in terms of age, sex, and ethnicity. These results are consistent with research suggesting that analytical reasoning enables individuals to discern fact from fiction (Alsuhibani et al., 2022; Pehlivanoglu et al., 2021; Pennycook et al., 2012; Pennycook et al., 2015; Pennycook & Rand, 2019, 2021; Swami et al., 2014) and detect phishing attempts (Ackerley et al., 2022; Bayl-Smith et al., 2020; Jones et al., 2019; Yan & Gozu, 2012).

In the next study we sought to identify a boundary condition of this effect: expertise.

## 3. Study 2

Expertise refers to "the ability, acquired by practice, to perform qualitatively well in a particular task domain" (Frensch & Sternberg, 1989, p. 158). How may intuitive versus analytical processing bear on experts ability to discern real from fake websites? Research reports that experts tend to rely more on intuitive than analytical processing when making decisions in their domain of expertise (Dane et al., 2012; Grant &Nilsson, 2020; Patel & Itri, 2022; Vincent et al., 2019). Previous research has reported that performance on the CRT is driven more strongly by analytical than intuitive processing (Pennycook et al., 2015). If experts rely less on analytical reasoning in their domains of expertise and CRT scores are more strongly driven by analytical reasoning, then one hypothesis is that CRT scores will not predict discriminability in an expert sample. Support for this hypothesis would suggest that expertise presents a boundary condition of the link between analytical reasoning and discriminability. However, while experts may rely more on intuitive than analytical processing in their domains of expertise, reliance on intuition can lead to poor performance among experts in the context of hiring decisions (Highhouse, 2008) and predicting employee performance (Sleesman et al., 2022). Then an alternative hypothesis would predict that CRT scores may be associated with better discriminability in an expert sample. To test these hypotheses, we recruited a sample of participants working in the field of information technology from Prolific and asked them to complete the same measures as Study 1.

### 3.1. Method

#### 3.1.1. Participants and procedure

As in Study 1 we sought to sample approximately 300 participants. We slightly under sampled as 298 participants completed our study entitled "Reactions to websites" via the online platform Prolific (https://www.prolific.co). Ten participants were excluded because they indicated at the end of the that their data should not be used in our analyses leaving 288 participants. This sample allows us to detect effects as small as $r = 0.16$ with 80% power. Participants were 18–72 years old ($M_{years} = 38.96$, $SD_{years} = 12.14$) UK residents working in Information Technology. Participants were primarily male ($N = 186$, 64.58%). Participants completed the website discrimination task, the CRT, and the Internet knowledge measure. In this study, Internet knowledge was assessed on scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Average scores ranged from 3.57 to 7.00 ($M = 6.03$, $SD = 0.75$, $\alpha = 0.88$).

### 3.2. Results

#### 3.2.1. Discriminability index

The average inauthenticity rating of fake websites ($M = 5.84$, $SD = 1.04$) was higher than real websites ($M = 2.26$, $SD = 0.95$), $F$ (1, 287) = 1599.54, $p < .001$, partial $\eta^2 = 0.848$. We then computed the discriminability index (fake – real) for each participant with larger values reflecting better discriminability. In this study, discriminability scores ranged from −0.50 to 6.00 and the average score was 3.58 ($SD = 1.52$).

#### 3.2.2. Covariates

Males ($M = 3.63$, $SD = 1.52$) discriminability scores were not significantly different than females ($M = 3.47$, $SD = 1.52$), $F$ (1, 280) = 0.68, $p = .415$, partial $\eta^2 = 0.002$. Age was associated with worse discriminability ($r = -0.23$, $p < .001$). Internet knowledge ($r = 0.39$, $p < .001$) was associated with better discriminability. See Table 2.

#### 3.2.3. Main analyses

Consistent with our boundary condition hypothesis, analytical reasoning was not significantly correlated with discriminability in a high expertise sample, $r = 0.10$ $p = .10$. Next, we conducted a hierarchical multiple regression to examine whether analytical reasoning predict discriminability above and beyond the significant covariates above. In the first step, Internet knowledge ($\beta = 0.36$, $t = 6.63$, $p < .001$, partial $r$ = .32) predicted better discriminability whereas age ($\beta = -0.20$, $t = -3.65$, $p < .001$, partial $r = -0.21$) predicted worse discriminability. Overall, the model was significant, $F$ (2, 279) = 31.19, $p < .001$ and predicted approximately 18% of the variance in discriminability (adjusted R2 = 0.177). In the second step analytical reasoning was entered. It was not a significant predictor of discriminability ($\beta = .07$, $t = 1.16$, $p = .245$, partial $r = .07$). The second model was significant, $F$ (3, 278) = 21.27, $p < .001$ and predicted approximately 18% of the variance in discriminability (adjusted R2 = 0.178). The second model did not fit significantly improve model fit, $F$change (1, 278) = 1.36, $p = .245$, R2 change = 0.004).

Last we tested whether the correlation between analytical reasoning and discriminability observed among experts was significantly weaker than the correlation observed our first three studies (Study 1, Supplemental Studies 1–2). First, we conducted an internal meta-analysis (Goh et al., 2016) to obtain a more precise estimate of the association between analytical reasoning and discriminability across Study 1 and

**Table 2**
Descriptive statistics and bivariate correlations (Study 2).

| | Variable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **1.** | Discriminability | – | | | | |
| **2.** | Real | −.74*** | – | | | |
| **3.** | Fake | .79*** | −.16* | – | | |
| **4.** | CRT | .10† | −.12† | .04 | – | |
| **5.** | iKNOW | .39*** | −.31** | .30*** | .20*** | – |

Note. – Discriminability = Real – Fake; CRT = Cognitive Reflection Task; iKNOW = Internet Knowledge. We used the following schema to indicate significance: †p < .10; *p < .05; **p < .01; ***p < .001.

Supplemental Studies 1–2. This analysis suggests that the correlation between analytical reasoning and discriminability was moderate in size, $r = 0.23$, $SE = 0.04$, $Z = 6.20$, 95% CI [0.16, 0.30]. Further, this association was significantly larger than the correlation between analytical reasoning and discriminability among experts ($r = 0.10$), $Z = 2.31$, $p = .010$. Finally, the correlation among experts the was also not significantly different from zero, $t = 1.68$, $p = .10$.

### 3.3. Discussion

Boundary conditions place limits on the generalizability of a theory and to that end are a crucible of theory testing (Busse et al., 2017). In a sample of putative Internet experts –Information Technology professionals – analytical reasoning did not predict discriminability. Furthermore, this association was significantly weaker than the meta-analytic estimate observed in non-experts and not significantly different from zero. This finding is consistent with previous research demonstrating that experts do not rely on analytical reasoning to make decisions in their domain of expertise (e.g., Dane et al., 2012; Grant; Nilsson, 2020; Patel & Itri, 2022; Vincent et al., 2019). Although Studies 1–2 as well as our supplemental studies demonstrate a reliable association between analytical reasoning and discriminability we are unable to make directional claims. To address this issue, we used experimental methods in Studies 3–4.

## 4. Study 3

Researchers (e.g., Fiske & Taylor, 1991) often cast individuals as “cognitive misers” who preferentially engage the intuitive (System 1) over the analytical (System 2). This preference emerges particularly when resources such as time are scarce. For example, research shows that when participants are under explicit time pressure (e.g., De Dreu, 2003; Evans & Curtis-Holmes, 2005; Roskes et al., 2013, Study 3; Schroyens et al., 2003) they are more likely to engage the intuitive system. Moreover, a meta-analysis shows that time pressure weakens the effects of reflective, analytical thinking (Phillips et al., 2016). Similarly, web-based fraudsters prime consumers to engage the intuitive system by pressuring them to act quickly to respond to scams (e.g., phishing, Wang et al., 2012). Thus, Study 3asked participated to evaluate the authenticity of websites under explicit time pressure or free from time pressure. Insofar as time pressure engages the intuitive system, we predicted that it would cause a decrease in discriminability.

### 4.1. Participants and procedure

We conducted a power analysis in G*Power 3.1 (Faul et al., 2009). We sought to sample at least 146 participants to detect effects as large as the meta-analytic estimate above ($r = 0.23$; Cohen’s $d = 0.47$) with 80% power. We oversampled as 202 participants via Prolific (https://www.prolific.co). We stratified recruitment evenly among the following age groups: younger adults (18–40), middle-aged adults (41–64) and older adults (65+). Participants were 18–80 years old ($M_{years} = 48.06$, $SD_{years} = 17.98$) UK residents who were primarily female ($N = 118$, 58.42%). Participants first completed a website discrimination task with or without time pressure. Afterward they completed the CRT and the Internet knowledge measure which was administered on scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Average scores ranged from 1.43 to 5.00 ($M = 3.78$, $SD = 0.86$, $\alpha = 0.93$).

#### 4.1.1. Time pressure manipulation

Given that Supplemental Study 2 used an age-stratified sample, we used participants average time to complete the website discrimination task from Supplemental Study 2 to guide our time pressure manipulation. In the *time pressure* condition participants were asked to evaluate each website quickly. Specifically, they were given 1 standard deviation below the average completion time from Supplemental Study 2 to evaluate each website. Given that in Supplemental Study 2 we observed a pronounced effect of age group on completion time with the oldest group taking the most time[1] we calibrated the time pressure manipulation within group. Thus, younger adults (18–40) were given 5 s to evaluate each website, middle-aged adults (41–64) were given 10 s to evaluate each website, and older adults (65+) were given 15 s to evaluate each website.

#### 4.1.2. Pilot testing

We conducted a pilot study to examine the efficacy of the time pressure manipulation. Sixty participants (20 per age group) viewed the same websites from the studies above with and without time pressure in a counterbalanced order. After they viewed each website, they evaluated its authenticity and reported on subjective feelings of pressure to respond quickly. As intended, participants reported significantly greater feelings of pressure on websites with time pressure ($M = 4.33$, $SD = 1.66$) compared to websites without time pressure, $M = 2.39$, $SD = 1.34$), $F\,(1, 54) = 64.26$, $p < .001$, partial $\eta^2 = 0.543$. There was no effect of age group on feelings of pressure, $F\,(2, 54) = 1.23$, $p = .301$, partial $\eta^2 = 0.043$. Moreover, there was no time pressure × age-group interaction, $F\,(2, 54) = 0.99$, $p = .379$, partial $\eta^2 = 0.035$. The results of this pilot testing suggest that the time pressure manipulation is effective and equivalently effective across age groups.

### 4.2. Results

#### 4.2.1. Discriminability index

As expected, the average inauthenticity rating of fake websites ($M = 5.23$, $SD = 1.08$) was higher than real websites ($M = 3.01$, $SD = 1.08$), $F\,(1, 210) = 399.28$, $p < .001$, partial $\eta^2 = 0.665$. We then computed the discriminability index (fake – real) for each participant with larger values reflecting better discriminability. In this study, discriminability scores ranged from −0.83 to 6.00 and the average score was 2.22 ($SD = 1.58$).

#### 4.2.2. Main analyses

We evaluated participant’s discriminability in a 2 (Time Pressure: Yes vs. No) × 3 (Age Group: 18–40; 41–64; 65+) between-subjects ANCOVA, controlling for Internet knowledge. Consistent with our hypothesis, participants evaluating websites under time pressure websites ($M = 1.89$, $SD = 1.49$) were significantly worse at discriminating real from fake websites compared to those evaluating websites without time pressure websites ($M = 2.54$, $SD = 1.60$), $F\,(1, 195) = 9.02$, $p = .003$, partial $\eta^2 = 0.044$. Age Group did not significantly influence discriminability, $F\,(2, 195) = 2.53$, $p = .114$, partial $\eta^2 = 0.022$. The Time Pressure × Age Group interaction was not significant, $F\,(2, 195) = 1.26$, $p = .286$, partial $\eta^2 = 0.013$. See Fig. 2.

Next, we sought to explore the extent to which the effects of time pressure above were moderated by individual differences in analytical reasoning ability. Accordingly, we explored the effects of time pressure, CRT scores, and their interaction on discriminability. As above, the presences (vs. absence) of time pressure decreased discriminability, $B = -0.69$, $SE = 0.34$, $t = -2.00$, $p = .047$. Consistent with the studies above, CRT scores were associated with better discriminability, $B = 0.41$, $SE = 0.13$, $t = 3.22$, $p = .002$. The Time Pressure × CRT interaction was not significant, $b = -0.05$, $SE = 0.19$, $t = -0.24$, $p = .808$.

### 4.3. Discussion

When resources like time are scarce, people preferentially engage the

[1] In Supplemental Study 2, the average time to evaluate each website for each of the age stratified groups was as follows: younger adults ($M = 19.65$, $SD = 15.87$), middle-aged adults ($M = 23.18$, $SD = 14.10$) and older adults ($M = 33.33$, $SD = 19.79$), $F\,(2, 196) = 11.86$, $p < .001$, partial $\eta^2 = 0.108$.

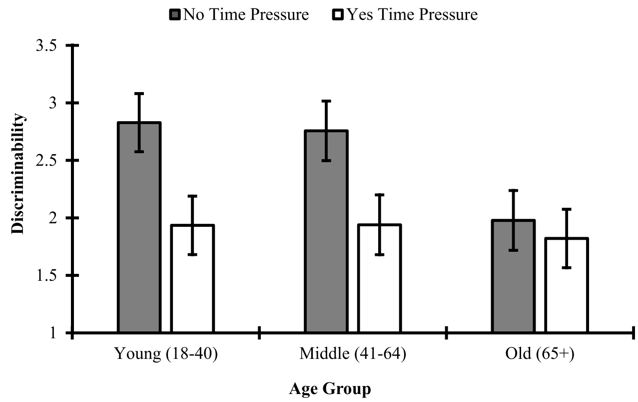


**Fig. 2.** The effect of time pressure on discriminability (Study 3).
Note. Error bars reflect ± 1SD from the mean. Discriminability was quantified as the different in inauthenticity ratings between fake and real websites (Fake – Real). Larger values on this index reflect simultaneously a greater tendency to rate fake websites as fake and real websites as real.

intuitive system. Accordingly, we observed that time pressure caused a decrease in discriminability. We also again observed that individual differences in analytical reasoning ability increased discriminability. Although we can infer based on theory and research that the effects of time pressure are due to a reduction in analytical reasoning, Study 3 only offers indirect support for the hypothesis that analytical reasoning influences discriminability. In Study 4 we offer a more direct experimental test of the role of analytical reasoning in discriminability.

## 5. Study 4

In Study 3 we found initial evidence that analytical reasoning may influence the ability to dissociate real from fake websites. However, in Study 3 we can only speak to the effect of impaired analytical reasoning (via time pressure) on reduced discriminability. We are unable to say whether a manipulated *increase* in analytical reasoning increases discriminability. Studies inspired by research on cognitive disfluency (Alter, 2013; Alter & Oppenheimer, 2009) initially found that completing the CRT in a difficult (vs. easy) to read font reduced CRT performance (Alter et al., 2007) but other research has shown that disfluency is not a robust method for inducing analytical reasoning under any circumstances (e.g., Meyer et al., 2015; Thompson et al., 2013). Instead of a disfluency manipulation, we asked participants to prioritize speed or accuracy as they completed the CRT to prime System 1 and System 2 respectively. First, we predicted that participants in the accuracy condition would perform better on the CRT. Second, we predicted that participants in the accuracy (vs. speed) condition would perform better on the website discrimination task indirectly via their increased CRT performance.

### *5.1. Method*

#### *5.1.1. Participants and procedure*

In Study 4 we sought to sample approximately 278 participants to detect small-to-medium effects ($d = 0.30$) with 80% power based on a power analysis conducted in G*Power 3.1 (Faul et al., 2009). Due to failures to replicate research with disfluency manipulations we used a more cautious effect size estimate from Study 3. We slightly oversampled and 300 participants completed the study via Prolific. Twelve participants were excluded because they indicated at the end of the that their data should not be used in our analyses leaving 288 participants. Participants were 18–67 years old ($M_{years} = 25.82$, $SD_{years} = 8.08$) UK residents who were primarily male ($N = 170$, 59.03%). Participants were randomly assigned to prioritize speed or accuracy as they completed the CRT. Participants in the *speed condition* ($n = 143$) were told to "work as quickly as possible" as they completed the CRT. Participants in the *accuracy condition* ($n = 145$) were told to "work as accurately as possible" as they completed the CRT. Immediately afterward they completed the website discrimination task and the Internet knowledge measure. In this study Internet knowledge was assessed on scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Average scores ranged from 2.71 to 7.00 ($M = 5.29$, $SD = 0.97$, $\alpha = 0.92$).

### *5.2. Results*

To test our hypotheses, we conducted a mediation analysis using Model 4 of the Process Macro (Hayes, 2017). First, as predicted, accuracy (vs. speed) increased CRT performance (i.e., the *a* path), $B = 0.31$, $SE = 0.14$, $t = 2.24$, $p = .026$, 95% CI [0.04, 0.58]. Moreover, CRT scores were associated with better discriminability (i.e., the *b* path), $B = 0.32$, $SE = 0.08$, $t = 3.19$, $p = .002$, 95% CI [0.10, 0.43]. Consistent with our second hypothesis, the indirect of accuracy (vs. speed) on discriminability via CRT (*ab*) was significant, $ab = 0.08$, $SE = 0.05$, 95% CI [0.01, 0.18]. Finally, the partially standardized indirect effect (Preacher & Kelley, 2011) was small-to-moderate in size, $ab_{ps} = .05$, $SE = 0.03$, 95% CI = [0.01, 0.11]. Controlling for Internet knowledge did not change the interpretation of the results.[2] See Fig. 3.

### *5.3. Discussion*

In Study 4 we primed participants to engage in System 1 (intuitive) or System 2 (analytical) processing by asking them to prioritize speed or accuracy as they completed the CRT. Consistent with our hypothesis, those prime to engage System 2 (vs. System 1) performed better on the CRT. As a result of this increased CRT performance, those for engaged System 2, performed better on the website discrimination task. These results replicate and extend Study 3 and show that analytical reasoning may influence the ability to discriminate real from fake websites. In the next study we examined whether expertise represents a boundary condition on this pathway, as it did in Study 2.

## 6. Study 5

In Study 2 we found evidence that expertise represents a boundary condition of the association between analytical reasoning ability and discriminability. The purpose of Study 5 was to re-examine this boundary condition in the casual pathway identified in Study 4. Accordingly, in Study 5 we recruited a sample of experts (i.e., participants working in Information Technology) and asked participants to prioritize speed or accuracy as they completed the CRT to prime System 1 and System 2 respectively. Afterward, they completed the website discrimination task. Based on past research showing that experts do not rely on analytical reasoning in their domain of expertise (e.g., Dane et al., 2012; Grant; Nilsson, 2020; Patel & Itri, 2022; Vincent et al., 2019) we predicted that expertise would represent a boundary condition of our experimental effects as it did with our correlational effects in Study 2. Accordingly, we predicted that priming a group of experts to prioritize accuracy (vs. speed) would not increase CRT scores or indirectly increase discriminability.

### *6.1. Method*

#### *6.1.1. Participants and procedure*

As in Study 4 we sought to sample approximately 278 participants to detect small-to-medium effects ($d = 0.30$) with 80% power based on a power analysis conducted in G*Power 3.1 (Faul et al., 2009). We slightly

[2] Age was not significantly related to discriminability in this study thus we did not consider it as a covariate in this study.

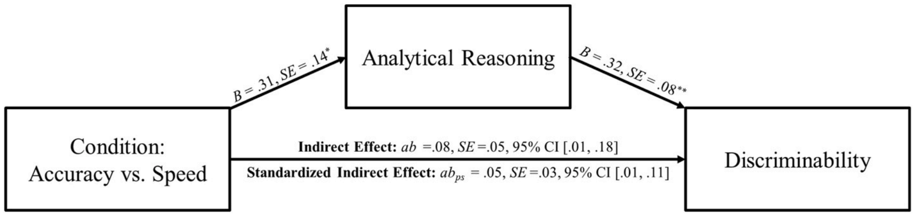


**Fig. 3.** Accuracy (vs. speed) priming increases CRT scores and indirectly increases discriminability (Study 4).
Note. Parameter estimates are unstandardized unless otherwise noted. Standard errors and 95% confidence intervals for the indirect effect were calculated with the percentile bootstrap approach based on 10,000 bootstrap samples (Hayes, 2017). We used the following schema to indicate significance: *p < .05; **p < .01.

oversampled as 301 participants completed our study via Prolific. Four participants were excluded because they indicated at the end of the that their data should not be used in our analyses leaving 297 participants. Participants were 18–65 years old ($M_{\text{years}} = 30.49$, $SD_{\text{years}} = 8.87$) UK residents who were primarily male ($N = 241$, 81.14%). Participants were randomly assigned to prioritize speed or accuracy as they completed the CRT. Participants in the *speed condition* ($n = 150$) were told to "work as quickly as possible" as they completed the CRT. Participants in the *accuracy condition* ($n = 147$) were told to "accurately as possible" as they completed the CRT. Immediately afterward they completed the website discrimination task and the Internet knowledge measure. In this study Internet knowledge was assessed on scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Average scores ranged from 3.14 to 7.00 ($M = 6.14$, $SD = 0.68$, $\alpha = 0.85$).

### 6.2. Results

As in Study 4, we conducted a mediation analysis using Model 4 of the Process Macro (Hayes, 2017). First, as predicted based on our boundary condition hypothesis, accuracy (vs. speed) did not significantly influence CRT performance (i.e., the *a* path) in experts, $B = 0.19$, $SE = 0.13$, $t = 1.46$, $p = .147$, 95% CI [-0.07, 0.46]. Moreover, CRT scores were associated with better discriminability (i.e., the *b* path), $B = 0.30$, $SE = 0.08$, $t = 3.72$, $p < .001$, 95% CI [0.14, 0.46]. Again, consistent with our boundary condition hypothesis, the indirect of accuracy (vs. speed) instruction on discriminability via CRT (*ab*) was not significant, $ab = 0.06$, $SE = 0.04$, 95% CI [-0.02, 0.16]. Controlling for Internet knowledge did not change the interpretation of the results.[3]

### 6.3. Discussion

In Study 5 we re-tested the hypothesis that expertise represents a boundary condition in the relationship between analytical reasoning and discriminability. Recall that in Study 2, we found correlational evidence that analytical reasoning (i.e., CRT scores) were not significantly associated with discriminability in a group of experts. Here we re-tested that hypothesis using experimental rather than correlational methods. In Study 5, expert participants were primed to engage System 2 (or not) before the website discrimination task. System 2 priming did not facilitate discriminability for experts like it did for non-experts (Study 4). Insofar as experts rely less on analytical reasoning in their domain of expertise – in this case making judgements about the veracity of websites for a group of IT workers – these results are consistent with a boundary condition interpretation and Study 2. Collectively, these first 8 studies (Studies 1–5, Supplemental Studies 1–3) provide robust evidence that among non-experts analytical reasoning leads to better ability to discriminate real from fake websites. In our final study we examined a possible mechanism for this effect – memory recall.

[3] Age was not significantly related to discriminability in this study. Thus we did not consider it as a covariate in this study.

## 7. Study 6

Researchers have shown that analytical reasoning increases memory and learning of novel information in laboratory settings and real-world educational contexts (Diemand-Yauman et al., 2011; Hernandez & Preston, 2013; Katzir et al., 2013; cf.Ilic & Akbulut, 2019; Taylor et al., 2020). In Study 6 we built on this literature and examined whether memory recall drives the link between analytical reasoning and discriminability in two ways. First, we predicted that participants higher in analytical reasoning ability (i.e., higher CRT scores) would recall more information conducive to identifying fake websites and then by virtue of this increased memory recall, perform better on the website discrimination task. Second, building on Study 4, we predicted that this indirect pathway (CRT → recall → discriminability) would be stronger when participants were initially told to prioritize accuracy (vs. speed) at the beginning of the study. To test these hypotheses, participants first viewed a list of tips for spotting fake websites taken from consumer protection websites (See Table 3). Then they completed the CRT, a surprise memory recall test, and the website discrimination task. To control for prior knowledge and memory participants also completed the Internet knowledge measure and a working memory task described below.

### 7.1. Method

#### 7.1.1. Participants and procedure

We implemented the MedPower app (Kenny, 2017) to estimate the sample size required to observe an indirect effect of analytical reasoning (CRT scores) on discriminability via memory recall. We specified small-to-medium relations ($rs = .20$) between analytical reasoning and memory recall (path *a*), memory recall and discriminability (path *b*), and a small direct association ($r = 0.10$) of analytical reasoning with discriminability (path *c*'). Based on these parameters, we were able to detect an indirect effect with 318 participants at 90% power. We sought to at least double this sample size to test our second, moderated-mediation hypothesis. We slightly oversampled, assuming attrition, and 689 participants completed our study via Prolific. Participants were excluded if they indicated at the end of the study that their data should not be used in our analyses ($n = 58$) or if they did not follow directions or complete one of the tasks described below ($n = 23$) leaving 608 participants for the analyses described below. Participants were 18–77 years old ($M_{\text{years}} = 37.23$, $SD_{\text{years}} = 12.66$) UK residents who were primarily female ($N = 357$, 58.72%).

#### 7.1.2. Tips for spotting fake websites

We first presented participants with a list of 15 tips for spotting fake websites (see Table 3). To ensure that participants read each tip and engaged with the task we asked participants to rate their familiarity with each tip on a 5-point scale from 1 (*not at all familiar*) to 5 (*very familiar*). We randomly assigned participants to prioritize accuracy ($n = 307$) or speed ($n = 301$) as they read and rated their familiarity with the tips. Specifically, participants in the *accuracy condition* were told, "In the next task you will be asked to view a series of tips for spotting fake websites.

**Table 3**
Participants prioritized speed or accuracy as they viewed and responded to 15 tips for spotting fake websites (Study 6).

| | Tip Description |
|---|---|
| 1. | **Check the domain name –** domain names of fraudulent websites may have random letters before or after a reputable company or contain spelling mistakes. Domains ending in.net or.org are also rarely used by online shopping so may indicate a scam. |
| 2. | **Never pay by bank transfer –** paying by bank transfer makes it harder for you to get your money back so any website that asks you to do this could be suspicious. Other unusual payments such as MoneyGram can also be an indication of a scam. |
| 3. | **Watch out for poor spelling and grammar –** poor English may be a sign the website is fake. |
| 4. | **Look at contact information –** reputable sites will provide details of how to contact them so if these are missing or only a brief form is provided this is suspicious. |
| 5. | **Check returns policy –** there should be a reasonable returns policy for products sold online. |
| 6. | **Browse the website –** check areas of the website such as the 'about us' section to see what has been written. |
| 7. | **Read online reviews –** it is always worth checking online reviews to see if other people have had bad experiences. |
| 8. | **Look for the padlock next to the website's URL –** this is an indication the website is secure and more likely to be genuine. |
| 9. | **Trust-marks –** trust mark labels can be used to gain your confidence. Check with the trust-mark company. |
| 10. | **The offer is too good to be true –** fraudulent website will try and draw you in with extreme discounts. |
| 11. | **Check if https or http is used –** https is the secure version of http so websites using http are more likely to be fraudulent. |
| 12. | **Graphics and layout –** fraudulent websites can be very convincing but graphics that are not in high resolution and layouts that are slightly off can be indications. |
| 13. | **Check company address –** company addresses should have street names, if the address is just a post box this is suspicious. |
| 14. | **Sense of time urgency –** scammers often put a limited time on deals to make you rush into things without thinking about them. |
| 15. | **Asking for personal information –** never trust a website that asks for personal information such as bank details passwords and access to your computer. |

*Note.* These tips were compiled from four consumer protection websites: (1) Burns, 2018; (2) Citizens,Advice, 2019; (3) Consumer,Consumer Rights, 2020; and (4) ,(n.d.ScamWatch).

After viewing each tip, you will be asked to rate your familiarity with that tip. Please work **as accurately as possible** throughout this task." Participants in the *speed condition* were told, "In the next task you will be asked to view a series of tips for spotting fake websites. After viewing each tip, you will be asked to rate your familiarity with that tip. Please work **as quickly as possible** throughout this task."

#### 7.1.3. Cognitive reflection test

Next, participants completed the CRT. We presented the CRT after the tip presentation in order to provide a buffer before the memory recall task. The total number of correct responses (0–3) was our index of analytical reasoning, and the average total score was 1.26 ($SD = 1.18$, $\alpha = 0.74$).

After the CRT, we gave participants a surprise free-recall memory test. Specifically, we told participants the following: "In the space below please list as many of the tips for spotting fake websites that you can remember. There is no need to list them in a particular order. Simply list as many tips as you can as they come to mind."

Immediately after the memory recall test, participants completed the website discrimination task. In this study, discriminability scores ranged from −0.67 to 5.83 and the average score was 3.72 ($SD = 1.38$).

#### 7.1.4. Working memory capacity

Participants completed an operational span task (OSPAN; Garrison & Schmeichel, 2019) which measures working memory capacity. The OSPAN was modified for online delivery. It measures the capacity a participant has to maintain words in short term memory while they complete mathematical operations. The mathematical operations consisted of simple equations that the participant had to identify as being correct or incorrect by selecting "yes" or "no" (e.g., $3 + 4 = 5$). After each equation a word would be displayed, which they would be asked to recall at the end of the set. There were 16 sets in total ranging from two to five equations and words. In total the OSPAN has 56 equations and words to recall. We quantified working memory capacity as the number of perfect sets ($M = 10.35$, $SD = 4.56$). Afterward, participants completed the Internet knowledge measure. In this study Internet knowledge was assessed on scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Average scores ranged from 1.86 to 7.00 ($M = 5.15$ $SD = 1.02$, $\alpha = 0.91$).

### 7.2. Results

#### 7.2.1. Discriminability index

The average inauthenticity rating of fake websites ($M = 6.10$, $SD = 0.83$) was higher than real websites ($M = 2.38$, $SD = 0.96$), $F(1, 607) = 4448.12$, $p < .001$, partial $\eta^2 = 0.880$. We then computed the discriminability index (fake – real) for each participant with larger values reflecting better discriminability. In this study, discriminability scores ranged from −1.33 to 6.00 and the average score was 3.72 ($SD = 1.38$).

#### 7.2.2. Main analyses

We conducted a moderated-mediation analysis using Model 58 of the Process Macro (Hayes, 2017) to examine whether instructing participants to prioritize accuracy (vs. speed) influences the analytical reasoning → recall → discriminability pathway. First, as predicted, analytical reasoning ability were associated with better tip recall (i.e., the *a* path), $B = 0.24$, $SE = 0.10$, $t = 2.30$, $p = .022$, 95% CI [0.03, 0.44]. Accuracy (vs. speed) instructions did not moderate this association, $B = 0.22$, $SE = 0.14$, $t = 1.52$, $p = .129$, 95% CI [-0.06, 0.49]. Internet knowledge ($B = 0.17$, $SE = 0.08$, $t = 2.01$, $p = .045$, 95% CI [0.00, 0.34]) and working memory capacity ($B = 0.13$, $SE = 0.02$, $t = 6.93$, $p < .001$, 95% CI [0.09, 0.17]) were significant covariates but age was not ($B = -0.01$, $SE = 0.01$, $t = -0.95$, $p = .341$, 95% CI [-0.02, 0.01]).

Second, tip recall was associated was associated with better discriminability (i.e., the *b* path), $B = .07$, $SE = 0.03$, $t = 2.21$, $p = .027$, 95% CI [0.01, 0.14]. Accuracy (vs. speed) instructions trended toward moderating this association, $B = 0.08$, $SE = 0.04$, $t = 1.89$, $p = .062$, 95% CI [0.00, 0.17]. Specifically, tip recall was more strongly associated with discriminability for participants instructed to prioritize accuracy ($B = .16$, $SE = 0.03$, $t = 4.97$, $p < .001$, 95% CI [0.09, 0.22]) compared to speed ($B = 0.07$, $SE = 0.03$, $t = 2.21$, $p = .028$, 95% CI [0.01, 0.14]). Internet knowledge ($B = 0.40$, $SE = 0.05$, $t = 8.17$, $p < .001$, 95% CI [0.31, 0.50]), working memory capacity ($B = 0.03$, $SE = 0.01$, $t = 2.86$, $p = .004$, 95% CI [0.01, 0.06]), and age ($B = -0.02$, $SE = 0.00$, $t = -4.73$, $p < .001$, 95% CI [-0.03, −0.01]) were significant covariates.

Finally, the indirect effect of analytical reasoning on discriminability via tip recall (*ab*) was significant in both participants instructed to prioritize accuracy ($B = .07$, $SE = 0.02$, 95% CI [0.03, 0.12]) and speed ($B = 0.02$, $SE = 0.01$, 95% CI [0.00, 0.04]). The index of moderated mediation (i.e., the difference between conditional indirect effects; Hayes, 2015) was significant, *Index* = 0.05, $SE = 0.02$, 95% CI [0.01, 0.10]) suggesting that the indirect effect was significantly stronger when participants were instructed to prioritize accuracy. See Fig. 4.

### 7.3. Discussion

As in our previous studies analytical reasoning was associated with a greater ability to discriminate real from fake version of popular websites. We show for the first time that this relationship is driven by memory recall. Consistent with research showing that System 2 processing influences learning and memory (Diemand-Yauman et al., 2011; Hernandez & Preston, 2013; Katzir et al., 2013) priming participants to prioritize accuracy (vs. speed) amplified this indirect pathway.

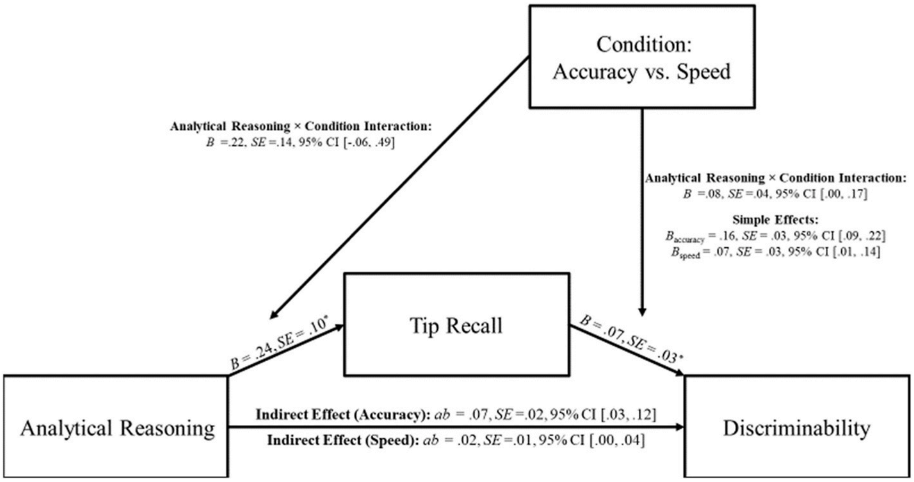


**Fig. 4.** Priming accuracy (vs. speed) modulates analytical reasoning's indirect effect on discriminability via tip recall (Study 6).
*Note.* Parameter estimates are unstandardized unless otherwise noted. Standard errors and 95% confidence intervals for the indirect effect were calculated with the percentile bootstrap approach based on 10,000 bootstrap samples (Hayes, 2017). The index of moderated mediation (i.e., the difference between conditional indirect effects; Hayes, 2015) was significant, *Index* = 0.05, SE = 0.02, 95% CI [0.01, 0.10]) suggesting that the indirect effect was significantly stronger when participants were instructed to prioritize accuracy. We used the following schema to indicate significance: $^*p < .05$.

## 8. General discussion

### 8.1. Summary of findings

As the financial toll associated with responding to fake websites increases and trust is being eroded, government officials, organizations, journalists, IT professionals and behavioural scientists have all highlighted the importance of protecting the public from fraudulent websites. Prior attempts to help protect the public have largely focused on software developments that have attempted to make the Internet a safer place and media literacy solutions to help consumers discern fact from fiction on the Internet (Lee, 2018). However, the very act of visiting a website and the decisions individuals make within those websites continue to confer risk. Despite this fact and the importance placed on web safety, research on psychological processes conferring risk and resilience is limited.

Previous research has observed that individual differences related to analytical reasoning provide a resilience against sources of internet fraud (e.g., Jones et al., 2019) and that analytical reasoning promotes the rejection of misleading, potentially harmful information (Pennycook et al., 2012; Pennycook et al., 2015; Pennycook & Rand, 2019; Swami et al., 2014). The current research represents an important attempt to connect these two literatures. Consistent with hypotheses derived from dual-process models of human cognition we observed that analytical reasoning is robustly associated with a greater ability to discriminate real from fake versions of popular websites. We found evidence in support of this hypothesis in individual difference studies using both convenience and representative samples (Studies 1–4). We also found evidence for this hypothesis experimentally by inducing time pressure (Study 3) and instructing participants to engage System 1 versus System 2 (Study 4). Furthermore, we also identified expertise as a boundary condition of both our individual differences (Study 2) and experimental (Study 5) effects. Finally, we showed that the link between analytical reasoning and discriminability is mechanistically driven by memory recall (Study 6). This robust evidence that analytical reasoning is associated with and predicts better discriminability should be considered by software developers, organizations, and policy makers focused on web-based fraud prevention.

### 8.2. Implications

In line with dual process theories of human cognition we observed, for the first time, that analytical reasoning is associated with a greater ability to discriminate fake from real websites. Moreover, we also show that analytical reasoning influences discriminability. These findings are generally consistent with prior research which finds that analytical reasoning is associated with the tendency to reject misleading, potentially harmful information such as conspiracy theories (e.g., Swami et al., 2014), paranormal beliefs (e.g., Pennycook et al., 2012), "pseudo-profound bullshit" (Pennycook et al., 2015) and fake news (Pehlivanoglu et al., 2021; Pennycook & Rand, 2019). By showing that analytical reasoning confers resilience against fraudulent websites, the current research conceptually replicates prior research and demonstrates the broader explanatory power of analytical reasoning to protect individuals from harmful, misleading information.

The results of the current research have implications for understanding the role motivated reasoning plays in discerning fact from fiction. Previous research has linked lower levels of analytical reasoning with the endorsement of conspiracy theories (e.g., Swami et al., 2014), paranormal beliefs (e.g., Pennycook et al., 2012), "pseudo-profound bullshit" (Pennycook et al., 2015) and fake news (Pehlivanoglu et al., 2021; Pennycook & Rand, 2019). Conspiracy theories, paranormal beliefs, and fake news typically involve deeply held, personally relevant beliefs. As a result, they are difficult to separate from goal-oriented motivated reasoning accounts. Consistent with a goal-oriented motivated reasoning perspective, researchers have found that analytical reasoning can increase motivated reasoning about politically charged topics (e.g., Kahan et al., 2012; Kahan et al., 2017) which in turn can lead to belief in false or misleading information. Our results are unlikely to be drive by goal-oriented motivated reasoning (Kunda, 1990) or non-motivated reasoning accounts (Pennycook & Rand, 2021). Rather our results are best understood through the lens of accuracy-oriented motivated reasoning. People are likely to engage in accuracy-oriented motivated reasoning when the stakes of being wrong are high (Kunda, 1990). Consistent with this view, mistaking a fake website as real can have immediate (e.g., paying for products that will never arrive) and enduring (e.g. identity theft) financial costs to individuals. Given these potential costs, accuracy-oriented rather than goal-oriented motivated reasoning or a non-motivated reasoning account is the most likely explanation for the link higher analytical reasoning and the ability to spot fake websites. Taken together with past research, the current studies enrich our understanding of the role motivation reasoning plays in detecting fake or misleading information.

This research also has implications for the study personality and individual differences within the context of Internet fraud susceptibility. Previous research has observed that a variety of traits that are associated with Internet fraud susceptibility. For example, Big Five traits (Cho et al., 2016, pp. 7–13; Hong et al., 2013, pp. 1012–1016; Judges et al., 2017; Pattinson et al., 2011), cognitive ability (James et al., 2014; Judges et al., 2017), Internet knowledge (e.g., Internet knowledge/-experience (e.g., Dhamija et al., 2006; Downs et al., 2007; Vishwanath et al., 2011), trust/gullibility (Fischer et al., 2013), risk-taking tendencies (Moody et al., 2017), and self-control (Holtfreter et al., 2008) are all confer risk for or resilience against Internet fraud. This research has largely been inspired by the ELM of persuasion (Petty & Cacioppo, 1986) which proposes that persuasion follows one of two paths. Whereas the central route (i.e., System 2) is slow and deliberate the peripheral route (i.e., System 1) is fast and automatic. While the ELM represents an application of dual process theories of human cognition to persuasion, research explicitly linking these dual processes to Internet fraud susceptibility have been limited. In the current research, we offer robust evidence that the activation of these systems, rather than the traits that subserve them, impact Internet fraud susceptibility. Thus, rather than focusing on individual traits, future research should continue to examine how the activation of these systems predicts fraud susceptibility in various contexts.

To date, reliable methods for experimentally testing the impact of analytical reasoning ability have been limited. Studies inspired by research on cognitive disfluency were initially thought to be a fruitful avenue for testing this hypothesis (e.g., Alter et al., 2007) but recent research has shown that disfluency is not a robust method for inducing analytical reasoning under any circumstances (e.g., Meyer et al., 2015; Thompson et al., 2013). The current research offers a reliable alternative. In Study 4, rather than presenting the CRT is a disfluent font we asked participants to prioritize speed or accuracy as they completed the CRT. The manipulation was effective and impacted both CRT scores and discriminability. Moreover, this manipulation offers a degree of sensitivity as it modulated performance in the general population (Study 4) but not experts (Study 5). Finally, asking participants to prioritize accuracy (versus speed) also impacted the link between memory and discriminability (Study 6). Collectively, these studies suggest that accuracy (versus speed) priming may offer a reliable experimental method for examining the effects of analytical (vs. intuitive) processing on a wide range of behaviours.

In addition to analytical reasoning, we also observed that Internet knowledge was an especially strong predictor of discriminability. Prior knowledge is among the most critical variables influencing evaluative information processing from the perspective of the ELM (Petty & Cacioppo, 1986). Consistent with this view, Study 6 showed that the ability to recall previously presented tips for spotting fake websites drove the link between analytical reasoning ability and discriminability. Moreover, we show that this pathway was strengthened when participants were primed to engage System 2 and prioritizes accuracy over speed. Thus, another recommendation for educators, organizations, researchers, and policy makers is to explore low-cost interventions to facilitate widespread knowledge. Such an endeavour will help combat the influence of fake websites and the current research suggest that attempts to prime analytical reasoning should form the lynchpin of these interventions.

### *8.3. Limitations and future directions*

Several limitations speak to the generalizability of the current set of studies. The first of these limitation concerns the selection of websites. In the current research participants viewed screenshots depicting real and fake versions of the following six websites in a randomised order: Amazon. co.uk, ASOS.com, Lloyds Bank, the World Health Organization COVID-19 donation website, PayPal, and HMRC (GOV.UK Verify). These websites were selected because they are among the most visited websites in the UK. Even so, they are not necessarily representative of the fake websites that people typically come across. Future studies using more representative websites are needed. Related to this issue, we asked participants to view and evaluate static images of websites which does not map directly on web browsing behavior. Future studies examining how analytical reasoning relates to and influences real time web-browsing behavior are needed.

In the current research we relied primarily on self-report measures of analytical reasoning ability, particularly the CRT. A key limitation of the CRT is its reliance on math ability (Sinayev & Peters, 2015; Sirota et al., 2021) Although the CRT does reflect, in part, math ability, mathematical modelling approaches (e.g., Campitelli & Gerrans, 2014) suggest that models which also include an inhibition parameter fit the data better than models that only include math ability. Moreover, we show in Supplemental Study 3 that the association between analytical reasoning and discriminability replicates with measure besides the CRT. Recently researchers have developed innovative, new measures of analytical reasoning that do not require math (Sirota et al., 2021), and future research should continue to explore the relationship between analytical reasoning and discriminability with a wider range of measures beyond the CRT.

While self-report measures have offered us important insights into the link between analytical reasoning and discriminability in the current research, they are not ideal for examining real time variation in web-browsing behavior. Electroencephalographic (EEG) research has observed that intuitive processing (System 1) is associated with greater parietal alpha EEG activity whereas analytical (System 2) processing is associated with increase in frontal theta EEG activity (Williams et al., 2019). Future research should examine how these neural markers of intuitive and analytical processing impact Internet fraud susceptibility in real time. Such an endeavour would extend the neuroscience of consumer behavior (Morin, 2011) into the domain of consumer protection.

## 9. Conclusion

The Internet is a technological marvel that has revolutionized education, communication, and commerce. With the proliferation of the Internet has also come scammers, whose fraudulent websites have profound psychosocial and financial costs. The current research demonstrates that analytical reasoning may confer resilience to consumers against the machinations of Internet scammers.

## Credit statement

**Nicholas J. Kelley**: Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Project administration. **Anna L. Hurley-Wallace:** Investigation, Methodology, Writing – review & editing. **Katherine L. Warner**: Investigation, Writing – review & editing. **Yaniv Hanoch**: Conceptualization, Writing – review & editing, Project administration, Supervision.

## Data availability

Data will be made available on request.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2022.107648.

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