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# The Effects of Bilingualism and Trust on Digital Scam Susceptibility

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**THE EFFECTS OF BILINGUALISM AND TRUST  
ON DIGITAL SCAM SUSCEPTIBILITY**

BY

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Associates of Arts, University of Central Florida

A thesis submitted in partial fulfillment of the requirements  
for the Honors Undergraduate Thesis program in Psychology  
in the College of Sciences  
and in the Burnett Honors College  
at the University of Central Florida  
Orlando, Florida

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Thesis Chair: Dr. Nichole Lighthall

## **ABSTRACT**

Trust is an essential component of social relationships and is connected to how we make informed decisions. Humans tend to use mental shortcuts to arrive to decisions, a strategy which may be exploited by scammers. As online scams have become more common, it is critical to understand factors that can influence appraisal of potentially untrustworthy sources. The present study focused on language, in the form of self-reported bilingualism, and its relation to scam susceptibility. Language is a factor that contributes to alterations in brain structure, cognitive performance, and cognitive control systems. Bilinguals show advantages in the form of increased synaptic density and coupling which can leave highly efficient neural circuitry following early language acquisition. There is also potential for disadvantages, especially in the form of deficiencies in semantic fluency and lexical task accuracy. The present study investigated bilingualism in the realm of defense and protection from a form of cyber-attack known as phishing. The ability to detect trustworthiness or suspiciousness is the ultimate defense against scam victimization. Results supported the hypothesis that bilinguals have greater phishing classification accuracy and confidence shown by a higher end-game score during The Phishing Email Suspicion Test (PEST). Post-hoc analyses indicated marginally lower rates of false alarms and marginally higher correct rejections in bilinguals compared with monolinguals. In contrast, results did not support the hypothesis that self-reported general trust is associated with overall performance on the PEST, but some indication that lower general trust predicted more false alarms (classifying safe emails as phishing) and higher general trust predicted more misses (classifying phishing emails as safe). As the population of bilinguals is expected to increase along with sophisticated scams, this study highlights the importance of understanding the

neurocognitive mechanisms associated with additional language learning and its potential impacts on decision making and trust-related behavior.

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## INTRODUCTION

Trust is an essential facet of social relationships and is associated with the risk of harm or damage if the decision to trust is not formed correctly (Hancock et al., 2023). When one makes the decision on who or what to trust, they must process a myriad of information and cues. Past literature references decision making heuristics as a way that people form decisions with limited information (McAlaney & Hills, 2020). The cognitive miser approach (Fiske and Taylor, 2013, as cited in McAlaney & Hills, 2020), refers to when humans attempt to conserve cognitive processes that are inherently time consuming which may lead to them making less logical decisions. On the other hand, the main theory prior to the cognitive miser approach was called the naïve scientist approach, which proposes that humans make rational and intricate decisions by thoroughly evaluating all the cues and information provided to them (McAlaney & Hills, 2020). The ability of a human to judge trustworthiness is of utmost importance, especially as our society is now existing in a technological age. Cues of trustworthiness are essential to decision making and can be used for protection from scams and fraud (Burnes et al., 2017). The current rise of cyber-attacks occurs alongside advancements in socio-technology, in which phishing emails can play on human decision making shortcuts (heuristics). Understanding how trust can affect decision making, especially in scenarios of high-stake credentials on the line, is important for protecting consumers.

The present study will utilize the Trust Inventory to examine general trust. The Trust Inventory is a 40-item survey with two sub-scales of 20 items each (Couch et al., 1996). General trust, also called global trust, refers to one's orientation toward others and human nature in general (Rotter, 1967 and Wrightsman, 1974, as cited in Couch & Jones, 1997). General trust is frequently connected to early childhood and the formation of attachments to primary caregivers

(Erikson, 1964, as cited in Couch & Jones, 1997). This then influences the development of interpersonal trust, an essential facet of relationship development (Rotter, 1967; Wrightsman, 1974; Erikson, 1964, as cited in Couch & Jones, 1997). Trust can also be examined within the realm of close personal relationships in the Trust Inventory under the subscale of partner trust. Partner trust entails a person's confidence and positive emotions within a close interpersonal relationship (Rempel et al., 1985, as cited in Couch & Jones, 1997). We will not be examining this component of the Trust Inventory as it is less relevant to the study's focus on online phishing by strangers.

The present study will also examine the relationship between language and scam susceptibility using self-reported bilingualism. Although proficiency of more than one language is not specific to any demographic, many bilinguals tend to belong to marginalized groups. Literature references second-generation offspring, who tend to be raised in households where a non-English language may be spoken at home, although many are still proficient in English (Alba., 2004). This creates a bilingual world for the offspring. Additionally, studies have found trust behaviors to vary amongst cultures (Chuah et al., 2007; Chuah et al., 2009; Cochard et al., 2021; Hui et al., 1991; Jiao, 2023). Differences in cultures may play a role in interpersonal relationships and variations of trust among societies. Furthermore, racial, and ethnic demographics can contribute to discrepancies in trust. Marginalized groups often face substantial amounts of discriminatory treatment and are disadvantaged in terms of socioeconomic status (Smith, 2010). Smith also suggests that minority groups that are often targeted tend to perceive that they are being discriminated against, which can ultimately lead them to be less trusting than the majority (2010).

Language is considered central to the human experience and is a factor that contributes to alterations in brain structure, nonverbal cognitive performance, and greater cognitive control systems (Bialystok, 2007). Many studies utilize the criterion introduced by Bialystok et al. (2007) to define bilingualism (Chertkow et al., 2010; Craik et al., 2010; Gold, 2015). This criterion characterizes bilinguals as individuals who “had spent a majority of their lives, at least from early adulthood, regularly using at least two languages.” Other studies have utilized objective measures of language proficiency, such as the Multilingual Naming Test (MINT) (Gollan et al., 2017) and semantic and phonemic fluency tests (Salvatierra et al., 2007). Furthermore, the population of bilinguals is expected to increase in the United States, especially with the rise in immigration (Houseman, 2023). With this increase, the role of language should be examined as a mechanism for behavioral differences.

Previous literature has shown evidence to suggest a phenomenon known as the *bilingual advantage* (Bialystok et al., 2014; Van den Noort et al., 2019). Studies have found a protective advantage possessed by those who speak multiple languages (Chertkow et al., 2010). This protective advantage relates to enhanced executive control systems and neurological mechanisms affected by language processes (Gold, 2015). This advantage can be linked to inhibition, memory, attention, decision making, and more. Enhanced cognitive reserve is a prominent component of this phenomenon, which refers to the theory that bilinguals can mitigate neurodegenerative brain damage related with aging processes (Anderson et al., 2020; Craik et al., 2010; Costumero et al., 2020). Several studies have found that the effects of neurological decline, specifically in the form of the manifestation of dementia symptoms, occur at a significantly delayed rate in comparison to monolingual older adults (Gold, 2015; Craik et al., 2010; Chertkow et al., 2010; Anderson et al., 2020; Costumero et al., 2020). Craik et al. (2010)

found that bilingual older adult individuals reported the onset of their symptoms of Alzheimer's Disease (AD) 5.1 years later and were diagnosed 4.3 years after their monolingual counterparts which remained consistent when controlling for gender, years of education, and socioeconomic status. It is suggested that the delay in the onset of AD symptoms is not necessarily due to the protection of memory circuits but because of the aforementioned enhanced cognitive reserve and executive control processes (Gold, 2015). This advantage does not mean that bilinguals will never get the disease, but that they may experience symptoms at a later age than monolinguals. Delayed onset can also be seen as a disadvantage as individuals may not seek assistance with symptoms causing missed early detection. These differences are also linked to neuropathology. A PET scan study showed greater cerebral hypometabolism in bilingual individuals, which is related to the ability to compensate for symptoms of cognitive decline and ultimately allow bilinguals the *advantage* of delayed manifestation of neurodegenerative disease (Anderson et al., 2020). Throughout the literature, the *bilingual advantage*, in terms of variables for executive functioning, is oftentimes linked with the older adult age group (Ware et al., 2020). For young adults, early language acquisition is also linked to increased synaptic density and coupling (Pliatsikas, 2019; Anderson et al., 2020) and increased subcortical gray matter volume (Anderson et al., 2020). Although these neurological changes subside with time, Anderson et al. (2020) suggest that these changes leave highly efficient circuitry.

The bilingual differences are linked to the changes in executive control systems used during linguistic processing in which individuals have two competing language systems (Stilwell et al., 2015). In contrast to the research presented above, some studies suggest that bilinguals are *disadvantaged* in cognitive tasks because of competition for cognitive resources, specifically in semantic fluency (Salvatierra et al., 2007), reaction time, and lexical task accuracy (Stilwell et

al., 2015). Semantic fluency and lexical task accuracy can be pertinent in scam detection regarding context, spelling, and grammar errors. Previous research has shown that performance on lexical decision tasks for bilinguals and monolinguals is similar. A study by Soares and Grosjean (1984) found that English monolinguals and English-Portuguese bilinguals had equivalent scores. This study was conducted in the United States where fluency, proficiency, and immersion were controlled for. Another study by Ransdell and Fischler (1987) utilized American bilinguals whose dominant language was English compared to monolingual English speakers. The results revealed that bilinguals had a slower response time in recognizing abstract, concrete, and nonwords. As previously stated, scammers use misspelled words to bypass filters. Deficits in lexical recognition could pose a detriment to identifying scams. The present study aims to examine if this bilingual advantage can be expanded into protective behaviors concerning scam susceptibility or if its deficits can contribute to a decreased ability to discern the trustworthiness of emails.

In regard to scams, there are several forms of cyber-attacks including malware, cyberbullying, hacking, and more. The current study focuses on phishing emails, which can be defined as a “common type of cyber attack...aims to trick recipient to fall for attacker’s desired actions” (Proofpoint, 2021). The attacker is usually interested in being given the consumer’s sensitive information such as login and financial credentials. The messages utilized in a phishing attack oftentimes attempt to resemble trustworthy organizations and businesses. Phishing attacks have become widespread and common, to the point where sub-categories of the scam type were created. Smishing refers to attacks via text messages, whereas vishing entails voice-relying attacks (Al-Qahtani & Cresci, 2022). Al-Qahtani and Cresci even reference a subcategory called pharming, in which cyber-attackers utilize devices to reroute consumers towards dangerous

websites (2022). These emerging subcategories of phishing reveal the increasing complexity and sophistication of digital scams.

During the COVID-19 pandemic, the world shifted further into the digital age, with many consumers relying on technology for communication, entertainment, employment, and more. Throughout the pandemic, phishing was considered the most frequent form of digital attacks (Al-Qahtani & Cresci, 2022). It is reported that an average of 3.4 billion emails sent daily are scam, making phishing the most common type of digital crime (AAG IT, 2024), and this frequency is expected to continue to increase. Although technological advancements have added additional boundaries to protect consumers from fraud, such as filters and email flagging, scam emails have also become more sophisticated, making the human ability to discern trustworthiness an essential facet of protection (Hakim et al., 2021). As scam emails learn how to bypass filters and avoid detection, they begin to resemble safe emails, which can make it harder to discern their trustworthiness (Jáñez-Martino et al., 2023). Scammers attempt to mislead scam detection software by poisoning text, obfuscated words, hidden text salting, and images (Jáñez-Martino et al., 2023).

To address susceptibility to digital scams, the present study utilized The Phishing Email Suspicion Test (PEST). The PEST is designed to be an ecologically valid lab-based scam susceptibility and detection measurement. This test allows trust-related behavior to be quantifiable and can examine a participant's ability to detect and distinguish fraud. Additionally, phishing attacks are often initiated through emails (Parno et al., 2006) making research in this realm of greater necessity. As the world has begun to shift increasingly more technological, consumers must be wary of the trustworthiness of the digital communication that makes its way into their inbox.

As scams continue to rise, and human detection accuracy becomes crucial, trust-behavior is highlighted. Previous literature has found people who are high in trust are better at detecting lies, more accurate in discerning intentions, and better at detecting deceit than people who exhibit low trust (Carter & Weber, 2010). Carter and Weber's finding contradict logical game theory. They explain that their study results show that high generalized trust scores signify an individual who has participated in social risk taking and therefore has learned the cues of trustworthiness and deceit. This study also found that general trust and the ability to classify a trustworthy candidate was not significant. Additionally, a study examining phishing suspiciousness in older and younger adults found that young adults were too trusting and fell victim to the experimental phishing (Gavett et al., 2017). Older adults on the other hand, had personal experience related to being victims of phishing which may have been useful in protecting them (Gavett et al., 2017). Contrastingly, some research has found that there is no significant relation between trust and scam victimization (Judges et al., 2017). The current study examined if trust, specifically general trust as measured from the Trust Inventory, can predict outcomes on The Phishing Email Suspicion Test.

Based on the existing literature, the following hypotheses were formed:

Hypothesis 1: Compared with monolinguals, bilingual participants will have more accurate classification and high confidence (discernment) on The Phishing Email Suspicion Test.

Hypothesis 2: General trust scores will be positively associated with discernment on The Phishing Email Suspicion Test.

## **METHODS**

### **Demographics Questionnaire**

A demographic questionnaire was administered to collect information regarding gender, sexual orientation, marital status, race, ethnicity, language, educational level, annual household income, occupational and living situation, political orientation, and miscellaneous questions regarding their participation. The study focused on their self-reported language. This questionnaire is included in Appendix A.

### **Trust Inventory**

The Trust Inventory included 40 items on 2 sub-scales to assess general trust and partner trust in specific individuals. The 2 sub-scales included are generalized trust (G) and partner trust (P). The present study did not utilize partner trust as we were not examining trust amongst close social relationships. These forms of trust are important aspects of interpersonal relationships and effective social functioning (Couch, Adams, & Jones, 1996). Participants were instructed to rate how much a statement applies to them on a five-point scale from “Strongly Disagree” to “Strongly Agree.” This survey is included in Appendix B.

### **Phishing Email Suspicion Test (PEST)**

The present study utilized the Phishing Email Suspicion Test (PEST), where participants were presented with various emails selected from four distinct categories: real-phish, simulated-phish, real-safe, and simulated-safe. The PEST measures one’s ability to detect phishing emails and utilizes an ecologically valid inbox environment. Participants evaluated each email on a four-point scale from “definitely safe” to “definitely suspicious.” The participant was presented with a total of 40 emails, 10 from each email category. Participants were told that they could maximize their score thorough classification accuracy with high confidence ratings (i.e.,



responses of “definitely safe” versus “possibly suspicious”) and were not told their score until the end (Hakim et al., 2021). A visual example of the task and example of three of the four classification types is included in Appendix C.

## **Procedure**

Young adults were recruited via SONA which is UCF’s Psychology Research Participation System. The experiment occurred in a laboratory setting on the UCF Main Campus. At the beginning of the session, participants were tasked with completing the Demographic Survey. Following this, participants completed a series of cognitive tasks, including the PEST. A survey battery was also administered at the end of the experiment. Participants were compensated for their time with 3.5 SONA credits.

## **RESULTS**

### **Participants**

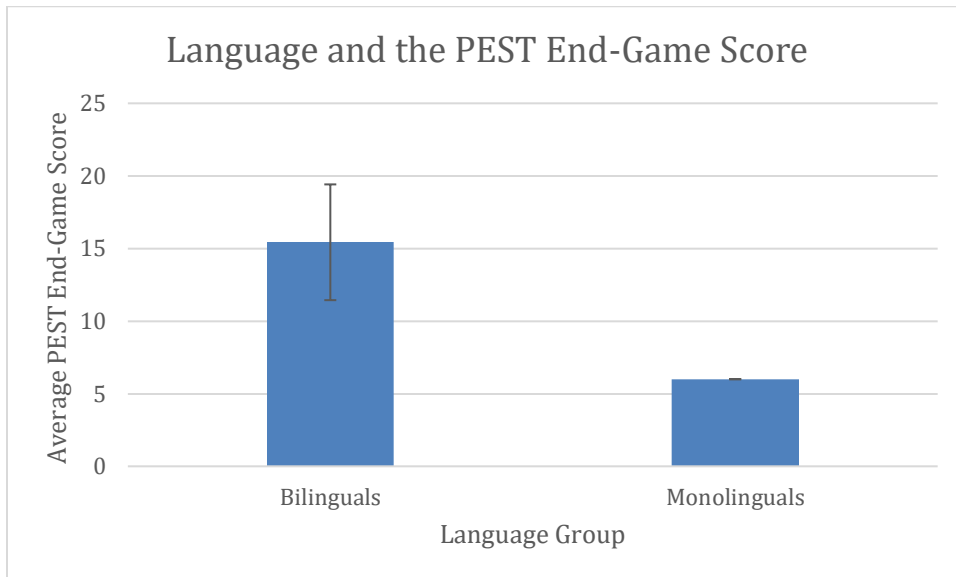
Undergraduate students at The University of Central Florida were recruited via SONA. The present study primarily focuses on the young adult population. A majority of the sample were female non-Hispanic Asians. The average age of the participants was 22.22 years old, and a range of 21-23 years old. Out of the young adult population of nine undergraduate students, seven were bilingual and two were monolingual.

Table 1: Demographics of Sample

	Full Sample				General Trust Score		PEST Score	
	<i>n</i>	%	M	Range	M	SD	M	SD
Age	-	-	22.22	21-23				
Gender								
Female	7	77.8	-	-	-	-	-	-
Male	2	22.2	-	-	-	-	-	-
Race								
Asian	5	55.6	-	-	-	-	-	-
Black or African American	2	22.2	-	-	-	-	-	-
White	1	11.1	-	-	-	-	-	-
More Than One	1	11.1	-	-	-	-	-	-
Ethnicity								
Hispanic or Latino	3	33.3	-	-	-	-	-	-
Not Hispanic or Latino	6	66.7	-	-	-	-	-	-
First Language								
Non-English	6	66.7	-	-	70.50	13.55	14.17	10.96
English	3	33.3	-	-	75.00	7.21	11.67	9.82
Language								
Monolingual	2	22.2	-	-	78.00	7.07	6.00	0.00
Bilingual	7	77.8	-	-	70.29	12.38	15.43	10.55

## Bilingual Advantage and Ability to Discern Email Scams

There was a marginal effect of bilingualism on the PEST end-game score ( $t(7) = 1.204, p = 0.77$ ). Bilinguals has a higher end-game score on the PEST ( $M = 15.43, SEM = 3.99$ ) than monolinguals ( $M = 6.00, SEM = 0.00$ ). The evidence from the independent samples t-test provides support for our hypothesis that the bilingual advantage may be extended to benefits in scam detection.



**Figure 1: Language and the PEST End-Game Score**

*Note.* Bilinguals had better discernment abilities in terms of higher accuracy in classifications and higher confidence in their decisions leading to a higher average PEST end-game score than monolinguals ( $t(7) = 1.204, p = 0.77$ )

## Trust as a Predictor for PEST Scores

The present study's results do not support the hypothesis that general trust is a predictor variable for PEST end-game scores. The regression analysis was conducted ( $R = .206, p = .594$ ) between young adult's general trust score ( $M = 72.00, SD = 11.52$ ) and PEST score ( $M = 13.33, SD = 10.04$ ). These results reject the hypothesis that general trust can be used as a predictor on the PEST end-game score.

*Post-Hoc Analysis*

Correct Email Classification		
Participant Response	Scam	Safe
Scam	Hit	False Alarm
Safe	Miss	Correct Rejection

**Figure 2: PEST Response Types**

*Note.* There are four response types depending on participant response and correct classification on the PEST.

Post-hoc analyses were conducted on trust scores and PEST classification accuracy to examine possible language differences in classification frequencies based on the signal detection theory (SDT) as well as general trust scores in association to frequencies of incorrect classifications. Individual participant PEST decisions were organized into “safe” or “scam” from their four-point experimental classifications of “definitely suspicious” to “definitely safe”. The emails were also converted into “safe” or “scam” classifications from their “simulated-phish” to “simulated-real” experimental classifications. This organization allowed to analyze the data in terms of different types of correct and incorrect responses on the PEST. Correctly identified scams (targets) were coded as a *hit*. Emails marked as a scam when they were safe (non-targets), were coded as a *false alarm*. Scams identified as safe were coded as a *miss*. Finally, safe emails marked as safe were coded as a *correct rejection*.

The post hoc analyses examined differences in these measures between monolinguals and bilinguals using independent samples t-tests for all four response types.

In reviewing *hit* rates, which refer to when participants correctly identify a scam as a scam, we found no significance between language groups ( $t(7) = 1.089, p = 0.312$ ).

Monolinguals had a higher average frequency of *hits* ( $M = 14.50$ ,  $SEM = 3.50$ ) than bilinguals ( $M = 11.00$ ,  $SEM = 1.45$ ) although not statistically significant. Both language groups had statistically similar frequencies of correct classification of scams.

For *false alarms*, which is when participants input an email as a scam when it is safe, we found marginal significance based on language group differences ( $t(7) = 2.083$ ,  $p = .076$ ).

Monolinguals had a higher average frequency of *false alarms*, ( $M = 12.50$ ,  $SEM = 3.50$ ) than bilinguals ( $M = 6.57$ ,  $SEM = 1.23$ ). Monolinguals tended to incorrectly label safe emails as scams more than bilinguals did, making their language group potentially overly suspicious to emails.

When reviewing *misses*, we found no statistical significance between scores across language groups ( $t(7) = -1.040$ ,  $p = .333$ ). Monolinguals had lower average frequencies of *misses* ( $M = 5.50$ ,  $SEM = 3.50$ ) than bilinguals ( $M = 8.86$ ,  $SEM = 1.46$ ) although not significant. *Misses* are when the participant inputs that an email is safe when it is a scam. Bilinguals having higher average frequencies of *misses* could relate to them expressing overly gullible behavior.

*Correct rejections* refer to when participants correctly identify an email as safe. We found marginal significance when comparing between language groups ( $t(7) = -2.158$ ,  $p = 0.68$ ). Monolinguals had lower frequencies of *correct rejections* ( $M = 7.50$ ,  $SEM = 3.50$ ) than bilinguals ( $M = 13.57$ ,  $SEM = 1.21$ ). Bilinguals were more successful in identifying safe emails.

We chose to focus specifically on two response types when analyzing general trust as a predictor variable, the frequencies of *false alarms* and *misses*. These two response types represent when input from the participant were incorrect. A regression analysis was used to examine if general trust predicts frequency of *false alarms*. The regression model was marginally significant ( $F(1, 7) = 5.321$ ,  $p = .054$ ). The results showed that general trust scores served as a

marginal predictor variable for frequency of *false alarms* during the PEST, referring to when participant input was “scam”, and the correct email classification was “safe”. It was found that lower general trust scores were associated with higher frequencies of *false alarms* with marginal significance ( $\beta = -.237, p = .054$ ).

Another regression analysis was conducted to examine if general trust scores predicted frequency of *misses* during the PEST. A *miss* is referred to as when the participant’s input is “safe” while the correct email classification is “scam”. The regression model was statistically significant ( $F(1,7) = 8.625, p = .022$ ). The results revealed, with statistical significance, that high trust scores are associated with higher frequencies of *misses* ( $\beta = .672, p = .022$ ).

## DISCUSSION

### **Bilingual Advantage and Ability to Discern Email Scams**

The study supports Hypothesis 1, which states that bilingual participants will have higher PEST end-game scores due to more accurate classification with higher confidence than monolinguals. A higher end-game PEST score would mean that the participant could accurately categorize an email as safe or suspicious and successfully maximize their points. This hypothesis intended to see if the phenomenon known as the “bilingual advantage”, often stated in literature to provide enhanced control systems (Gold, 2015), could be extended into the realm of protection against scams and fraud. The results indicate that this extension may be true, especially for young adult bilinguals.

An unfortunate limitation of the present study was the low enrollment in participants, causing a low sample size of bilingual and monolinguals. Further research is needed to understand better how facets of the bilingual experience, such as primary language, age of acquisition, and more, can affect psycholinguistic measures. The results of this study also pose questions for future research. If the bilingual advantage can truly be extended to scam protection, and many bilinguals come from marginalized communities, why is it that racial and ethnic minorities are at the highest risk for victimization from fraud? The Federal Trade Commission states that members of minority groups are more likely to be fraud victims in comparison to non-Hispanic whites (2016). Perhaps it is due to confounding variables that are often linked to scam susceptibility such as socioeconomic status, financial literacy deficits in semantic memory or psychological health (Yu et al., 2021). The results reveal that perhaps language is not the main factor contributing to minority victimization in scams. Regardless, the results of this study enable a call to action for future research to find strategies to help bilinguals and minority groups to



avoid scams and fraud. In November of 2023, the Federal Trade Commission (FTC) expanded its website to allow consumers to report fraud in both English and Spanish (2023). Additionally, the FTC has added the following languages to be able to report scams and fraud via telephone call: “Mandarin, Tagalog, Vietnamese, French, Arabic, Russian, Korean, Portuguese, and Polish” (2023). As the bilingual population continues to grow, the efforts to protect are imperative for the safety and well-being of the community.

The present study did not include objective language proficiency such as the Multilingual Naming Test or semantic and phonemic fluency tests. Instead, the study utilized a demographic questionnaire with self-reported measures of language. Future iterations of bilingual research should aim to include an objective measure of language and a more robust population size of bilingual participants. Studies examining language specifically should attempt to control for confounding variables, especially race and ethnicity.

### **Trust as a Predictor for PEST Scores**

The results do not support Hypothesis 2, which states that scores on the general trust portion of the Trust Inventory can be used to predict the overall performance on the PEST regarding the end-game score. As previously mentioned, a high end-game PEST score would refer to a maximalization of points through classification accuracy and confidence.

This outcome reflects previous research that found no significant relation between trust and fraud victimization (Judges et al., 2017). On the other hand, the results also contradict the findings of previous studies examining phishing suspiciousness. The study by Tornblad et al., specifically discovered that distrust may be a predictor to susceptibility (2021). Although these analyses focused primarily on dispositional trust and distrust. Conversely, the present study utilized general trust, which refers to belief in the trustworthiness of others and society in general

(Couch, Adams, & Jones, 1996). In agreeance with Judges et al., future research should examine trust and fraud victimization with trust measures relating to strangers and institutional trust instead of generalized trust (2017).

Future research should also examine trust differences between young adults and older adults regarding their scam susceptibility. Previous literature has shown that older adults have deficits in their ability to gauge the trustworthiness of others. A study by Castle et al., found that older adults rated faces normed for untrustworthiness significantly higher in trustworthiness than their young adult counterparts (2012). A study that examined phishing suspiciousness specifically found that personal experience of having been victimized by phishing in the past may provide protection, especially for older adults (Gavett et al., 2017). Utilizing a survey to inquire about previous victimization and comparing this to PEST end-game score may be incredibly interesting to examine in conjunction with potential age-related differences.

#### *Post-Hoc Analysis*

The present study conducted post-hoc analyses on trust as a predictor variable utilizing the signal detection theory (SDT) approach (Green & Swets, 1966). The original signal detection theory was created to understand how individuals can distinguish signals among noise but has since then been adapted throughout several realms of psychology (Batailler et al., 2021). Ultimately, the SDT is meant to see how individuals can distinguish amongst stimuli. The present study examined response types for two separate analyses.

To analyze how language group, bilingual or monolingual, can affect email classification on the PEST, SDT was utilized. We analyzed the data in terms of frequencies of *hits*, *false alarms*, *misses*, and *correct rejections* to reveal if bilinguals had better discernment abilities than monolinguals. We found that bilinguals had marginally higher frequencies of *correct rejections*

and lower frequencies of *false alarms*. There was no statistical significance regarding language group differences in average frequencies of *hits* and *misses*. These results reveal that bilinguals and monolinguals perform similarly when encountering a scam email, but differently when encountering a safe email. Bilinguals performed, with marginal significance, better on the PEST for *correct rejection*, meaning they were more successful in identifying a safe email than monolinguals.

Our second analyses utilized SDT response types to examine trust as a predictor variable. By analyzing the results through this approach, we can detect, to what extent, general trust can predict how participants will incorrectly classify emails during the PEST. We analyzed these results for only two response types, *false alarms* and *misses* to best examine the instances of incorrect classifications. The participants' individual decisions from the 40 PEST emails were organized into "safe" or "scam" from their four-point scale options of: "definitely suspicious, possibly suspicious, possibly safe, or definitely safe". Additionally, the email classifications from the PEST were organized into "safe" or "scam". This organization allowed the formation of Table 2, which organizes the PEST options into the classifications from the signal detection theory.

*False alarms*, in the case of the PEST, refers to when a participant's input is "scam", and the correct identification is "safe". These instances reveal that a participant is overly doubtful of the trustworthiness of an email and marks it as suspicious, when it is safe. This regression analysis had marginal significance and found that low general trust can serve as a predictor for higher instances of *false alarms*. When an individual trusts less, they may exhibit overly suspicious behavior, which may lead to them being distrustful of stimuli regardless of it possibly exhibiting trustworthy cues.

Our additional analyses also examined *misses* in the PEST. A *miss* is classified as an instance when the participant indicated that an email was “safe” when it was a “scam”. This form of classification indicates that the participant may be overly gullible and too trusting of possible scams. The regression analysis results showed statistical significance and found that high trust scores were associated with higher frequencies of *misses*. In this case, participants are trusting the emails more regardless of if they may exhibit cues that should warn them that the email is untrustworthy. This analysis features some interesting results and future studies can aim to include SDT response types to analyze how participants respond to the PEST.

## **Conclusion**

The present study aimed to examine the language and trust-behavior differences that could contribute to variations in email scam susceptibility. The results revealed that participants who self-reported to be bilingual performed with higher accuracy and classification confidence on the PEST than those who identified as monolinguals with a marginally significant effect. Additionally, it was found that trust does not serve as a predictor variable for this population on the PEST end-game score. Post-hoc analyses found that bilinguals and monolinguals performed similarly on *hits* and *misses*, but different on *false alarms* and *correct rejections* with marginal statistical significance. When comparing between language groups, bilinguals showed higher average frequencies of *correct rejections* meaning they were more successful in identifying safe emails. Post-hoc analyses found that general trust can serve as a predictor for instances of incorrect classification, which would be frequencies of *false alarms* or *misses*. The present study utilized a small sample of undergraduates. Future research should aim to isolate language and control for other confounding variables such as race and ethnicity to better understand how language affects decision making. Additionally, future research examining language and scam

susceptibility should expand to include objective measures of language as well as further analyses on the effect of L1 and L2 variations in trust decisions. Utilizing trust scales specific to stranger or institutional trust may be most suitable for future studies on digital scams as many come from people the victim is unfamiliar with.

As the population of bilinguals and multicultural individuals is expected to increase (Houseman, 2023), research that places them in the spotlight is of utmost importance. The bilingual experience can affect decision making and trust behavior, therefore, viewing its potential protection in terms of new contexts can contribute to a better comprehension of the extent of language differences. Additionally, the PEST is relatively new and research that seeks to understand how groups perform on it can be useful. Examining these variations in addition to trust in relation to scams, can provide a well-rounded framework for preventative education and initiatives to protect consumers from the dangers of phishing.

**APPENDIX A:**  
**DEMOGRAPHICS QUESTIONNAIRE**

## Demographics

Please complete the survey below.

Thank you!

Participant ID

Participant ID:

Date:

Time:

Date of Birth (Month, Day, Year)

Zip Code

Sex at Birth

Male  Female

Gender Choice

Male  
 Female  
 Both  
 Neither  
 Prefer not to answer

What is your sexual orientation?

Heterosexual  
 Bisexual  
 Homosexual  
 Asexual  
 Pansexual  
 Other  
 Prefer not to answer

---

What is your current marital status?

- Married    Single    Divorced    Separated    Widowed    Prefer not to answer

---

What is your race?

- American Indian/ Alaska Native    Asian    Native Hawaiian or Other Pacific Islander  
 Black or African American    White    More than one race

---

What is your ethnicity?

- Hispanic or Latino    Not Hispanic or Latino

---

### **I. Language & Education & Income**

First (Primary) Language:

---

If NOT English, at what age approximately did you begin to learn English:

---

Are you bilingual?

- Yes    No

If you reported English as your primary language and are bilingual: What other language(s) do you speak or know?  
(Please mention all of them)

---

If you reported additional languages: At what age did you learn this/these additional language(s)?

---

For each additional language(s) you reported, could you estimate how often you currently use them?

- Not very often    Often    Very often

---

What is the highest level of school you have completed or the highest degree you have received?

- No schooling completed  
 Nursery school to 8th grade  
 10th or 11th grade  
 12th grade, no diploma  
 High school degree or equivalent (e.g., GED)  
 Some college but no degree  
 Associate degree  
 Bachelor degree  
 Graduate degree



---

What is your total annual household income?

- \$0
- \$1 to \$9,999
- \$10,000 to \$24,999
- \$25,000 to \$49,999
- \$50,000 to \$99,999
- \$100,000 to \$149,999
- \$150,000 to \$199,999
- \$200,000 to \$249,999
- \$250,000 to \$299,999
- \$300,000 to \$399,999
- \$400,000 to \$499,999
- \$500,000 and greater
- Prefer not to answer

---

## II. Occupational and Living Situation Questions:

What is your occupation category?

- Full-Time
- Part-Time
- Unemployed
- Volunteer

---

What is your current living situation?

- Live alone in my own home (house, apartment, condo, trailer, etc.); may have a pet
- Live in a household with other people (family, friends, roommates, etc.)
- Live in a residential facility where meals and household help are routinely provided by paid staff (or could be if requested)
- Live in a facility such as a nursing home which provides meals and 24-hour nursing care
- Temporarily staying with a relative or friend
- Temporarily staying in a shelter or homeless
- Other

---

## III. Political Orientation:

In American politics, do you consider yourself a member/supporter of:

- Republican Party
- Democratic Party
- Other (write the name of your political party here)

---

Overall, on the scale of political orientation (from extremely liberal to extremely conservative) where would you place yourself?

- 1 (Extremely Liberal)
- 2
- 3
- 4 (Moderate)
- 5
- 6
- 7 (Extremely Conservative)

---

**VII. Other**

---

Do you have health insurance?

- Yes
  - No
- 

Are currently participating in another research study?

- Yes
  - No
- 

If YES, does the research study involve an intervention (drug or exercise regime etc.)?

- Yes
  - No
- 

How did you find out about this study?

- Newspaper ad
  - Research match
  - Posted flier on UF campus
  - Posted flier in a public building
  - Hand out
  - Friend or family member
  - Other (please specify in Notes):
- 

Notes

---

Thank you!

---

**APPENDIX B:**  
**TRUST INVENTORY**

The following statements are about relationships. Please rate how much you feel each statement applies to you. There are no right or wrong answers.

**Trust Inventory:**

**The following statements are about relationships. Please rate how much you feel each statement applies to you. There are no right or wrong answers. Some statements may not apply to you if you do not have a partner, for these items please select N/A.**

1. My partner makes me feel safe.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

2. I tend to be accepting of others.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

3. My partner sometimes makes me uncomfortable.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

4. My relationships with others are characterized by trust and acceptance.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

5. I do not worry that my partner will leave me.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

6. Basically, I am a trusting person.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

7. It is better to trust people until they prove otherwise than to be suspicious of others until they prove otherwise.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

8. I accept others at "face value."

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

9. I am skeptical that relationships ever work out.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

10. Most people are trustworthy.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

11. I believe in my partner.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

12. In relationships, I tend to be alert for the possibility of rejection or betrayal.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

13. It is better to be suspicious of people you have just met, until you know them better.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

14. I make friends easily.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

15. I am sure about how my partner feels about me.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

16. Only a fool would trust most people.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

17. I am doubtful that my partner will always be there for me if I need him/her.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

18. I tell my partner that I trust him/her completely.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

19. I find it better to accept others for what they say and what they appear to be.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

20. I would admit to being more than a little paranoid about the people I meet.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

21. Relationships only will lead to heartache.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

22. I have few difficulties trusting people.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

23. I am rarely ever suspicious of people with whom I have a relationship.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

24. Basically, I tend to be distrustful of others.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

25. I am afraid my partner will hurt me emotionally.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

26. I am afraid my partner will betray me.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

27. Experience has taught me to be doubtful of others until I know they can be trusted.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

28. I generally believe what my partner tells me.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

29. I never believe my significant other when he/she tells me how he/she feels about me.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

30. I have a lot of faith in people I know.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

31. Even during the "bad times," I tend to think that things will work out in the end.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

32. I feel that I can be myself in the presence of my partner.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

33. I am uncertain about how my partner feels about me.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree



---

34. I tend to take others at their word.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

35. When it comes to people I know, I am believing and accepting.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

36. It is dangerous to "let your guard down" with your partner.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

37. I feel I can depend on most people I know.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

38. I am sometimes doubtful of my partner's intentions.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

39. When my partner is with others, I worry that he/she will not be faithful.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

40. I almost always believe what people tell me.

- Strongly Disagree
- Slightly Disagree
- Neither Agree or Disagree
- Slightly Agree
- Strongly Agree

---

**WARNING:** You have left at least one of the questions above unanswered. If this was intentional, then you may submit the survey. Otherwise, please scroll up and answer any unanswered questions.

---

The Trust Inventory

The Assessment of Trust Orientation

Couch, L. L., Adams, J. M., & Jones, W. H. (1996). The Assessment of Trust Orientation. *Journal of Personality Assessment*, 67(2), 305.

---

Partner Trust Scale score

\_\_\_\_\_

---

Generalized Trust Scale score

\_\_\_\_\_

**APPENDIX C:**  
**PHISHING EMAIL SUSPICION TEST**

## a) Task display with real phishing email

Google	
<b>Gmail</b>	Problems with item delivery, n.01403407
<p><b>Compose</b></p> <p>Inbox (160)</p> <p>Starred</p> <p>Important</p> <p>Drafts</p> <p>More ...</p>	<p>Dear Customer,</p> <p>We can not deliver your parcel arrived at August 17.</p> <p>Please review delivery label here: <a href="http://www.ups.com/track/label-29382">www.ups.com/track/label-29382</a></p> <p>Best regards,</p> <p>Sergio James,</p> <p>UPS Senior Support Manager</p>
	<div style="display: flex; justify-content: space-around;"> <div style="background-color: black; color: white; padding: 5px; text-align: center;">Definitely Safe</div> <div style="background-color: black; color: white; padding: 5px; text-align: center;">Possibly Safe</div> <div style="background-color: black; color: white; padding: 5px; text-align: center;">Possibly Suspicious</div> <div style="background-color: black; color: white; padding: 5px; text-align: center;">Definitely Suspicious</div> </div>

## b) Text from example emails

SIMULATED PHISH	REAL SAFE	SIMULATED SAFE
<p>Free Gift Received From Matt</p> <p>Dear Bob,</p> <p>Your friend Matt sent you a free gift through Games with Friends, a new social media site for keeping in touch through games and trades.</p> <p>Check out what Matt got you by following the link below:</p> <p><a href="http://www.tucsonweekend.com/gift-social/">http://www.tucsonweekend.com/gift-social/</a></p> <p>Matt Games with Friends</p>	<p>Please confirm your e-mail address - Airbnb</p> <p>Hi Bob,</p> <p>Welcome to Airbnb! In order to get started, you need to confirm your email address.</p> <p><a href="#">Confirm Email</a></p> <p>Thanks,</p> <p>The Airbnb Team Sent with Love from Airbnb Airbnb, Inc., 888 Brannan St, San Francisco, CA 94103</p>	<p>Apple iCloud Security</p> <p>Dear Bob,</p> <p>Your AppleID was used to sign in to iCloud on an iPhone 6S in Tucson, Arizona at 7:06 PM on Monday, January 8, 2018.</p> <p>If this was your sign-in, please disregard this email. If this was not your sign in, please contact Apple Support at the link below.</p> <p><a href="https://support.apple.com">https://support.apple.com</a></p> <p>iCloud Authentication Services Copyright 2018 Apple Inc. All Rights Reserved</p>

(Hakim et al., 2021)

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