2017-03-08

Internet Safety and the Silver Surfer: The Relationship Between Gist Reasoning and Adults' Risky Online Behavior

White, CM

http://hdl.handle.net/10026.1/9363

Abstract

Currently, fewer older adults are online compared to younger generations. However, with many new initiatives aiming to significantly increase the number of older internet users, they will increasingly be exposed to potential victimisation from internet fraud, a fundamental issue affecting all adult internet users. Despite this, little research has examined online risk-taking across the adult lifespan or adults' reasoning about risky online behaviours. Using fuzzy trace theory (FTT), we investigated adults' online risk-taking behaviour and intentions, and whether these behaviours were related to different ways of reasoning about risk, namely, gist reasoning (using qualitative, intuitive knowledge) and verbatim reasoning (using quantitative, specific knowledge). Participants (326 adults, 18–79 years old, $M_{age} = 49.54$ years) reported their past risk-taking behaviour, future online risk intentions, gist and verbatim reasoning about online risk, sensation seeking, and time spent online. Age was negatively correlated with past risk-taking, time online, future risk intentions, and sensation seeking. However, time spent online was positively related to future risk intentions, suggesting that spending more time using the internet could lead individuals to take more risks. Increased verbatim reasoning predicted increased intentions to take online risks, while gist reasoning predicted reduced intentions to take risks online. Our findings extend online risk research applying FTT to adolescents and young adults and suggests that online safety training incorporating gist-based reasoning strategies could benefit all adults and, in particular, older generations.

Keywords: fuzzy trace theory; gist and verbatim reasoning; online risk taking; older adults

Older adults use the Internet substantially less than younger adults. Throughout Europe, 90% of 16–24 year olds go online at least weekly compared to 37% of those over 55 (Eurostat, 2012). The majority (69%) of older adults, furthermore, lack basic digital skills (Age U.K., 2015). The U.K. government's Digital Inclusion Strategy aims to have more than 90% of the U.K. adult population online by 2020 (Cabinet Office, 2014) driven, to some degree, by the beneficial role the Internet plays in the lives of older adults (Coyle & Duggan, 2012; Steptoe Shankar, Demakaos, & Wardle, 2013; York Cornwell & Waite, 2009). For example, older adults can keep in touch with family and friends, and find information about health, finances, and leisure activities (Milligan & Passey, 2011) potentially reducing social isolation and loneliness (Blaschke, Freddolino, & Mullen, 2009; Cotton, Ford, Ford, & Hale, 2014). However, according to some estimates, online fraud costs the global economy more than $100 billion (McDonald, 2013) with many older adults victimised both in the U.K. (Home Instead, 2013) and the U.S. (Federal Bureau of Investigation, 2015).

Whether older adults are at heightened risk of consumer fraud victimisation is highly debated. On the one hand, there is research indicating that older adults are more likely to fall victim to telemarketing scams, possibly linked to their state of loneliness (Alves & Wilson, 2008; Langenderfer & Shrimp, 2001), and more likely to experience financial exploitation in general because of cognitive impairment, bereavement, financial pressures (Age U.K., 2015), and low numeracy skills (Wood, Liu, Hanoch, & Estevez-Cores 2015). On the other hand is the argument that ignorance and stereotyping of older adults is responsible for the popular notion that this age group are more commonly targeted and victimised than younger age groups, despite statistics failing to support these beliefs (Ross, Grossman & Schryer, 2014). The National Institute of Aging (2014) has called for a focus on research that can enhance our understanding of older adult's cognitive strengths in order to promote effective decision

making and reduce financial exploitation. Yet, to date, studies have mainly focussed on fraud associated with telemarketing and mail scams with very little empirical data on older adults' online behaviour and risk-taking tendencies, resulting in little knowledge about this age group's possible vulnerabilities in online environments.

Simply having an online presence can itself be a risk factor, with mere exposure to online fraudsters sufficient to increases a person's vulnerability (Holt & Bossler, 2008; Newman & Clarke, 2003; Pratt, Holtfreter, & Reisig, 2010; van Wilsem, 2011). Offenders require ways to identify potential victims online (Pratt et al., 2010) often gathering information in chat rooms, or using dating or social networking websites, for example. Lifestyle-routine activities theory highlights that cybercrime is most likely to occur "when individuals are in high risk situations, are in close proximity to motivated offenders, appear attractive targets for criminals, and lack capable guardians" (Holt & Bossler, 2008, p. 3). As such, research has unveiled that time spent online is a significant predictor of victimisation likelihood (Holt & Bossler, 2008; van Wilsem, 2011). Consequently, one of the fears is that the increased use of the Internet by older adults will allow fraudsters to target a larger pool of individuals with greater ease.

Adults' perceptions regarding the risks associated with online behaviour have previously been found to act as protective factors against risk-taking, resulting in them implementing stricter Facebook privacy controls (Christofides, Muise, and DeMernis, 2010) and reducing online credit card use (Reisig, Pratt, & Holtfreter, 2009). However, the online risk perceptions of older adults appear mixed. Some reports suggest that older adults are fearful of technology and the negative consequences that stem from its use (Kurniawana, 2008) while others indicate they may be more trusting of information they find on the Internet compared to younger individuals (Grimes, Hough, Mazur, & Signorella, 2010).

Online fraud is often successful because of the visceral cues that scammers incorporate into their communications, for example prizes, sex, love, and fame. Individuals focus on fulfilling their visceral desires (Wang, Herath, Chen, Vishwanath, & Rao, 2012) and "tend to produce decisions that are nearly devoid of cognitive deliberations.... Instead action is driven by instinct and gut feelings, and careful analysis is abandoned" (Langenderfer & Shimp, 2001, p. 769). However, Wang et al. (2012) argued that heuristic decision making can lead to a decrease in online risk-taking and susceptibility to victimisation. For example, individuals with knowledge of fraud perpetrated via phishing emails are more likely to intuitively pick up on deception indicators and are less likely to respond (Wang et al., 2012).

The idea that intuitive or heuristic processes do not necessarily have to lead to increased risk-taking has also been proposed by fuzzy trace theory (FTT; Reyna & Brainerd, 1995). FTT outlines that two different reasoning strategies—verbatim and gist—are utilised in risky decision making. Verbatim reasoning draws on precise memories and/or quantitative knowledge about risk. Gist reasoning is driven by intuition and based on the bottom line meaning of risky situations or activities (Corbin, Reyna, Weldon, & Brainerd, 2015). While some researchers (e.g. Evans & Stanovich, 2013) assume that a lack of deliberative information processing can explain increased risk-taking behaviour, FTT asserts that the opposite is true (Corbin et al., 2015). Studies (e.g., Mills, Reyna, & Estrada, 2008; Reyna et al., 2011) suggest that individuals can utilise both verbatim and gist reasoning routes to risk-taking along a continuum, but engaging in the systematic analysis of cost–benefit trade-offs (verbatim reasoning) can result in higher rates of risk-taking, particularly in situations where the perceived likelihood of a risky event occurring is low (Reyna & Brainerd, 1995). Conversely, relying on categorical gist reasoning ("No risk is better than some risk" or "It only takes once to get HIV") reduces risk-taking behaviour (Reyna & Brainerd, 2011).

Evidence to support these different routes to risky decision making are best provided by investigations of framing effects. In these studies individuals are presented with problems which are framed as involving either potential 'gains' (rewards) or potential 'losses', however the potential outcomes share equal expected value (e.g., the Asian Disease Problem, Tversky & Kahneman, 1986). Traditional economic theories suggest that trading off of risks versus rewards should result in individuals displaying either a consistent risk-seeking or risk-avoidant attitude. However, multiple studies have shown that participants are risk seeking in the loss frame but risk averse in the gain frame (Kühberger, 1998; Tversky & Kahneman, 1986). According to FTT, this effect can be explained by a hierarchy of reasoning along a gist-verbatim continuum with preferences for the simplest, categorical gist (e.g., "Some gain is better than a risk of no gain") leading to the framing effect and reduced risk taking for gains (e.g., Kühberger & Tanner, 2010; Reyna & Farley, 2006). Conversely, several studies demonstrated that more precise trading off (e.g., "A smaller gain with a higher probability is worse than a larger gain with a lower probability") was related to increases in risk taking (Mills et al., 2008) and an elimination of framing effects (Broniatowski & Reyna, 2015). That is, more precise reasoning (more toward the verbatim end of processing) is associated with greater risk taking relative to simple categorical gist. A preference for categorical gist reasoning has been shown to increase with age (Reyna et al., 2011; White, Gummerum & Hanoch, 2016) and experience (Reyna, Chick, Corbin & Hsia, 2014).

Most research applying FTT to (offline) risk taking has concentrated on adolescents and young adults, revealing that adolescents' preference for verbatim over gist reasoning can compel them to take more risks (Mills et al., 2008; Reyna et al., 2011). The ability to utilise gist reasoning strategies improves with age, so young adults begin to reason about risk in a more simplistic and heuristic (gist) fashion (Reyna & Farley, 2006). Since no (or fewer) risks

are preferred, risk-taking is more often avoided in adulthood (Reyna, Wilhelms, McCormick, & Weldon, 2015).

White, Gummerum, and Hanoch (2015) applied FTT to explain differences in adolescents' and young adults' online risk-taking behaviour finding that gist reasoning about online risks increased between adolescence and young adulthood. Furthermore, individuals who reasoned about online risk-taking using gist representations were less likely to have taken risks online and were less likely to take risks online in the future. Consequently, increased gist reasoning was protective of online risk-taking behaviour whereas increased verbatim reasoning was predictive of increased online risk-taking for adolescents.

Very little research exists on whether gist and verbatim reasoning strategies affect the risk-taking of younger and older adults differently. Memory research has indicated that gist reasoning is significantly higher in older, compared to younger, adults (Koustaal, Schater, Galluccio, & Stofer, 1999), and that relationships exist between older adults' reduced memory recall accuracy and increased reliance on semantic gist (Dennis, Kim, & Cabeza, 2008). Brainerd, Reyna, and Howe's (2009) results also demonstrated that memory declines in healthily-ageing older adults was associated with diminished direct access to verbatim memories, while gist-based familiarity for memories was unaffected by declines in age. Taken together these findings suggest that the reliance on gist reasoning might increase over the course of adulthood and might consequently lead to a decrease in risk-taking with age. To our knowledge, this is the first study to draw upon FTT to explore the processes underlying online risk-taking across adulthood.

To explore this topic, we focussed on two specific online activities that have been previously identified as risky, which adults of all ages are likely to engage in (Age U.K., 2015); the disclosure of personal information online and befriending strangers online

(Ybarra, Mitchell, Finklehor, & Wolak, 2007). To do so, we applied measures previously used to assess adolescents' and young adult's online risk-taking (White et al., 2015).

Research in the FTT framework suggests that the development and employment of gist representations improve and increase with age (e.g., Corbin, McElroy, & Black, 2010) in risky choice situations. Accordingly, we predicted that throughout adulthood, gist reasoning about online risk would increase with age and be predictive of lower online risk-taking behaviour and intentions to take risks online. We expected that sensation seeking would play a part in risk-taking behaviour showing positive relationships to past online risk-taking and future risk-taking intentions. We also explored possible relationships between exposure to risk and risk-taking behaviour, in line with lifestyle-routine activities theory (Holt & Bossler, 2008) by examining potential relationships between time spent online, past online risk-taking and future risk-taking intentions.

Method

Participants

Ethical approval was granted by the appropriate ethics committee prior to data collection. Participants were recruited through Amazon's Mechanical Turk website, where registered users are invited to participate in research for a token payment of 0.25 U.S. dollars (Buhrmester, Kwang, & Gosling, 2011; Mason & Suri, 2012; Paolacci, Chandler, & Ipeirotis, 2010). After non-completed questionnaires were removed, the sample consisted of 326 adults (171 female, 155 male; age range 18–79 years, M_{age} = 49.54 years, SD = 16.95). Participants were predominantly White (71.2%), followed by African American (13.8%), Latin American (4.9%), Filipino (3.1%), South Asian (1.8%), and Chinese (1.5%). The remaining adults (3.6%) were Arab, Southeast Asian, Japanese, Korean, Aboriginal, or 'Other'. Most participants indicated their highest educational attainment as 'some college' (35.9%) or higher (44.8%), 18.1% completed 'high school' and 1.2% reported less than a high school

education. Most participants resided with a spouse (40.5%), with others living with family members (23.6%), roommates/friends (4.9%), or other/shared accommodation (1.5%) and the remaining (29.4%) living alone. One hundred and sixty-six (51%) participants were 60 years or older.

Materials

Participants completed online questionnaires which recorded their demographic information followed by 9 measures containing 58 items investigating risk-taking attitudes (sensation seeking - 8 items), past and future online behaviour (hours online involved in various activities - 12 items; past risk-taking behaviour – 4 items; future online risk intentions – 4 items), and gist and verbatim reasoning (categorical gist – 9 items; gist principles – 14 items; global risk perceptions – 4 items; specific risk – 2 items; quantitative risk – 1 item).

Sensation seeking. The Brief Sensation Seeking Scale (BSSS-8; Hoyle, Stephenson, Palmgreen, Lorch, & Donohue, 2002) used a 5-point Likert scale scored from 1 (*strongly disagree*) to 5 (*strongly agree*) to assess participants' agreement with eight statements such as "I would like to explore strange places" and "I would like to try bungee jumping". Scores were averaged (α = .83).

Gist and verbatim reasoning. Psycholinguistic and memory research (e.g. Reyna & Brainerd, 1995) has revealed that presenting information in different ways can cue either verbatim or gist representations of memories, thereby influencing the retrieval of risk promoting or risk avoidant principles (Reyna et al., 2011). Presenting participants with very specific questions or statements about a risk behaviour cue specific (verbatim) memories of that particular risk behaviour. In contrast, presenting participants with general and global statements cues global (gist) representations. Such techniques have previously been used to investigate young people's sexual risk taking attitudes and behaviour (e.g., if you keep having unprotected sex, risks will add up and you will get an STD [gist]; what are the

8

chances that you have an STD? [verbatim]; Mills et al., 2008; Reyna et al., 2011) and adapted to explore adolescents' and young adults' online risk taking (e.g., if you keep giving out your personal details online to people you don't know, risks will add up and you will have your details stolen and abused [gist]; what are the chances that your personal information has been stolen? [verbatim]; White et al., 2015). These measures were adapted closely to explore adolescents' and young adults' online risk taking (e.g., If you keep giving out your personal details online to people you don't know, risks will add up and you will have your details stolen and abused [gist]; What are the chances that your personal information has been stolen? [verbatim]; White et al., 2015).

Gist reasoning about online risk-taking. Three individual measures assessed participants' use of gist reasoning in relation to risky behaviours online; the categorical risk measure, the gist principles measure, and the global risk perception measure (see White et al., 2015). Statements and questions were presented in such a way as to tap into participants' reasoning about risk.

The categorical risk measure included nine questions, for example, "It only takes ONCE to give up your personal information online for it to be misused". Participants indicated their agreement on a 5-point Likert scale from 0 (*strongly disagree*) to 4 (*strongly agree*) and scores across the nine items were averaged ($\alpha = .83$). Strongly agreeing to these statements indicated participants perceived higher risk compared to those participants who strongly disagreed.

The gist principles measure contained 14 statements (e.g., "Better to focus on work than communicating for fun online") presenting global statements relating to online risk. Participants were asked to tick the statements they endorsed and leave blank those they did not endorse. A higher number of endorsements again reflected higher risk perceptions. Four items were reverse scored and the number of endorsements summed ($\alpha = .71$).

Global risk perception measures included two questions aimed at assessing gist-based perceptions of risks ("Overall for YOU which best describes the risks of giving out your personal details online?" and "Overall for YOU which best describes the risks of making friends online with people you do not already know offline. Global risk perception was measured on a 4-point scale of *none* (0)*, low* (1)*, medium* (2)*,* and *high* (3). These two items were found to correlate significantly, $r(326) = .559$, $p < .001$, so scores were combined and averaged to create one global risk perception variable.

Verbatim reasoning about online risk-taking. Specific risk involved two verbatim-focussed questions that were specifically worded to assess participants' perceptions of their own future risk from using the Internet. Participants rated, on a 5-point Likert scale scored from 0 (*very unlikely*) to 4 (*very likely*), the statements "I am likely to have my personal details stolen and used against me in the next 6 months", and "I am likely to be bullied or harassed online in the next 6 months by a person I do not know offline" ($\alpha = .73$). As these two measures were significantly correlated, $r(324) = .587$, $p < .001$, they were summed and averaged to create one specific risk variable. For the quantitative risk scale, participants were asked "What are the chances that your personal information has been stolen?" and then indicated their answer on a scale ranging from 0% to 100%.

Online behaviour, past risk-taking, and future intentions. Participants were asked to describe how they spent their time online by indicating for how long each week, in hours, they were involved in these different online activities: using social networking sites (such as Facebook, Twitter, or MSN), emailing, gaming, shopping, trying to meet new people (including dating sites), doing work (in an employment capacity), visiting chatrooms, searching for information regarding health matters, searching for information regarding hobbies, reading the news, banking or completing finances, doing other things. Time spent participating in these activities was summed to create one variable: total time online. For four

participants, the sum of the hours spent on these activities each week exceeded the number of hours in a 7-day period. Data for these four cases were replaced with missing values. Since this variable was non-normally distributed, data were transformed using the square-root function. Participants were then asked to indicate whether they had ever given out personal information online or made friends with someone they knew only online. Two variables were created, (a) past online risk-taking: shared personal information and (b) past online risk-taking: made unknown friends, both coded as 0 ('no') and 1 ('yes'). If they responded yes to either of these questions participants were then asked to indicate how many times they had displayed this behaviour in the past 12 months. These past risk-taking variables were found to be significantly correlated, $r(323) = .29$, $p < .001$, and were therefore combined to create one past risk-taking variable.

Four questions then measured participants' intentions to give out their personal information (e.g., name, address, date of birth, email address and phone number), make unknown friends, communicate with unknown people in chatrooms, or share personal information with people they knew only online in the coming year. Participants answered on a 5-point Likert scale scored from 0 (*very unlikely*) to 4 (*very likely*) ($\alpha = .80$). These four intention measures were found to significantly correlate (all rs > .25, all ps < .001). Therefore scores were summed and averaged to create an online risk intentions variable.

Procedure

A link to the study was posted on the Mechanical Turk website. Data collection took place over a 3-week period. Individuals were invited to take part in this study and could access the questionnaire via a Web link. Participants were informed that the study aimed to determine whether people of different ages displayed different online behaviours in terms of judgement and decision making. They were invited to participate, fully briefed, and then provided consent by clicking on a 'continue' button. They were then guided through the

questionnaire items and fully debriefed on completion. Participants received $0.25 for their involvement and were allocated up to 30 minutes to complete the survey.

Results

In total, 61.3% of participants had disclosed personal information online, an average of 28.4 times during the preceding 12 months. One hundred and twenty-six (38.7%) participants had befriended, on average, eight unknown individuals in the 12 months prior to their participation in the study. There were no significant differences in risk-taking activities between those under 60 years old and those aged 60 and over. However, although fewer participants over 60 disclosed their personal information online, the mean number of information disclosures in the previous year for the over-60 group was higher (33.89 disclosures) compared to participants under 60 (23.55 disclosures). Additionally, fewer participants over 60 reported befriending strangers online. However, the mean number of strangers befriended in the previous year was higher for the over 60's (10.65 'friends') compared to the under-60 group (6.20 'friends'). These figures, however, were not significantly different (disclosed personal information, $t(198) = -.45$, $p=.66$; befriended strangers, $t(62.22) = -1.34$, $p=.19$).

Relationships of gist and verbatim measures

Drawing on FTT, we expected the two verbatim measures of risk perception (specific risk and quantitative risk) to positively correlate with each other and the same for the three gist measures of risk perception (categorical risk, gist principles, and global risk perception). However, gist and verbatim measures should not correlate with each other. Table 1, displaying these intercorrelations, reveals that the specific risk and quantitative risk verbatim measures were significantly and positively correlated. All three gist measures were also significantly and positively correlated. The first verbatim measure, specific risk, did not correlate with either the global risk or the categorical risk gist measures, and the second

verbatim measure, quantitative risk, did not correlate with any of the gist measures. However, specific risk and gist principles were found to significantly, negatively correlate with each other.

Based on these intercorrelations, we conducted a principal component analysis on all five (three gist and two verbatim) measures with orthogonal rotation (varimax). Two components, incorporating all five items, had eigenvalues over 1 and together accounted for 64% of the variance. Table 2 shows the factor loadings after rotation, which suggest that all three gist measures loaded onto Component 1 (gist component) and both verbatim measures loaded onto Component 2 (verbatim component).

Intentions to take online risks

Table 3 shows the intercorrelations between age (in years, treated as a continuous variable), the gist component, the verbatim component, total time online, sensation seeking, past online risk-taking, and online risk intentions. Age was significantly negatively correlated with past risk-taking, time spent online each week, sensation seeking, and intentions to take online risks but was significantly positively correlated with the gist reasoning component. Past risk-taking correlated significantly positively with both time spent online each week and online risk intentions. A significantly positive relationship was also found between future risk intentions and time spent online. Sensation seeking was found to significantly positively correlate with online risk intentions, but was negatively correlated with the gist component. Importantly, intentions to take online risks in the future were positively correlated with the verbatim component and negatively correlated with the gist component.

To further investigate the effect of age, past online risk-taking behaviour, time spent online, sensation seeking, and gist and verbatim representations on intentions to take online risks, we conducted hierarchical linear regressions. In Step 1 we entered the independent variables of age, time spent online, and past risk-taking. In Step 2 we additionally entered

sensation seeking, the gist component, and the verbatim component. Step 3 additionally included the interaction terms of Past Risk-Taking × Age, Sensation Seeking × Age, Gist Component × Age, and Verbatim Component × Age. Results can be found in Table 4 (in each regression model Age was used as a continuous variable).

The first regression model showed that age, time spent online, and past risk-taking behaviours significantly predicted online risk intentions, $\Delta R^2 = .17$, $\Delta F (3,316) = 22.57$, $p < .001$. Age marginally (p = .052) negatively predicted intentions to take online risks; that is, with increasing age intentions to take online risks decreased. Past online risky behaviours and increased time spent engaged in online activities significantly predicted online risk intentions.

The second regression model also included sensation seeking, the gist component, and the verbatim component as independent variables. The results showed that the gist and verbatim components additionally predicted online risk intentions, $\Delta R^2 = .38$, $\Delta F(6, 313) = 34.13$, $p < .001$. The age variable, however, became nonsignificant once the gist and verbatim predictors were added, as both these predictors explain effects of age, a result which is consistent with FTT. Although sensation seeking was significantly correlated with intentions to take online risks (see Table 3), it did not prove predictive of intentions to take online risks. Gist reasoning negatively predicted online risk intentions and verbatim reasoning positively predicted online risk intentions. The third regression model also included the interaction terms of Age × Past Risk-Taking, Age × Sensation Seeking, Age × Gist Component, and Age × Verbatim Component, but none of the interaction terms significantly predicted online risk intentions (see Table 4). Concordant with the predictions of FTT, the gist and verbatim components independently contributed to online risk-taking intentions even after the other potential predictors (i.e. age, past risk taking, time spent online, and sensation seeking) had been taken into account.

Discussion

According to the National Council on Aging (n.d.) "Financial scams targeting seniors have become so prevalent that they're now considered the crime of the 21st century", with Internet fraud representing one of the top 10 scams (see also van Wilsem, 2011). Although government agencies—such as the U.S. Federal Bureau of Investigation (FBI) - emphasise this issue, there is currently little empirical data on older adults' online risk-taking behaviour and the factors that could help mitigate their risk behaviour. The present study was designed to address this important lacuna.

Our findings revealed that the majority of adults, regardless of age, took some risks online with their personal information, disclosing details about themselves multiple times in the previous year. Clearly this type of risk-taking is not restricted to younger age groups, and is comparable to the 66% of adolescents in White et al. (2015) who reported personal information disclosure. Although it appears this behaviour is common, personal information disclosure is potentially problematic for a number of reasons, and requests for such information are pervasive in online scams (Newman & Clarke, 2003). Oftentimes fraudsters pose as reputable companies or organisations requesting that individuals update or verify their personal information, resulting in identity or financial fraud (Get Safe Online, n.d.).

In our present study, over one-third of adults had also befriended a number of strangers, developing online relationships with an average of eight people they did not know offline. This online behaviour has also proven to be risky with almost 6,000 individuals reporting financial losses of upwards of $86 million as a consequence of confidence fraud and romance scams in the United States (FBI, 2014). These financial losses affected adults of all ages, but while adults over age 60 constituted only 18% of those reporting victimisation, this age group accounted for 30% of the overall financial losses.

Although risk-taking behaviour in the present study did appear to decline with age, individuals over 60 who were involved in these two risky online activities reported higher

rates of risk-taking than those under 60 years old, both with information disclosure and 'friending' behaviour. Consequently, ensuring that increasing the number of older adults online does not lead to a substantial increase in the number of online fraud victims is vital. It is therefore crucial to discover why this particular subset of older adults were more risk-taking, given that the majority of those over 60 appeared to be more cautious in general compared to those under 60. Further investigation in this respect should be a focus of future research.

Capitalising on FTT (Reyna, 2004; Reyna & Brainerd, 1995), we were able to show that while verbatim reasoning about online risk can be reflective of actual risky behaviour online, simple, categorical gist reasoning about online risk can be protective of risk-taking behaviour among adults in general, with gist reasoning about risk increasing with age into older adulthood. Previous research has focussed almost exclusively on the application of FTT among younger age groups and has found that gist reasoning can be protective of sexual (Reyna et al., 2011) and online (White et al., 2015) risk-taking behaviour in young adults. In contrast, greater reliance on specific, deliberative, verbatim reasoning was associated with increased risky behavioural intentions.

Our findings, thus, nicely augment previous research by highlighting that the use of verbatim reasoning about online risk was not only correlated with increased past risk-taking behaviour, but also predictive of increased intentions to take online risks in the future among adults of all age groups. Conversely, adults who relied more on gist reasoning about online risk displayed lower rates of past risk-taking behaviour, and the use of intuitive, gist reasoning predicted lower behavioural intentions to engage in risky online activities. Critically, our research lends much-needed support to the findings relating FTT to risk-taking in younger individuals by showing that the use of gist reasoning about online risk appears to increase with age, well into adulthood.

Given the paucity of data on FTT among older adults, we can only speculate why gist reasoning increased with age. Prior research has attributed increased gist reasoning ability to experience (Reyna & Lloyd, 2006). However, in the domain of Internet use, this might not necessarily be the case, as increased aged was inversely associated with experience. During healthy ageing, specific (verbatim) representations of memory decay faster and are less accessible than gist representations, and as such older adults' increased gist reasoning in false-recall experiments has been linked to this decay in their neurocognitive functioning (e.g., Brainerd & Reyna, 2015; Koustaal et al., 1999). In addition, Corbin et al. (2010) found that individuals with higher working memory capacity show a preference for gist reasoning strategies in risky decision making, and Huang, Wood, Berger, and Hanoch (2015) have shown that a greater age effect exists when participants make decisions on deliberative tasks compared to experiential tasks. Therefore, it is possible that increases in, and preferences for, gist reasoning emerge via a process of increased life experience alongside reduced cognitive ability. As the present study did not measure cognitive ability, this idea should be taken with caution and much further work is needed to test this hypothesis.

In addition to investigating reasoning strategies, we aimed to assess the influence of sensation seeking on past risk-taking and risk-taking intentions. The development of sensation seeking has been shown to follow an inverted U-shaped function, with its peak at adolescence and a reduction thereafter (e.g., Steinberg, Albert, Cauffman, Banich, Graham, & Woolard, 2008). Our findings, likewise, demonstrate a continued reduction in sensation seeking with age. Higher sensation seeking was also related to gist reasoning about online risk-taking and showed a significant negative relation to online risk intentions. Within our regression models, however, sensation seeking did not significantly contribute to predicting online risk intentions, suggesting that further investigations are required to assess how sensation seeking interplays with other variables.

Finally, our findings show a clear relationship between time spent online and engaging in both past and future online risk-taking. Lifestyle-routine activities theory (Holt & Bossler, 2008) proposes four elements that can increase individuals' chances of victimisation: being in high-risk situations or environments, exposure/proximity to offenders, being attractive targets, and lacking protection from others. Our results showed that individuals who spent more time online (exposure) had also engaged in more, risky activity online in the past (high-risk situations). Since there are suggestions that older individuals are seen as profitable targets for online fraudsters (FBI, 2014), these are critical indications of potentially increased victimisation risk. Time spent online was also predictive of individuals' increased intentions to engage in risky online behaviour. However, time spent online was not related to either the verbatim or the gist component, suggesting that the protection from online risk-taking afforded by gist reasoning is not a function of experience alone. Further research in this area is essential before drawing any firm conclusions about the relationships between online exposure, risk-taking, and victimisation, particularly since we did not record individuals' victimisation experiences during this study. In addition, our assessment of online experience requires further investigation since this was based on time spent online. A finer distinction between novices and experts may be required as time online may not necessarily be reflective of online expertise for all individuals, and these distinctions are relevant to FTT research (Reyna et al., 2014).

Our study has some limitations. As shown by Rolison, Hanoch, Wood, and Liu (2014), risk-taking behaviour can vary depending on the risk domain, and as our study focussed on only the online risk domain, it is difficult to tell whether our findings could be extended to other risk domains (e.g., medical). Furthermore, there is very little data on whether offline and online risk-taking behaviour relate. For example, the online disinhibition effect (Suler, 2004) argues that people display behaviours online that are out of sync with

their offline personas. Thus our findings may be applicable to only online environments involving specific risk-taking behaviours, and our sample of North American participants possibly limits its applicability to individuals in other countries or cultures. Finally, our study was self-reported by nature and therefore not necessarily reflective of individuals' real online behaviours. More ecologically valid research methods would be helpful in this respect.

Despite these limitations, our findings highlight some interesting areas for future research and will hopefully prompt further studies into the online behaviour of older adults. Building on prior FTT investigations we have shown that gist reasoning about risk can continue into adulthood, and that gist reasoning about online risk can have a protective relationship with online risk-taking behaviours and behavioural intentions. We also highlighted that older adults do engage in risky behaviour online and put themselves in situations where they increase their chance of experiencing victimisation. Our findings suggest that all adults could benefit from 'e-safety' training incorporating gist values, and that older adults may be even more receptive to these types of messages than younger adults due to their increased reliance on gist reasoning strategies in older age. As a consequence, the emphasis on the requirement for gist focussed education programmes could potentially be even greater for younger adults. Gist-based intervention strategies have yet to be widely implemented, but have already been shown to significantly reduce sexual risk-taking in adolescents by educating young people to process information intuitively in order to retrieve categorical, risk-avoidant attitudes (Reyna & Mills, 2014; Reyna, Weldon & McCormick, 2015). With the number of older adults using the Internet set to increase significantly in the future it is essential that educational programs enhance adults' knowledge of, and protection from, online risks ensuring that their online experiences are pleasurable and safe.

References

Age U.K. (2015). *Only the tip of the iceberg: Fraud against older people. Evidence Review.* Retrieved from http://www.ageuk.org.uk/documents/en-gb/for-professionals/consumer-issues/age%20uk%20only%20the%20tip%20of%20the%20iceberg%20april%202015.pdf?dtrk=true

Alves, L. M., & Wilson, S. R. (2008). The effects of loneliness on telemarketing fraud victimization among older adults. *Journal of Elder Abuse & Neglect, 20*, 63-85.

Blaschke, C. M., Freddolino, P. P., & Mullen, E. E. (2009). Ageing and technology: A review of the research literature. *British Journal of Social Work, 39*, 641-656.

Brainerd, C. J., & Reyna, V. F. (2015). Fuzzy-trace theory and lifespan cognitive development. *Developmental Review, 38,* 89-121.

Brainerd, C. J., Reyna, V. F., & Howe, M. L. (2009). Trichotomous processes in early memory development, aging, and neurocognitive impairment: A unified theory. *Psychological Review*, 116, 783–832. doi:10.1037/a0016963

Broniatowski, D.A., & Reyna, V.F. (July 2015). Formalizing risky choice with a logistic model of Fuzzy Trace Theory. Paper presented at the 37th Annual Conference of the Cognitive Science Society. Pasadena, California USA.

Buhrmester, M., Kwang, T., & Gosling, S.D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high quality, data? *Perspectives on Psychological Science, 6,* 3-5.

Cabinet Office. (2014). *Government digital inclusion strategy.* Retrieved from https://www.gov.uk/government/publications/government-digital-inclusion-strategy/government-digital-inclusion-strategy

Christofides, E., Muise, A., & DeMernis, S. (2010). *Privacy and information disclosure on Facebook: Youth and adult's information disclosure and perceptions of privacy risks.* Report for the Office of the Privacy Commissioner Canada. Retrieved from https://www.ontariosciencecentre.ca/Uploads/researchlive/documents/OPC-FinalReport-FacebookPrivacy.pdf

Corbin, J., McElroy, T., & Black, C. (2010). Memory reflected in our decisions: Higher working memory capacity predicts greater framing bias in risky choice. *Judgment & Decision Making, 5*, 110-115.

Corbin, J. C., Reyna, V. F., Weldon, R. B., & Brainerd, C. J. (2015). How reasoning, judgment, and decision making are colored by gist-based intuition: A fuzzy-trace theory approach. *Journal of Applied Research in Memory & Cognition, 4*, 344-355.

Cotton, S. R., Ford, G., Ford, S., & Hale, T. M. (2014). Internet use and depression among retired older adults in the U.S.: A longitudinal analysis. *The Journal of Gerontology Series B: Psychological Sciences and Social Sciences, 69*, 763-771.

Coyle, C. E., & Dugan, E. (2012). Social isolation, loneliness, and health among older adults. *Journal of Aging and Health, 24*, 1346-1363.

Dennis, N. A., Kim, H., & Cabeza, R. (2008). Age-related differences in brain activity during true and false memory retrieval. *Journal of Cognitive Neuroscience, 20*, 1390-1402.

Eurostat. (2012). *Internet use in households and by individuals in 2012.* Retrieved from http://ec.europa.eu/eurostat/documents/3433488/5585460/KS-SF-12-050-EN.PDF/39000dab-e2b7-49b2-bc4b-6aad0bf01279

Evans, J.S.T.B., & Stanovich, K.E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science, 8,* 223-241.

Federal Bureau of Investigation (FBI). (2014). *Internet crimes report 2014.* Retrieved from https://www.fbi.gov/news/news_blog/2014-ic3-annual-report

Federal Bureau of Investigation (FBI). (2015). *2015 Internet Crime Report.* Retrieved from

https://pdf.ic3.gov/2015_IC3Report.pdf

Get Safe Online. (n.d.). *Think twice before you act.* Retrieved from

https://www.getsafeonline.org/scams/

Grimes, G. A., Hough, M. G., Mazur, E., & Signorella, M. L. (2010). Older adults'

knowledge of Internet hazards. *Educational Gerontology, 36*, 173-192.

Holt, T. J., & Bossler, A. M. (2008). Examining the applicability of lifestyle-routine activities

theory for cybercrime victimization. *Deviant Behavior, 30*, 1-25.

Home Instead. (2013). *Senior fraud protection toolkit: Helping seniors stay safely at home.*

Retrieved from http://www.homeinstead.co.uk/Resources/senior-fraud-toolkit.pdf

Hoyle, R.H., Stephenson, M.T., Palmgreen, P., Lorch, E.P., & Donohew, R.L. (2002).

Reliability and validity of a brief measure of sensation seeking. *Personality and*

Individual Differences, 32, 401-414

Huang, Y. H., Berger, D. E., Wood, S., & Hanoch, Y. (2015). Age differences in experiential

and deliberative processes in ambiguous and unambiguous decision making.

Psychology & Ageing, 30, 675-687.

Koustaal, W., Schater, D. L., Galluccio, L., & Stofer, K. A. (1999). Reducing gist-based false

recognition in older adults: Encoding and retrieval manipulations. *Psychology &*

Ageing, 14, 220-237.

Kühberger, A. (1998). The influence of framing on risky choices: A meta-analysis.

Organizational Behavior and Human Decision Processes, 75, 23–55.

Kurniawan, S. (2008). Older people and mobile phones: A multi-method investigation.

International Journal of Human-Computer Studies, *66*, 889-901.

Langenderfer, J., & Shrimp, T. A. (2001). Consumer vulnerability to scams, swindles and

fraud: A new theory of visceral influences on persuasion. *Psychology & Marketing, 18*, 763-783.

Mason, W., & Suri, S. (2012). Conducting behavioral research on Amazon's Mechanical

Turk. *Behavioral Research Methods, 44,* 1-23.

McDonald, H. (2013, October). Online fraud costs global economy 'many times more than

$100bn'. *The Guardian Online.* Retrieved from

http://www.theguardian.com/technology/2013/oct/30/online-fraud-costs-more-than-

100-billion-dollars

Milligan, C., & Passey, D. (2011). *Ageing and the use of the Internet: Current engagement

and future needs.* Report for the Nominet Trust. Retrieved from

https://www.nominettrust.org.uk/sites/default/files/NT%20SoA%20-

%20Ageing%20and%20the%20use%20of%20the%20internet_0.pdf

Mills, B., Reyna, V.F., & Estrada, S. (2008). Explaining contradictory relations between risk

perception and risk taking. *Psychological Science, 19,* 429-433.

National Council on Aging. (n.d.). *Top 10 financial scams targeting seniors.* Retrieved from

https://www.ncoa.org/economic-security/money-management/scams-security/top-10-

scams-targeting-seniors/

National Institute of Aging (2014). *Planning meeting on economic decision making in aging

populations.* Retrieved from https://www.nia.nih.gov/about/events/2015/expert-

planning-meeting-economic-decision-making-aging-populations

Newman, G. R., & Clarke, R. V. (2003). *Superhighway robbery: Preventing e-commerce

crime.* Devon, England: Willan.

Paolacci, G., Chandler, J., & Ipeirotis, P.G. (2010). Running experiments on Amazon

Mechanical Turk. *Judgement & Decision Making, 5,* 411-419.

Pratt, T. C., Holtfreter, K., & Reisig, M. D. (2010). Routine online activity and Internet fraud targeting: Extending the generality of routine activity theory. *Journal of Research in Crime & Delinquency, 47*, 267-296.

Reisig, M. D., Pratt, T. C., & Holtfreter, K. (2009). Perceived risk of Internet theft victimization: Examining the effects of social vulnerability and financial impulsivity. *Criminal Justice and Behavior, 36*, 369-384.

Reyna, V. F. (2004). How people make decisions that involve risk: A dual process approach. *Current Directions in Psychological Science, 13,* 60-66.

Reyna, V. F., & Brainerd, C. J. (1995). Fuzzy-trace theory: An interim synthesis. *Learning & Individual Differences, 7,* 1-75.

Reyna, V.F., & Brainerd, C.J. (2011). Dual processes in decision making and developmental neuroscience: A fuzzy-trace model. *Developmental Review, 31,* 180-206.

Reyna, V. F., Chick, C. F., Corbin, J. C., & Hsia, A. N. (2014). Developmental reversals in risky decision making: Intelligence agents show larger decision biases than college students. *Psychological Science, 25*, 76–84.

Reyna, V. F., Estrada, S. M., DeMarinis, J. A., Myers, R. M., Stanisz, J. M., & Mills, B. A. (2011). Neurobiological and memory models of risky decision making in adolescents versus young adults. *Journal of Experimental Psychology: Learning, Memory & Cognition, 37*, 1125-1142.

Reyna, V. F. & Farley, F. (2006). Risk and rationality in adolescent decision making implications for theory, practice, and public policy. *Psychological Science in the Public Interest, 7*, 1-44.

Reyna, V. F. & Mills, B. A. (2014). Theoretically motivated interventions for reducing sexual risk taking in adolescence: A randomised controlled experiment applying fuzzy-trace theory. *Journal of Experimental Psychology: General, 143*(4), 1627-1648

Reyna, V. F., & Lloyd, F. J. (2006). Physician decision making and cardiac risk: Effects of knowledge, risk perception, risk tolerance, and fuzzy processing. *Journal of Experimental Psychology: Applied, 12*, 179-195.

Reyna, V. F., Weldon, R. B., & McCormick, M. J. (2015). Educating intuition: Reducing risky decisions using Fuzzy Trace Theory. *Current Directions in Psychological Science, 24*(4), 392-398.

Reyna, V. F., Wilhelms, E. A., McCormick, M. J., & Weldon, R. B. (2015). Development of risky decision making: Fuzzy-trace theory and neurobiological perspectives. *Child Development Perspectives, 9*, 122-127.

Rolison, J. J., Hanoch, Y., Wood, S., & Liu, P. J. (2014). Risk-taking across the lifespan: A question of age and domain. *Journal of Gerontology: Psychological Sciences, 69,* 870-880.

Ross, M., Grossman, I., & Schryer, E. (2014). Contrary to psychological and popular opinion, there is no compelling evidence that older adults are disproportionately victimized by consumer fraud. *Perspecitives on Psychological Science, 9,* 427-436.

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., & Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behaviour and self-report: Evidence for a dual systems model. *Developmental Psychology, 44,* 1764-1778.

Steptoe, A., Shankar, A., Demakaos, P., & Wardle, J. (2013). Social isolation, loneliness, and all-cause mortality in older men and women. *Proceedings of the National Academy of Sciences of the United States of America, 100*, 5797-5801.

Suler, J. (2004). The online disinhibition effect. *Cyberpsychology & Behavior, 7,* 321-326.

Tversky, A., & Kahneman, D. (1986). Rational choice and the framing of decisions. *The Journal of Business, 59*, 251–278.

Van Wilsem, J. (2011). 'Bought it but never got it'. Assessing risk factors for online consumer fraud victimization. *European Sociological Review, 29*, 168-178.

Wang, J., Herath, T., Chen, R., Vishwanath, A., & Rao, H. R. (2012). Phishing susceptibility: An investigation into the processing of a targeted spear phishing email. *IEEE Transaction on Professional Communication, 55*, 345-362.

White, C.M., Gummerum, M., & Hanoch, Y. (2015). Adolescents' and young adults' online risk taking: The role of gist and verbatim representations. *Risk Analysis, 35*, 1407-1422.

White, C.M., Gummerum, M., & Hanoch. Y. (2016). The framing of online risk: Young adults' and adolescents' representations of risky gambles. *Decision*.

Wood, S. A., Liu, P. J., Hanoch, Y., & Estevez-Cores, S. (2015). Importance of numeracy as a risk factor for elder financial exploitation in a community sample. *Journal of Gerontology: Psychological Sciences*. Advance online publication. doi:10.1093/geronb/gbv041

Ybarra, M.L., Mitchell, K.J., Finkelhor, D., & Wolak, J. (2007). Internet prevention messages: Targeting the right online behaviors. *Archives of Paediatric Adolescent Medicine, 161*, 138-145.

York Cornwell, E., & Waite, L. J. (2009). Social disconnectedness, perceived isolation and health among older adults. *Journal of Health and Social Behavior, 50*, 31-48.

Table 1

Intercorrelations of Gist Measures of Risk Perception (Categorical Risk, Gist Principles, Global Risk Perception) and Verbatim Measures of Risk Perception (Specific Risk, Quantitative Risk) for Online Risk-Taking

Variable	Categorical risk	Gist principles	Global risk perception	Specific risk	Quantitative risk
Categorical risk					
Gist principles	.528**				
Global risk perception	.331**	.297**			
Specific risk	-.072	-.221**	.021		
Quantitative risk	-.038	-.094	.072	.365**	

**$p < .01$.

Table 2

Results of Principle Component Analysis for the Gist and Verbatim Measures (N=326)

Item	Rotated factor loading	
	Gist factor	Verbatim factor
Categorical risk (Gist)	.82	-.07
Gist principles (Gist)	.79	-.25
Global risk perception (Gist)	.69	.20
Specific risk perception (Verbatim)	-.10	.81
Quantitative risk (Verbatim)	.04	.81
Eigenvalue	1.84	1.37
% of variance	36.79	27.32

Table 3

Intercorrelations of Age, Past Online Risk-Taking, Time Spent Online, Sensation Seeking,

Gist and Verbatim Components, and Future Online Risk Intentions

	1	2[a]	3	4	5	6	7
1. Age	–						
2. Past risk-taking[a]	-.139*	–					
3. Time spent online	-.251**	.172**	–				
4. Sensation seeking	-.230**	-.065	.054	–			
5. Gist component	.109*	-.006	-.05	-.211**	–		
6. Verbatim component	-.046	.000	.099	.098	.000	–	
7. Online risk intentions	-.177**	.366**	.235**	.165**	-.421**	.256**	–

[a] Spearman correlations.

*p < .05. ** p < .001.

Table 4

Results of Hierarchical Regression Analysis Predicting Online Risk Intentions

Step	Independent variable	Online risk intentions				
		β	R^2	F	df	p
Step 1			.16	20.80	3, 321	<.001
	Age	-.10*				
	Time spent online	.15*				
	Past risk-taking	.33**				
Step 2			.37	32.06	6, 318	<.001
	Age	-.04				
	Time spent online	.13*				
	Past risk-taking	.33**				
	Sensation seeking	.05				
	Gist factor	-.40**				
	Verbatim factor	.24**				
Step 3			.36	19.56	10, 314	<.001
	Age	-.13				
	Time spent online	.12*				
	Past risk-taking	.33**				
	Sensation seeking	.05				
	Gist factor	-.40**				
	Verbatim factor	.24**				
	Age × Past Risk Taking	-.08				
	Age × Sensation Seeking	.16				
	Age × Gist Factor	.04				
	Age × Verbatim Factor	.01				

*$p < .01$. ** $p < .001$.