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The Influence of Age, Gender, and Cognitive Ability on the Susceptibility to Persuasive Strategies

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Abstract: The fact that individuals may react differently toward persuasive strategies gave birth to a shift in persuasive technology (PT) design from the one-size-fits-all traditional approach to the individualized approach which conforms to individuals' preferences. Given that learners' gender, age, and cognitive level can affect their response to different learning instructions, it is given primacy of place in persuasive educational technology (PET) design. However, the effect of gender, age, and cognitive ability on learners' susceptibility to persuasive strategies did not receive the right attention in the extant literature. To close this gap, we carried out an empirical study among 461 participants to investigate whether learners' gender, age, and cognitive ability significantly affect learners' susceptibility to three key persuasive strategies (social learning, reward, and trustworthiness) in PETs. The results of a repeated measure analysis of variance (RM-ANOVA) revealed that people with high cognitive level are more likely to be susceptible to social learning, while people with low cognitive level are more likely to be susceptible to trustworthiness. Comparatively, our results revealed that males are more likely to be susceptible to social learning, while females are more likely to be susceptible to reward and trustworthiness. Furthermore, our results revealed that younger adults are more likely to be susceptible to social learning and reward, while older adults are more likely to be susceptible to trustworthiness. Our findings reveal potential persuasive strategies which designers can employ to personalize PTs to individual users in higher learning based on their susceptibility profile determined by age, gender, and cognitive level.

Keywords: personalized persuasive technologies; cognitive ability; persuasive strategies; reward; social learning; trustworthiness; education

1. Introduction

Studies show that there is a strong connection between what we do and how we interact with technological devices [1,2]. Persuasive technology (PT) is an interactive application aimed to bring about desirable changes by reinforcing behavior, attitude, and thoughts about an issue, action, or object without using deception [3]. PTs are instrumental in deliberately changing behaviors in various domains of human endeavors such as health, commerce, etc. [2]. In the education domain, persuasive educational technologies (PETs) are employed to engage students and promote desired learning behavior using various persuasive strategies. The idea of integrating principles of persuasion into educational technologies to motivate and direct the behavior of learners stems from the behavioral

learning theory, which operates on the principle of stimulus response. This theory posits that all behavior is caused by external stimuli and that learners adapt behavior by responding to external stimuli. This means that, before a behavioral change can occur, people need to be stimulated. In other words, learners adopt behavior (learn) by responding to stimuli (influences) from their environment. This concept of stimulus response is in line with the concept of incorporating the principles of persuasion into educational technologies in order to stimulate learners and achieve the desired learning outcomes.

In practice, a one-size-fits-all approach is used in designing PTs to change behaviors [3]. This traditional blanket approach is based on the assumption that a persuasive strategy that works for one user will work for another, thereby treating all users as one and the same. However, research showed that individuals may differ in their responsiveness to various PT strategies [4]. This finding led to a shift of PT design from the traditional one-size-fits-all approach to a personalized approach that adapts to individual preferences and susceptibilities. Research showed that a persuasive strategy that motivates one type of person to change his or her behavior may discourage another [5]. As a result, the personalized approach that adapts persuasive strategies to user types is employed in PT interventions to amplify behavior change [6–8].

In pedagogy, research proved that learners have divergent comprehension abilities and learn at different paces [4]. As a result, teaching methods evolved to cater to the different learner types [9]. Hitherto, most PET research focused on subjects from Western countries. There is limited research on how subjects from African countries respond to various persuasive strategies in the education context. Specifically, research on how gender, age, and cognitive level moderate the responsiveness of African subjects is given little to no attention. In a previous study, we investigated the influence of cognitive ability on learners' susceptibility to reward, social learning, and trustworthiness persuasive strategies using Nigeria as a case study [10]. To extend this study, in this paper, we examined how cognitive level, as well as gender and age, influences learners' responsiveness to the three commonly employed persuasive strategies in PETs. The results of this current study are revealing. We found that learners of different age, gender, and cognitive level significantly differ in their responsiveness to the three persuasive strategies. PT designers can leverage these findings in tailoring PETs to the different learner types to make their future interventions more effective.

2. Background

In this section, we provide an overview of the three persuasive strategies of interest, personalization, and cognitive ability.

2.1. Persuasive Strategies

The concept of PETs is based on the idea that, through technology, the attitude and/or behavior of learners can be changed through the application of various persuasive strategies in the design of learning systems. For example, Lucero et al. [11] designed a PET to promote reading habits in children between eight and 11 years of age by integrating two principles of persuasion (similarity and credibility) in their system design. These persuasive strategies are based on the persuasive theories of social influence in the field of psychology. Over the year, several persuasive strategies were put forward in the extant literature. Cialdini [6] proposed six persuasive strategies, which he called principles of influence. They include reciprocity, scarcity, authority, commitment and consistency, liking, and consensus. These strategies are recognized as universal principles of persuasion, which are mainly applied in the field of marketing and advertising. In PT research, Fogg [2] proposed seven persuasive strategies for changing behaviors: reduction, tunneling, tailoring, suggestion, self-monitoring, surveillance, and conditioning. Moreover, Oinas-Kukkonen and Harjumaa [9] extended these persuasive strategies to 28, which are grouped into three categories. They include primary task support (e.g., reduction, personalization, simulation, etc.), dialogue support (e.g., praise, reward, reminders, etc.), system credibility support (e.g., trustworthiness, expertise, surface credibility, etc.), and social support (e.g.,

social learning, social comparison, cooperation, etc.). Similarly, Kelton et al. [12] and Kellerman and Cole [13] described over 469 strategies, compiled from the extant literature.

In this paper, we focused on three of the 28 persuasive strategies proposed by Oinas-Kukkonen and Harjumaa [9]. They include reward, social learning, and trustworthiness. Our choice of these three PT strategies is based on three reasons. Firstly, research on persuasion established the effectiveness of these strategies in changing behavior and/or attitude [14,15]. Secondly, these strategies are relevant in the context of learning [16]. For example, reward (which can be liked to grade, social recognition, or academic prize) has the potential to motivate students to learn and work hard. Secondly, social learning is a part of the learning process, as students learn from one another, such as their peers and teacher, in the classroom, laboratories, fields, virtual learning environments (VLEs), etc., through observation and imitation. In prior studies, Oyibo et al. [17] found that users from Nigeria are likely to be susceptible to these strategies. However, their work was not in the context of education. Finally, trustworthiness is an integral part of the perceived credibility of persuasive systems. Research shows that users are more likely to use a system they perceive as trustworthy compared with a system they perceive as untrustworthy. We believe that this is applicable to the education domain as well, especially given that (1) the information and knowledge students acquire from online learning systems will eventually affect their performance and grade, and (2) students' personal and academic information is stored in online learning management systems (LMSs, e.g., Moodle, Blackboard Learn, etc.) and accessed remotely. The second point requires trust of the LMSs by the users. In sum, given the importance of the three persuasive strategies to education, it is important to know how learners from the African continent respond to these strategies and how age, gender, and cognitive ability moderate their responsiveness. This will help designers to tailor PET interventions targeted at users on the African continent accordingly. We briefly provide an overview of the three persuasive strategies.

1. **Reward:** Reward is a persuasive strategy that involves offering incentives to users for performing a target behavior [9]. Generally, when people receive incentives for their performance of a given behavior, they are motivated. The reward strategy is mostly implemented in gamified systems, where users' status, badges, points, and ranks are increased as they advance in behavior-related tasks.
2. **Social learning:** Social learning is a persuasive strategy that allows a user to observer the behaviors of others in the hope that they will be influenced in one way or the other to behave in a similar way [9]. It originated from the social learning theory [18], which is premised on the belief that "learning is a cognitive process in which people learn by observing the behaviors of others and their consequences in a social context" (p. 28) [18]. In persuasive systems, the social learning strategy can apply in various ways. For instance, in PETs [6], some users may be inspired to perform better when scores, decisions, or methods used by other users to solve problems are shared in a social setting.
3. **Trustworthiness:** Trustworthiness is a persuasive strategy used to motivate users to adopt and/or use a system by enhancing their perceived trust in the system and the services it offers [9]. For example, users are more likely to use a persuasive system if it is unbiased, reliable, trustworthy, and secured.

2.2. Cognitive Ability

Cognitive ability is defined as the brain-based skills we need to carry out any task from the simplest to the most complex form [19]. Studies revealed that cognitive skills could promote or mar learning [19]. In this section, we focus on the four broad categories of cognitive abilities.

1. **Short-term memory:** Short-term memory skill is the ability to recall knowledge from memory without necessarily understanding what it stands for [20]. Examples of such include reciting facts or listing previously acquired pieces of information such as terminologies, dates, or events; naming, repeating, stating, and outlining are examples of mental actions that relate to short-term memory.

2. **Verbal comprehension:** Verbal comprehension refers to the learner's ability to understand, analyze, and interpret written information [20]. It has to do with using experiential knowledge. It is measured with a test of vocabulary, comprehension, and general information. For individuals to possess this ability, they must be able to organize, translate, interpret, and state the main ideas of a given topic of discussion.
3. **Quantitative reasoning:** This refers to the ability to use numerical skills to solve problems [20]. Quantitative reasoning is often assumed to be synonymous with mathematics. However, they should not be confused with each other. While mathematics is a discipline, quantitative reasoning is a skill [19]. According to Reference [21], quantitative reasoning is "the application of basic mathematics skills to the analysis and interpretation of real-world quantitative information in the context of a discipline or an interdisciplinary problem to draw conclusions that are relevant to students in their daily lives".
4. **Fluid reasoning:** This refers to do the ability to solve new problems by drawing on past knowledge [22]. Developing, restructuring, demonstrating, implementing things, and solving problems are examples of mental actions related to this function.

2.3. Related Works

Great attention was paid to the research area of user types and susceptibility to persuasive strategies in recent times. So far, a substantial amount of work was done in the area of explicit profiling of users on group basis [10,22]. Orji et al. [23] conducted a study on users' responsiveness to Cialdini's persuasive strategies (Authority, reciprocity, scarcity, consensus, and liking) and the effect of gender and age. They found that some strategies are more suitable for persuading one gender than the other. Specifically, they found that females are more likely to be responsive to most of the strategies than males. Similarly, Oyibo et al. [17,24] did a study of users' susceptibilities to four PT strategies drawn from the persuadability inventory (PI), which include reward, social learning, social comparison, and competition. They found that individuals are most likely to be influenced by reward, followed by competition. Their results revealed that males are more likely to be susceptible to both strategies than females [17], while younger people, regardless of culture, are more likely to be susceptible to competition than older people [24]. Similarly, Orji [25] investigated the susceptibility of individuals to 10 commonly used PT strategies, which include reward. The author found that individuals, regardless of gender, are likely to be susceptible to reward among the other strategies she investigated. More recently, Oyibo et al. [26] investigated the susceptibility of subjects from Canada/America and Nigeria to six persuasive strategies, including reward and social learning, in the health domain. They found that both groups of subjects were more likely to be susceptible to reward. However, they found that only the Nigerian subjects were likely to be susceptible to social learning. Also, in our previous paper, Abdullahi et al. [27], we investigated how cognitive ability levels of learners relate to their susceptibility to three persuasive strategies (reward, social learning, and trustworthiness) that are commonly used in PET design. We found that learners with high ability to remember and evaluate concepts are more likely to be susceptible to the reward strategy, while those high in ability to understand are more likely to be susceptible to the trustworthiness strategy. We also uncovered that learners high in the ability to apply, analyze, and synthesize ideas are more likely to be susceptible to the social learning strategy. These studies provide empirical evidence regarding the importance of tailoring persuasive strategies to users' susceptibilities to make them more effective. However, in the education context, few studies investigated how age and gender affect students' susceptibility to the persuasive strategies of reward, social learning, and trustworthiness, given their importance in the use of LMSs and VLEs.

3. Materials and Methods

In this section, we present the research objective of our study, the data sampling technique, the demographic of participants, and the research instruments used to measure the participants' cognitive level and persuasive strategies.

3.1. Research Objective

This study aims to investigate the influence of learners' age, gender, and cognitive ability on their susceptibility to social learning, reward, and trustworthiness strategies. Given that prior research showed that difference types of users respond to persuasive strategies in different ways, we hypothesize that, in the education context, learners of different age groups, genders, and cognitive ability levels would perceive the persuasiveness of these strategies differently.

3.2. Data Collection

The recruitment of participants was carried out in a university in northern Nigeria. Various faculties and departments were enlisted for the study. We approached students after their lecture and gave them a brief introduction of the study prior to responding to our questionnaire. Students who were willing to participate in the study stayed back in their classes. Paper–pencil questionnaires were administered to them in their classes. We repeated this technique in recruiting all of the study participants. We ensured that the classes had the same conditions during the administration of the survey: quiet halls, same time, and same number of invigilators. The intelligent quotient (IQ) test was firstly administered to the participants, which took approximately 90 min to complete, after which the PI questionnaire was administered. The PI questionnaire took approximately 15 min to complete. No identifying information was collected. We adopted the random sampling technique approach because of the paucity of research in this area in the extant literature. Participants willingly volunteered to participate in this study; as a result, they were not compensated. The data collection was overseen by the Federal University of Dutse's research ethics committee.

3.3. Participants' Demographic Information

Table 1 shows the demographics of participants based on gender, age, and cognitive level. A total of 461 participants, who were from different levels, faculties, and programs of the university, took part in the study. Overall, 246 (53%) of the participants were males and 215 (47%) were females. Since our study aimed at investigating the effect of age and cognitive level on learners' susceptibility to three persuasive strategies, we considered participants belonging to the 16–24 age bracket as younger adults and those over 45 as older adults. Similarly, we considered participants whose IQ score was from the 91st percentile and above as high cognitive level and those whose IQ score was below the 23rd percentile as low cognitive level. This was to ensure that the two age groups and cognitive levels were distinct enough for comparison. As a result, the total sample involved in the age group analysis was 254 and the total sample involved in the cognitive ability analysis was 250, which are relatively good sample sizes for this type of analysis. However, for the gender group analysis, the full sample size of 461 was used.

Table 1. Demographic of participants by gender, age, and cognitive level.

	Subgroup	**Type of Analysis**		
		Gender (*n* = 461)	**Age (*n* = 254)**	**Cognitive Level (*n* = 250)**
Gender	Female	53%	52%	62%
	Male	47%	48%	38%
Age	16–25	31%	57%	12%
	26–35	24%	-	22%
	36–45	21%	-	29%
	46+	24%	43%	37%

3.4. Measurement Instrument

Existing validated instruments were used to measure the study participants' levels of cognition and susceptibility to persuasive strategies. Cognitive ability was measured using the Wechsler Abbreviated

Scale Intelligence II (WASI-II) [8]. WASI-II is a reliable measure of cognitive ability for educational and research settings. There are four subscale tests on WASI-II: block design (BD), vocabulary index (VI), matrix reasoning (MR), and similarities index (SI). The VI and SI subtest scores are combined to give the broad verbal comprehension index (VCI) score and the BD and MR subtest scores are combined to form the perceptual reasoning index (PRI) score. A full-scale IQ (FSIQ) score is computed as a combined performance of the VCI and PRI. The FSIQ score is used to summarize the general intellectual abilities of the participants. The FSIQ has a standard score with a mean of 100 and standard deviation of 15. For example, a participant who obtained an FSIQ score between 90 and 109 falls into the average range.

With regard to individuals' susceptibility to persuasive strategies, we used the PI scale developed by Busch et al. [28]. This scale was chosen because it allows a comprehensive assessment of users' susceptibility to the strategies examined in this study. The PI was widely validated and used by many PT researchers, including Oyibo et al [17], due to the high internal consistency of its constructs. The PI scale has five scales for measuring susceptibility to five persuasive strategies: reward, competition, social comparison, trustworthiness, and social learning. However, only the reward, social learning, and trustworthiness scales were chosen and used in measuring participants' susceptibility to persuasive strategies. As shown in Table 2, six items were used to measure reward, five items were used to measure social learning, and three items were used to measure trustworthiness. Each item in each of the persuasive constructs was measured using a Likert scale ranging from "1 = strongly disagree" to "9 = strongly agree".

Table 2. Study's measurement instrument [15].

Persuasive Construct	Measurement Instrument's Items
Social Learning	1. I often modify myself to other people. 2. I ask for advice from other people before I make a decision. 3. I adapt my behavior quickly to the model of other people. 4. I adapt my behavior to other people around me. 5. I take other people as role models for new behaviors.
Reward	1. It is important for me that my actions are rewarded. 2. It is important for me to see my success before me. 3. I put more ambition into something if I know I am going to be rewarded for it. 4. I do more work when I know that I will get something for it (something materialistic). 5. I am willing to change myself if I get rewarded. 6. Rewards motivate me.
Trustworthiness	1. I think carefully about a system before I use it. 2. I trust information that comes from a specified source more. 3. It is important for me to be precisely informed about things that I need to do before I do them.

3.5. Data Analysis and Validity of Study Instruments

To analyze the data, we conducted repeated measure analysis of variance (RM-ANOVA) using SPSS. Gender, age, and cognitive level were included as between-subject variables, while persuasive strategy was included as the within-subject variable. To validate the reliability of the study instruments, we performed principal component analysis (PCA). Below, we summarize the steps taken to check that our data met the assumptions necessary to conduct a valid ANOVA.

1. Firstly, we checked for outliers using the boxplot, which showed no significant outlier in all variables.
2. Next, we conducted a Shapiro–Wilk test to check for data normality. The results showed that the data were normally distributed ($p > 0.05$).
3. Finally, we checked for sphericity. The results of Mauchly's test for sphericity showed that sphericity was not violated ($p > 0.05$).

With regard to the reliability of the instrument used to measure cognitive ability level, prior research showed that the WASI-II is a well-established scale with high consistency, with a test reliability between 0.70 and 0.90 and inter-scorer coefficient of 0.90.

In our study, four categories of age (16–25, 26–35, 36–45, and over 45) were collected. However, in our analysis, to investigate whether a significant difference existed between subjects of different age groups with respect to their responsiveness to the strategies, we compared participants within the 16–25 (younger adults) and over 45 (adults) groups to ensure that the ages were very distinct. With regard to investigating whether significant differences exist between individuals of different cognitive level with respect to their responsiveness to the strategies, we aimed at two groups of individuals with a considerable cognitive level difference. We selected and considered participants with FSIQ scores from the 91st percentile and above as learners with high cognitive level (HCL). On the other hand, we considered participants with FSIQ scores from the 23rd percentile and below as learners with low cognitive level (LCL). The FSIQ is considered the most representative estimate of global intellectual functioning. An FSIQ score is computed as a combined performance of the four subtests. A wide range of FSIQ scores were observed from the test. The mean was 102.17 and the standard deviation was 15. The mean scores and standard deviations of our data are similar to the WASI-II standardized IQ scores.

4. Results

In this section, we present the results of our analysis, which is focused on uncovering the significant differences that exist between males and females, between younger adults (16–25) and older adults (over 45), and between high cognitive learners (HCL) and low cognitive learners (LCL), with respect to their susceptibility to three persuasive strategies (social learning, reward, and trustworthiness). We also compare the overall susceptibility of participants to the three strategies regardless of gender, age, and cognitive level.

4.1. Overall Susceptibility of Learners to the Three Persuasive Strategies

Figure 1 shows the overall mean rating of the persuasive strategies. The result of our RM-ANOVA shows that there is a main effect of persuasive strategy in learners' susceptibility to reward, social learning, and trustworthiness ($F(3.42, 359.42) = 925.431$, $p < 0.001$ and $\eta^2 = 0.255$). As shown in Figure 1, learners are most likely to be susceptible to trustworthiness (mean (M) = 5.4, standard deviation (SD) = 1.01), followed by social learning (M = 4.2, SD = 1.15), and reward (M = 3.5, SD = 1.31). Overall, participants are likely to be susceptible to trustworthiness, while they are unlikely to be susceptible to reward and social learning, as their mean scores were less than the neutral value of five.

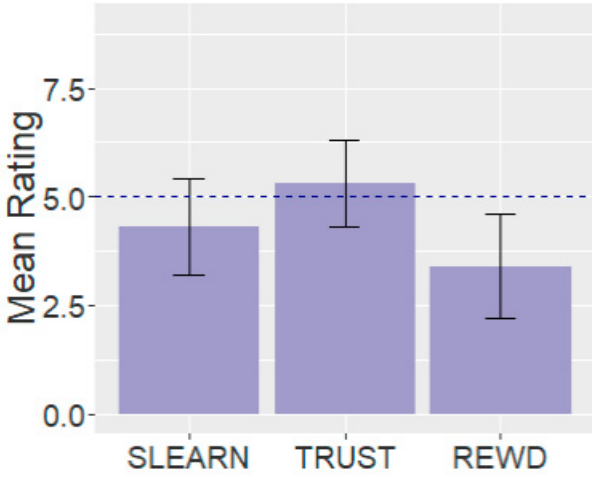

Figure 1. Overall mean rating of the persuasive strategies (SLEARN = social learning, TRUST = trustworthiness, REWD = reward; horizontal bar indicates the neutral of five on the 1–9 Likert scale).

4.2. Effect of Gender on Susceptibility to Persuasive Strategies

Figure 2 shows the gender-based mean rating of the persuasive strategies, while Table 3 shows the result of the RM-ANOVA. Our results show that gender has a significant main effect on susceptibility to persuasive strategies regardless of their age and cognitive level, with Pillai's trace = 0.17 (F (1, 459) = 925.431, $p < 0.001$ and $\eta^2 = 0.725$). The univariate test result showed that males and females differ in their susceptibility to social learning (F (1, 459) = 10.22, $p < 0.001$, $\eta^2 = 0.134$), with males (M = 5.14, SD = 1.201) being more likely to be susceptible than females (M = 3.91, SD = 1.143). Males and females also differ in their susceptibility to trustworthiness (F (1, 459) = 17.14, $p < 0.001$, and $\eta^2 = 0.710$), with females (M = 5.421, SD = 1.232) being more likely to be susceptible than males (M = 4.521, SD = 1.414). Similarly, males and females significantly differ in their susceptibility to reward (F (1, 459) = 12.510, $p < 0.001$, and $\eta^2 = 0.421$], with females (M = 4.474, SD = 1.21) being more likely to be susceptible than males (M = 3.193, SD = 1.12).

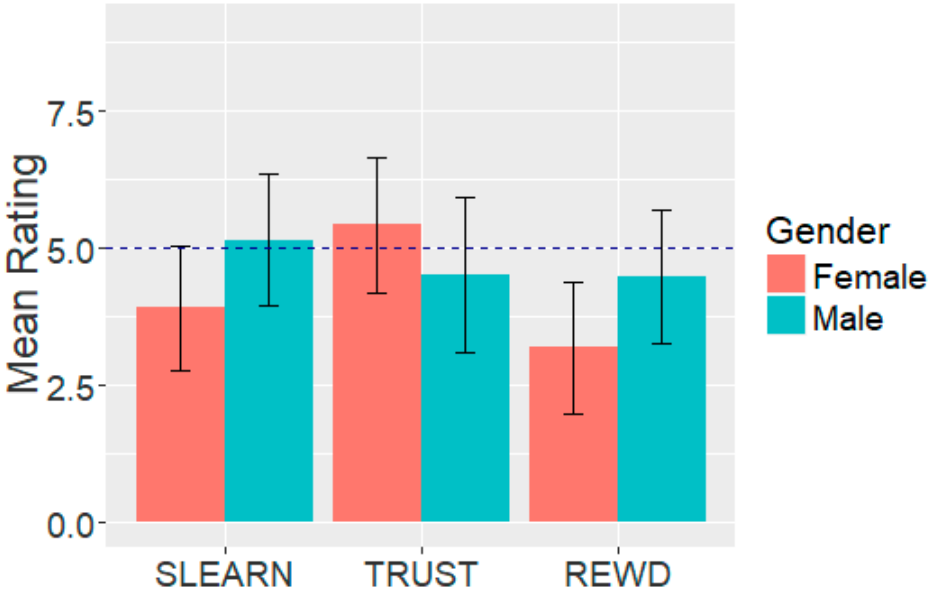

Figure 2. The effect of gender on susceptibility to persuasive strategies (SLEARN = social learning, TRUST = trustworthiness, REWD = reward; horizontal bar indicates the neutral of five on the 1–9 Likert scale).

Table 3. Between-group analysis based on gender.

Group	Social Leaning	Trustworthiness	Reward
Male	5.14	4.52	4.47
Female	3.91	5.42	3.19
***p*-Value**	$p < 0.001$	$p < 0.001$	$p < 0.001$

4.3. Effect of Age on Susceptibility to Persuasive Strategies

Figure 3 shows the age-based mean rating of the persuasive strategies, while Table 4 shows the result of the RM-ANOVA. Our results show that age has a significant main effect on participants' susceptibility to persuasive strategies, regardless of gender and cognitive level, with Pillai's trace = 0.25 (F (1, 334) = 718.434, $p < 0.001$, and $\eta^2 = 0.215$). The univariate test result showed that younger adults and adults significantly differ in their susceptibility to social learning (F (1, 238) = 17.233, $p < 0.001$, and $\eta^2 = 0.100$), with younger adults (M = 5.321, SD = 1.121) being more likely to be susceptible than adults (M = 4.322, SD = 1.217). Younger adults and adults also significantly differ in their susceptibility to trustworthiness (F (1, 238) = 12.17, $p < 0.001$, and $\eta^2 = 0.142$), with adults (M = 5.930, SD = 1.740) being more likely to be susceptible than younger adults (M = 4.730, SD = 1.284). Finally, younger

adults and adults also significantly differ in their susceptibility to reward (F (1, 238) = 11.162, $p < 0.001$, and partial $\eta^2 = 0.012$), with younger adults (M = 4.434, SD = 1.251) being more likely to be susceptible than adults (M = 3.161, SD = 1.174).

Figure 3. The effect of age on susceptibility to persuasive strategies (SLEARN = social learning, TRUST = trustworthiness, REWD = reward; horizontal bar indicates the neutral of five on the 1–9 Likert scale).

Table 4. Between-group analysis based on age.

Group	Social Leaning	Trustworthiness	Reward
Younger Adult	5.32	4.73	4.43
Adult	4.32	5.93	3.16
***p*-Value**	$p < 0.001$	$p < 0.001$	$p < 0.001$

4.4. Effect of Cognitive Level on Susceptibility to Persuasive Strategies

Figure 4 shows the cognitive-level-based mean rating of the persuasive strategies, while Table 5 shows the result of the RM-ANOVA. The results show that cognitive level has a significant main effect on susceptibility to persuasive strategies, regardless gender and age, with Pillai's trace = 0.25 (F (1, 248) = 718.434, $p < 0.001$, and $\eta^2 = 0.215$). The univariate test result showed that the HCL group and the LCL group significantly differ in their susceptibility to social learning (F (1, 248) = 15.67, $p < 0.001$, and $\eta^2 = 0.125$), with the HCL group (M = 4.06, SD = 1.41) being more likely to be susceptible to social learning than the LCL group (M = 3.17, SD = 1.16). Secondly, there is a significant difference between the HCL group and the LCL group in their susceptibility to trustworthiness (F (1, 248) = 612.183, $p < 0.001$, and $\eta^2 = 0.311$) with the LCL group (M = 5.32, SD = 1.01) being more likely to be susceptible to trustworthiness than the HCL group (M = 3.25, SD = 1.40). Finally, there is no significant difference between the HCL group (M = 3.54, SD = 1.13) and the LCL group (M = 3.50, SD = 1.11) in their susceptibility to reward (F (1, 115) = 5.34, $p = 0.364$, and $\eta^2 = 0.111$), as evident in their respective average scores.

Figure 4. The effect of cognitive level on susceptibility to persuasive strategies (SLEARN = social learning, TRUST = trustworthiness, REWD = reward; horizontal bar indicates the neutral of five on the 1–9 Likert scale; HCL = high cognitive leaners, LCL = low cognitive leaners).

Table 5. Between-group analysis based on cognitive level (HCL = high cognitive leaners, LCL = low cognitive leaners; n.s. = not significant).

Group	Social Leaning	Trustworthiness	Reward
HCL	4.06	3.25	3.54
LCL	3.17	5.32	3.50
***p*-Value**	$p < 0.001$	$p < 0.001$	n.s.

5. Discussion

We presented the results of our investigation of the effect of learners' gender, age, and cognitive level on users' susceptibility to three persuasive strategies drawn from the PI. From our results, we found that there is a significant difference between the different groups of learners with respect to their susceptibility to the three persuasive strategies. We discuss our results, taking each of the three pairs of groups (age, gender, and cognitive level) at a time.

5.1. The Influence of Age on Susceptibilty to Persuasive Strategies

Firstly, our findings reveal that younger learners are more likely to be susceptible to social learning than older learners. This finding is supported by Johnson's study [29], which revealed that an increasing learning practice amongst learners within the age range of 18 to 24 is social/collaborative learning. This could be because of the opportunity they get to socialize while they learn. Research showed that individuals within this age group enjoy being around themselves [30]. This implies that persuasive educational interventions targeted at promoting learning behaviors among students within age 16 to 24 can employ the social learning strategy to achieve their goal. Using appropriate persuasive strategies that match learners' preference activates the right behavior change process, which can lead to the desired learning outcomes. **Therefore, we recommend that personalized PETs designed for young learners within the age range of 16 to 24 should leverage the social learning strategy to facilitate the target behavior change.**

Furthermore, our findings (as shown in Figure 3 and Table 4) reveal that learners within the age range of 16 to 24 years (M = 4.43) are more likely to be influenced by the reward strategy than learners over 45 years (M = 3.16). A possible explanation for this is that younger adults tend to appreciate being

rewarded for their hard work, as it boosts their ego. This implies that younger adults in the education domain are more likely to be persuaded using reward. However, the reward strategy in general shows a mean score below the neutral value of five (as shown in Figure 3) for both age groups. One possible explanation for this is that most of our participants in the current study practice a religion which discourages accepting rewards for engaging in altruistic activities. This indicates that, in PETs, reward is not likely to be effective for this target audience, regardless of age. Moreover, our finding reveals that learners over 45 years (M = 5.93) are more likely to be susceptible to trustworthiness strategy than their younger counterparts (M = 4.73), who are unlikely to be susceptible. Interestingly, this finding is supported by the study of Poulin et al. [31], which revealed that people grow to trust as they get older. **Thus, we recommend that, in designing personalized PETs, the trustworthiness persuasive strategy should be employed to persuade learners over 45 years rather than learners within the age range of 16 to 24 years**.

5.2. The Influence of Cognitive Level on Susceptibilty to Persuasive Strategies

As shown in Figure 4, our findings reveal that learners with low cognitive level are more likely to be susceptible to the trustworthiness strategy than learners with high cognitive level. This finding is supported by results from a recent study which revealed that people with low cognition trust easily and, as a result, are more likely to be victims of fraud and scams compared to people with higher levels of cognition [32]. A plausible reason could be that people with low cognition are less willing to invest time and effort to critically scrutinize information than people with high cognition. This implies that persuasive education interventions targeted at promoting learning behaviors in students with low cognitive level can employ the trustworthiness strategy, i.e., by designing the persuasive systems to be more trustworthy. The reward of gaining and building learners' trust during the learning process is that it lowers the learners' stress levels due to the psychological safety that learners experience while learning in an environment or using a system they perceive to be safe and trustworthy. This can improve learning outcome. **Therefore, we recommend that personalized PETs designed for learners with low cognitive levels should leverage the trustworthiness strategy.**

Also, our findings reveal that people with high cognitive level are more likely to be influenced by the social learning strategy than people with low cognitive level. This finding is consistent with that of Finn [33], who found that people with high cognitive level possess technical skills that help in teamwork. A possible explanation for this is that people with high cognitive level are more open to experience than people with low cognitive level. As a result, high-cognitive-level learners are more likely to explore new ideas and learn from others owing to their curiosity compared with low-cognitive-level learners. This may increase the tendency of high-cognitive-level learners to interact with peers and learn from them as opposed to people with low cognitive level, who might find social learning too intimidating because of their close nature. **Thus, we recommend that, in designing personalized PETs, the social learning strategy should be used more to persuade people with high cognitive level rather than people with low cognitive level.**

5.3. The Influence of Gender on Susceptibilty to Persuasive Strategies

Our findings reveal that male learners are more likely to be susceptible to the social learning strategy than their female counterparts. This implies that persuasive education interventions that designers target at promoting learning behaviors among male students can achieve that by employing the social learning strategy in designing their interventions. This strategy may promote learning among male students, as it gives them the opportunity to interact with one another, which is more popular among male students than female students. This strategy can consequently improve learning outcome. **Therefore, we recommend that personalized PETs designed for male learners should leverage the social learning strategy.**

Furthermore, our findings reveal that female learners are more likely to be influenced by the reward strategy than male learners. This can be largely explained by the dominant ideology of patriarchy

in northern Nigeria, where the study was conducted, where women are often not appreciated for their hard work and achievements compared to their male counterparts, whose achievements are often overemphasized. As a result, the reward persuasive strategy will be more appealing to females. This implies that female students can be more persuaded using the reward strategy. **Thus, we recommend that, in designing personalized PETs, the reward strategy should be used to persuade female learners.**

Lastly, our findings reveal that female students are more likely to be susceptible to the trustworthiness persuasive strategy than male students. This finding is not surprising as several empirical studies reported women having higher trust than men [34]. This implies that female learners can be more persuaded using the trustworthiness persuasive strategy. **Thus, we recommend that, in designing personalized PETs for female learners, the trustworthiness persuasive strategy should be leveraged.**

6. Limitations and Future Work

This study examined the perceived persuasiveness of strategies using the PI scale. Although this is still the most predominantly used approach, we acknowledge that the actual susceptibility may differ when implemented and evaluated in PETs. Therefore, as part of our future work, we plan to evaluate susceptibility in an actual PET targeting Nigerians. Also, there are ethical guidelines guiding the design and use of persuasive technology which all designers of PTs are required to adhere to. However, some people may apply our results for other unintended purposes. We acknowledge that some adverse and ethical consequences may result from using PTs just like every other modern technology.

7. Summary and Conclusions

This paper brought to the fore results of an empirical study among 461 participants from northern Nigeria, focusing on the influence of gender, age, and cognitive level on the susceptibility of individuals to three persuasive strategies: reward, social learning, and trustworthiness. We found that people with high cognitive level are more likely to be susceptible to the social learning strategy. On the other hand, people with low cognitive level are more likely to be susceptible to the trustworthiness strategy than people with high cognitive level. Again, our results revealed that males are more likely to be susceptible to the social learning strategy, while females are more likely to be susceptible to the reward and trustworthiness strategies. Furthermore, our results reveal that younger adults are more likely to be susceptible to the social learning and reward strategies, while older adults are more likely to be susceptible to the trustworthiness strategy. Our findings can be leveraged in group-based tailoring of persuasive applications to users with these preferences.

In the context of personalization of PTs for the studied population, it can be deduced from these findings that social learning is likely to be an effective persuasive strategy in motivating people with high cognitive level, while the trustworthiness strategy is likely to be an effective persuasive strategy for motivating people with low cognitive level. Moreover, the trustworthiness strategy is likely to be effective in motivating females, while the social learning strategy is likely to be effective in motivating males. Lastly, social learning is likely to be effective in motivating younger adults while trustworthiness is likely to be effective in motivating older adults. Our study contributes to the body of knowledge by showing the effect of gender, age, and cognitive level on users' susceptibility to three persuasive strategies in the context of persuasive educational technology (PET) research using an audience from northern Nigeria as a case study. Our main contribution to current knowledge is that we provided an empirical insight into how people belonging to different genders, ages, and cognitive levels are likely to respond to three important persuasive strategies (social learning, trustworthiness, and reward) in PET design. These results can inform PET personalization.

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