ROLE OF EXPERIENTIAL LEARNING IN FINANCIAL LITERACY AMONG ADOLESCENTS WITH AUTISM SPECTRUM DISORDER

by

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Presented to the Faculty of the Graduate School of

The University of Texas at Arlington in Partial Fulfillment

of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

THE UNIVERSITY OF TEXAS AT ARLINGTON

May 2021

Acknowledgments

Like any other journey, this educational journey was supported by many people to whom I am ever grateful. Thanks to Dr. Gagne and Dr. Coleman for introducing me to the broad scope of psychology as an undergraduate student at UTA. Thanks to Dr. Wyn Taylor and Dr. Audrey Snowden for introducing me to research, and special thanks to Wyn for providing strength and support on those long days of writing. Thanks to Dr. Liegey-Dougall and Dr. Layman for their support and insights. Thanks to Dr. Jensen-Cambpell for making statistics tolerable. Thanks to Dr. Peng and Dr. Lin for teaching me how to be enthusiastic about neuroscience and letting me explore the field. Thanks to Karen Ritz, Betty Keyes, Dr. Fuchs, and Luis Zornoza for all the departmental support during the long journey of five years.

Thanks to Dr. Kenworthy and Dr. Williford for letting me vent about the ineffectiveness of governmental climate change initiatives. Thanks to Dr. Paulus for teaching me how to teach. Thanks to Dr. Hunter Ball, Dr. John Romig, and Josh Wilson for their patience as I worked through my dissertation. Special thanks to Benjamin Wagley and Stephen Doerfler for keeping me grounded in reality. Finally, thanks to Dr. Daniel Levine for his unconditional support and for allowing me to explore my academic curiosities for five years!

Thanks to Dr. Vivian Ta and Dr. Celina Salcido for their friendship and support. Thanks to Aman Mahal, Joel Roberts, Shane Snyder, Norma

Garza, Adrian Abellanoza, Brock Rozich, and Julia Whitaker for seeing me through good times and bad. Thanks to my parents for all their sacrifices over the years, I can never thank them enough for leaving their family and friends behind and moving to America so I could have a better future. Thanks to my children Ariana and Mehar, for being understanding and patient for the past five years. Thanks to my dear wife Jyoti for her unconditional love and support over the past fifteen years and many more to come.

May 4, 2021

Abstract

ROLE OF EXPERIENTIAL LEARNING IN FINANCIAL LITERACY

AMONG ADOLESCENTS WITH AUTISM SPECTRUM DISORDER

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Autism Spectrum Disorder (ASD) is a developmental disorder with deficits in social and communication skills with repetitive or restricted behaviors. High functioning ASD individuals report poor financial literacy as a hindrance to independent living (Cheak-Zamora et al., 2017). Study 1 (N = 379) measured a construct of Autism Spectrum Quotient (ASQ), autistic traits such as difficulties with attention switching, social skills, and communication in individuals with average intelligence. Results indicate that ASQ is negatively correlated with executive functioning and poor executive functioning predicted poor money management in individuals with more autistic traits. Low levels of financial literacy result in suboptimal financial behaviors that lead to reduced long-term financial well-being. Educating adolescents with ASD is challenging because the financial literacy curriculum is based on passive learning strategies, whereas ASD students learn best from active learning. Study 2 evaluated the effectiveness of a simulation designed to improve financial literacy based on the Experiential learning theory (ELT; Kolb & Kolb 2005) and the Experiential gaming model (Kiili, 2005) ─ active learning strategy. Participants (N = 31), thirteen autistic and eighteen age and grade matched neurotypical adolescents, were recruited from the local school district. Results indicate that simulation effectively taught financial responsibility as indicated by timely “hypothetical bill” payments. Additionally, the simulation was effective in teaching budgeting skills to both groups. However, there were no improvements in debt management ability. Furthermore, the simulation tested prospective memory in both autistic and neurotypical students. Prospective memory is remembering to act in the future either at a specific time (time-based) or upon the occurrence of a pre-specified event (event-based). Simulation improved the performance of time-based PM tasks over five days but did not improve the performance of event-based PM tasks.

Keywords: Autism Spectrum Quotient, Experiential learning, Financial literacy, Video game.

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Chapter 1

INTRODUCTION

Autistic spectrum disorder (ASD) is a developmental disorder, varying in severity, characterized by difficulty in social interaction and communication and restricted or repetitive patterns of thought and behavior (APA, 2013). There is a debate about whether normal intelligence individuals also lie on the autism continuum (Baron-Cohen et al., 2001). These so-called “autistic traits” are sets of behaviors that are common in the autistic population but also exist in neurotypical individuals. These traits vary in degree and not in type. The severity of the symptoms determines the individual’s functional level as either low, mild, or high functioning. Low functioning autistic individuals are dependent on caretakers and have more deficient communication skills than high functioning autistic individuals. Limited financial capabilities are the leading cause of barriers to independent living in the high functioning autistic population (Cheak-Zamora, 2017). Educating adolescents with ASD about financial decision-making is challenging because the financial literacy curriculum in K-12 classrooms fails to engage these students. An active learning pedagogy should be used to increase classroom engagement. Active learning is defined as any learning activity in which the student participates or interacts with the learning process instead of passively taking in the information. Despite the abundance of research investigating the usage of active learning instructional strategies to improve general student performance (Michael, 2006; Armbruster, Patel, & Johnson, 2009; Butler, Veltre, & Brady, 2009), relatively little is known about the role of active learning in autistic students. An additional obstacle that students with ASD face is poor executive functioning, leading to disruptive classroom behavior resulting in decreased instruction time. Executive functions (E.F.) broadly encompass a set of cognitive skills responsible for planning, initiation, sequencing, and monitoring complex goal-directed behavior (Fuster, 2008; Pennington & Ozonoff, 1996; Royall et al., 2002). Thus, the current study set aimed to establish a relationship between autistic traits, executive functioning, financial literacy, and autistic disorder. Furthermore, a simulation was developed to teach financial concepts, increase classroom engagement, and improve specific aspects of executive functioning in adolescents with ASD.

Financial Literacy in the Classroom

Financial literacy in literature is commonly used for knowledge of financial concepts and procedures. Furthermore, financial capability can change one's behavior based on financial knowledge, such as budgeting. The majority of financial education programs designed for secondary school primarily focus on improving financial literacy to lead to financially capable youth. Low levels of financial literacy result in suboptimal financial behaviors that lead to reduced long-term financial well-being. Thus it is important to teach financial concepts at an early age because financial knowledge and skills acquired early in life prepare the individual for optimal financial behavior and long-term well-being (Sohn et al., 2012; Beverly & Burkhalter, 2005). A systematic literature review suggests that school-based financial education programs can improve adolescents' financial knowledge and attitudes. However, studies that evaluate adolescents' actual financial behavior are scarce and show hardly any effect (Amagir et al., 2018).

High School Financial Planning Program© (HSFPP) is a widely used financial education curriculum. For the academic year of 2009-2010, four thousand and seven hundred high schools across the U.S. used this program. HSFPP is designed to acquaint students with basic financial planning concepts. Students who completed the HSFPP reported significant improvement in their financial knowledge, behavior, and confidence immediately after studying the HSFPP. Students must demonstrate competencies in financial planning by creating a financial plan, creating a personal budget, proposing a personal saving, and investing plan, selecting strategies to manage debt. Also, demonstrate how to use financial services, create a personal insurance plan to minimize financial losses, and examine career choices. Two significant limitations of HSFPP for students with ASD are (1) the length of time it takes to complete the program (10 hours) and (2) the passive nature of the program (written instructions and video modules). The passive learning nature of this program disengages the students with ASD, and student performance declines. Based on a review of sixty (60) studies on improving financial literacy among children and adolescents in primary and secondary schools, Amagir et al. (2018) recommend using an experiential learning method ─ an active learning model.

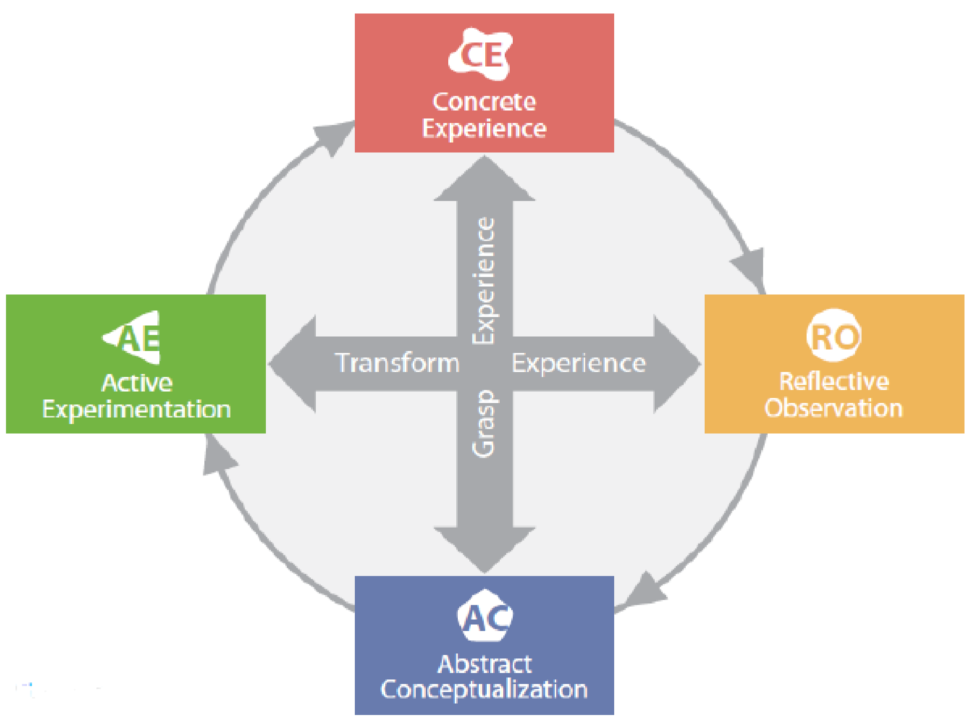
Experiential Learning Framework

Learning in its most basic sense is defined as a process by which a relatively lasting change in potential behavior occurs because of experience. Learning is best conceived as a process that occurs through connected experiences in which pre-established knowledge is modified (Dewey, 1897). Experiential learning theory (ELT) has its roots in the works of Dewey, Lewin, Jung, and Piaget and is an extension of cognitive and behaviorist learning theory. ELT (figure 1) theorizes the process of learning that merges experience, perception, cognition, and behavior (Kolb, 1984, 2005; McCarthy, 2016). Kolb (1984, p. 41) defined learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience." ELT posits four phases that an individual cycle through in the learning process.

In the first phase, an individual experiences an event in the world registered by the sensory system. Learning by direct experience with the environment (concrete experience) is defined as the "bottom-up" experience, that is, the feelings and perceptions experienced by the individual as a result of interaction with the environment. These experiences can be either in the natural environment, such as tasting an orange (e.g., taste perception), or in a virtual environment (e.g., visual perception). The second learning phase involves becoming aware of the feelings and perceptions that resulted from the interaction with the environment (reflective observation). During this phase, the individual presumably thinks about the thoughts generated by the experience (i.e., metacognition). The third phase of the learning cycle involves abstracting the meaning of the experience (abstract conceptualization). The individual logically evaluates the experience and tries to make sense of it. The fourth phase of the learning process involves adaptively interacting with the environment, resulting in new concrete experiences, and the cycle repeats itself.

Figure 1.

The Experiential Learning Cycle. Adapted from Kolb and Kolb, 2013.



Neural correlates of ELT. Based on fMRI studies, specific association areas of the brain are believed to be involved in the type of learning that takes place (Zull, 2002). Learning that takes place by having concrete experiences in the environment requires association areas in the parietal and occipital cortices. Reflective observation involves the temporal cortex. This brain region is known to be involved in integrating sensory input for recognition. The frontal cortex is active during the abstraction and understanding process, and the premotor region is active during the experimental learning phase.

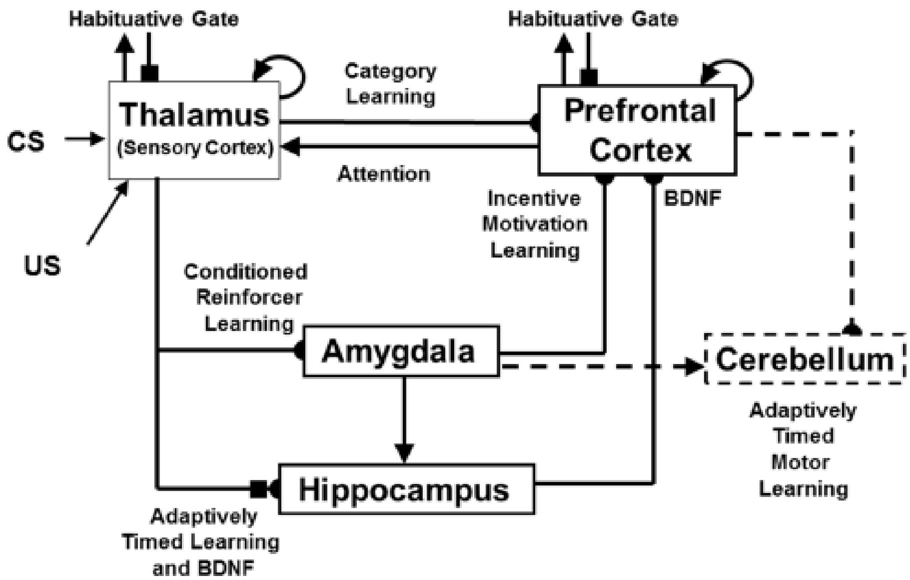
Adaptive Resonance Theory (ART)

Individuals with ASD struggle to shift between concrete experience and abstract conceptualization (Grossberg & Seidman, 2006). A neural model explains the reason for this impairment (figure 2) called the Imbalanced Spectrally Timed Adaptive Resonance Theory (iSTART). This three-part model explains the neural mechanisms that play an essential role in merging “bottom-up” perceptual inputs with “top-down” expectations while being influenced by the affect and timing of motor behavior. One component of the three-part model is adaptive resonance theory (ART), which states that the brain learns to recognize objects and events through an interplay between bottom-up perceptual inputs and learned top-down expectations. When the perceptual input matches (to a certain degree) with the expectation, the system locks into an attentive resonant state, which drives the recognition learning process. The degree of match required between perception and expectation is set by a *vigilance* parameter. Low vigilance allows the learning of broad, abstract recognition categories, while high vigilance forces the learning of specific, concrete categories (Grossberg & Seidman, 2006; Grossberg & Kishnan, 2018). The iSTART model proposes that people with ASD have their vigilance fixed at a high setting such that their learned representations are very concrete or hyperspecific.

Consequently, this abnormally high vigilance results in learning, cognition, and attention problems – core symptoms of ASD. ART model suggests that thalamocortical-hippocampal interactions are responsible for this sort of impairment. Individuals with ASD tend to learn concrete details of an experience and fail to infer the bigger picture due to impaired connections between the frontal cortex and temporal cortex. Additionally, impaired frontal cortical functioning explains the poor executive functions observed in the ASD population.

Figure 2.

Neural mechanisms of the iSTART model. It was adapted from Grossberg & Kishnan, 2018.



Executive dysfunction. Research suggests discrete and measurable components of executive functions, such as attention, working memory, planning, and impaired decision-making, in individuals with ASD (Pennington and Ozonoff, 1996; Grossberg and Seidman, 2006). May and Kana (2020) reported that individuals with ASD have poor connectivity of the frontoparietal networks with other regions during executive function tasks based on 16 fMRI studies. Recall that the frontal cortex is vital for abstraction, whereas the parietal cortex is essential for concrete experiences. Hence disruption in the frontoparietal network also explains the difficulty with higher-order abstraction from lower-order concrete experiences found in autistic individuals.

Additionally, the relationship between executive functioning and prospective memory performance is unclear. Prospective memory (PM) is remembering to act in the future either at a specific time (time-based) or upon the occurrence of a pre-specified event (event-based). A study of neurotypical adults (N = 80) indicated that the construct of executive functioning predicts performance on prospective memory performance (both time-based and event-based) such that poor executive functioning leads to poor prospective memory tasks on complex tasks (Martin, Kliegel, & McDaniel, 2010). However, another study indicated mixed results that involved twenty-one (N =21) autistic children. Williams, Boucher, Lind, & Jarrold (2012) found impaired time-based but undiminished event-based prospective memory performance in autistic children. Therefore the relationship between executive dysfunctioning in autistic individuals and their performance on prospective memory tasks is inconclusive.

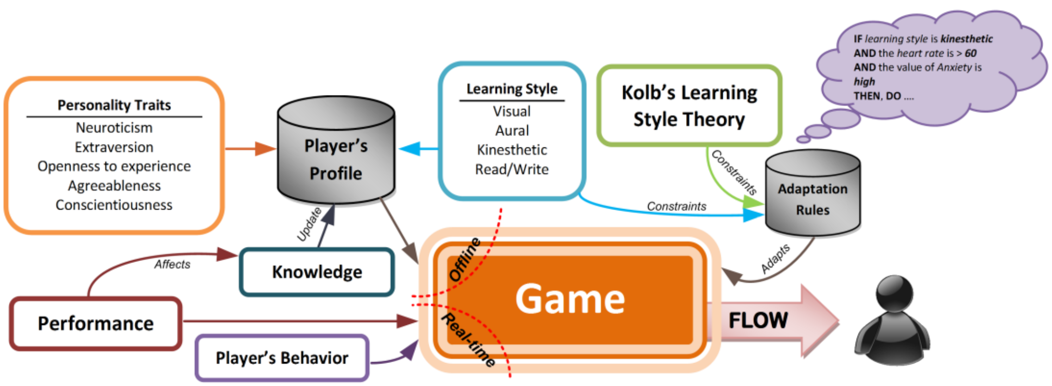
Simulations as a pedagogical tool

Gamification of educational content leads to a higher student engagement rate and improved attention (Radianti et al., 2020; AlAwadhi et al., 2017). As part of cognitive rehabilitation for children with ASD, games provide a safe and controlled environment for learning skills that may be anxiety-provoking in a real-world scenario (Brooks et al., 2014; Riva et al., 2009). Caria et al. (2018) and Lopez-Basterretxea et al. (2014) developed a web-based game application to support children with high-functioning ASD learn the concept of money and apply it in practical life situations. The results indicate that computer games in an educational setting can assist individuals with ASD to learn the concept of money. However, the task was mainly oriented towards teaching how to discriminate between currency denominations (e.g., coins and bill notes) rather than a concept of personal finance (e.g., budgeting).

Optimizing simulation for Autistic students. The educational game can be effective if the game is designed with the user in mind. Because autistic students struggle with reading comprehension, the game must employ a graphical interface with minimal dependence on written instructions. Tsikinas and Xinogalos (2020) recommend that game design for the ASD population use a simpler graphical interface as this population performs poorly in games requiring managing multimodal interfaces. Additionally, the player's personality type is an essential factor to consider when designing an educational game. Essentially there are four types of player personalities: competitors, dreamers, logicians, and strategists (Bontchev et al. 2018). Competitors prefer playing games that require good hand-eye coordination and prefer games that require quick thinking when planning and choosing tactics in gameplay. Dreamers prefer role-playing games and considering different perspectives of the game mission before they start playing actively. Logicians enjoy logic, analyses, and pattern-based approaches in the game. They like exploring the game space and being recognized by others as rational, methodical, and objective. Strategist personality players like solving complex problems within a game. These players demonstrate long-term thinking when planning their strategies and decision-making. Kiili (2005) and Sajjadi et al. (2014) proposed an *experiential gaming model* for digital game-based learning (figure 3). It provides a framework for improving student engagement by inducing a state of flow by accounting for a player's personality, knowledge, and learning style. It is still unclear which playing style is preferred or optimal for high functioning autistic students.

Figure 3.

Game design flow adapted from Sajjadi et al., 2014.



CURRENT STUDIES

The literature review results suggest developing an engaging financial literacy program designed specifically for autistic children. Although the ELT framework explains the learning process, it remains to be seen if an educational program can be developed that assists the learner transition from the concrete phase to the abstraction phase. Furthermore, the relationship between autistic personality traits, executive functioning, and financial literacy has been largely unexplored. Therefore, in Chapter 2, I explore the individual differences in autistic personality traits related to executive functioning. Additionally, I assess the role of both autistic traits and executive functioning related to financial literacy.

Furthermore, I explore the association between autistic traits, learning style preference, and gaming preference to guide the development of an intervention. In Chapter 3, I more directly test the developed intervention with adolescents with ASD. Precisely, I assess the effectiveness of a simulation designed to provide concrete experiences with money transactions and teach financial responsibility. In Chapter 4, I discuss the intervention implications as they pertain to executive functioning and financial management.

Chapter 2

STUDY 1A AND 1B: OVERVIEW

Individuals with autism struggle with communication skills such as expressive and receptive language, poor eye contact, and the ability to understand another person's perspective (Pennington & Ozonoff, 1996). Additionally, the ASD population struggles with social skills such as making friends, maintaining long-term relationships, and failing to understand and respond to social cues (Venturini & Parsons, 2018). Furthermore, ASD is associated with deficits in planning, attention switching, impulsivity, and joint attention (Parsons & Carlew, 2015; Mundy, 1995). However, some of these deficits are not only restricted to ASD but are generally found in populations with executive dysfunction. The purpose of Study 1a is to explore the relationship between executive dysfunction and autistic traits as they relate to financial decision-making.

STUDY 1A

Autistic traits such as poor social skills, communication deficits, and attentional impairments may be more common in the general population than previously believed. Baron-Cohen et al. (2001) developed an instrument to measure Autism-Spectrum Quotient (ASQ) to screen for possibly affected individuals to assist in making referrals for a complete diagnostic assessment. A positive relationship exists between poor executive functioning and ASD, but whether that relationship exists for individuals with high ASQ is unclear. Furthermore, individuals with poor executive control tend to struggle with skills such as money management (Kamradt et al., 2014; Perna et al., 2012). Consequently, if executive functioning is impaired in individuals with high ASQ, they would struggle with money management. Study 1a was conducted to test if executive functioning moderates the effect of money management in a population with ASQ.

METHOD

Participants

Two hundred and fifty-five (N = 255) participants were recruited from Amazon's Mechanical Turk platform (MTurk). Participants were paid $0.20 for completing an online survey. Participants were told that the survey would take 15 minutes to complete. No deception was used in the study. Out of two hundred and fifty-five participants that completed the study, thirty-six either failed the attention check or did not fully complete the survey. After data screening, a total of two hundred and nineteen (N = 219) participant's data were used for the final analysis. See Table 1 for a complete list of demographic frequencies.

Table 1.

Demographic frequencies for MTurk sample.

Age		Frequency	Percent
	18-24 years old	7	3.2
	25-34 years old	75	34.2

	35-44 years old	59	26.9
	45 years or older	78	35.6
	Total	219	100.0

Gender		Frequency	Percent
	Male	93	42.5
	Female	122	55.7
	Transgender Female	1	.5
	Gender Variant/Non-Conforming	2	.9
	Prefer Not to Answer	1	.5
	Total	219	100.0

Ethnicity		Frequency	Percent
	African American or Black	25	11.4
	Asian / Pacific Islander	26	11.9
	Hispanic or Latino	10	4.6
	White	156	71.2
	Global Citizen	1	.5
	Other	1	.5
	Total	219	100.0

Education Level		Frequency	Percent
	High school graduate, GED	41	18.7
	Associate degree	29	13.2
	Bachelor's degree	109	49.8
	Master's degree	33	15.1
	Doctorate	7	3.2
	Total	219	100.0

Household Income		Frequency	Percent

Less than $19,999	22	10.0
$20,000 to $39,999	59	26.9
$40,000 to $59,999	47	21.5
Above $60,000	85	38.8
Prefer not to say	6	2.7
Total	219	100.0

Materials and Procedure

The study was created using the online survey engine QuestionPro©. The study involved a 50-item Autism-Spectrum Quotient (ASQ) scale (Baron-Cohen, 2001), a 25-item executive skills questionnaire - revised (ESQ-R) (Strait et al., 2019), and an 18-item brief money management survey (BMMS) (Ksendzova et al., 2017).

ASQ comprises 50 questions, made up of ten questions assessing each of the five factors related to autistic traits: *social skills*, *attention switching, attention to detail, communication,* and *imagination* (Appendix A). Participants responded to each question on a 4-point Likert scale (1= definitely agree, 2= slightly agree, 3= slightly disagree, 4= definitely disagree). Moderate to high internal consistency of items in each of the five factors is indicated by the Cronbach's alpha coefficients (Communication = .65; Social skill = .77; Imagination = .65; Attention to detail = .63; Attention Switching = .67). Each item on the scale scores 1 point if the participant report abnormal or autistic-like behavior, either mildly or strongly. A higher score on the scale indicates poor social skills, poor communication skills, poor imagination, exceptional attention to detail, and poor attention-switching/strong focus on attention (Baron-

Cohen et al. 2001). Previous research involving males, females, scientists, and nonscientists indicates that individuals with autistic traits score near or above 30 on the ASQ scale, whereas neurotypical adults score near or below 20 (Baron-Cohen et al., 2001).

Executive skills questionnaire-revised (ESQ-R) is a 25-item scale that measures a person's cognitive ability on five factors: *plan management, time management, organization, emotional regulation,* and *behavioral regulation* (Appendix B). The revised version of the ESQ shows high internal consistency with Cronbach's alpha of .91 (Strait et al., 2019). Individuals responded to each item on a four-point Likert scale (0 = never or rarely, 1 = sometimes, 2 = often, 3 = very often), a high score on the scale indicates executive dysfunctioning. The scale was reverse coded before analyses such that a high score indicated optimal executive functioning.

A brief money management scale (BMMS) is an 18-item Likert scale that evaluates an individual's money management tendencies. BMMS measures four factors of money management: *saving, insurance, credit management,* and *cash management* (Appendix C). A high score on the saving subscale indicates understanding the concept of saving. A high score on the insurance subscale indicates an understanding of hedging against property or health loss. A high score on the credit management subscale indicates an understanding of the concept of debt and an ability to manage debt. A high score on the cash management subscale indicates an understanding of currency usage. An overall high score on BMMS indicates good money management, whereas lower scores indicate poor money management skills (Ksendzova et al., 2017).

Once participants clicked on the link to the survey on MTurk, they were taken directly to the informed consent document at the beginning of the study. All instructions on how to complete the survey were explicitly provided to the participants. Participants began by filling out the demographical information that included age, gender, ethnicity, education level, and household income. After demographical information was completed, participants completed the three scales: ASQ, ESQ-R, and BMMS. Upon completing the survey, participants were thanked for participation, and a payment of $0.20 was made to their amazon account.

RESULTS

Data screening

Before hypothesis testing, the data were screened for outliers and ensured that all the necessary assumptions were met. Inspection of the histogram and Q-Q plot for the continuous variable of ASQ indicated a normal distribution. Two outliers were found in the dataset, but the results did not vary with or without the two outliers. Thus, they were kept in the dataset. ASQ score was computed by assigning one point for each “agree” and “slightly agree” response to the questions on the ASQ scale and summing the points, as suggested by Baron-Cohen et al. (2001). The histogram and Q-Q plot for the continuous variable of executive functioning indicated a slightly positively skewed distribution. The continuous variable of money management was slightly negatively skewed. Although square-root transformation improved the distribution of executive functioning variable and log transformation improved money management variable, analyses with and without the transformed variables did not substantially change the results of the analyses. Untransformed variables were used in all analyses, and stringent alpha level ($p < .025$) was used to determine significant effects. The negative Shapiro-Wilk test of normality indicated equal variance. Descriptive statistics for each of the measures can be found in Table 1.

Table 2.
Descriptive Statistics for ASQ, ESQ-R, and BMMS

	Mean	SD	Min	Max
ASQ	22.77	6.09	4	43
ESQ-R	49.57	13.69	9	72
BMMS	50.64	12.69	10	72

Note. ASQ = Autism-Spectrum Quotient; ESQ-R = Executive Skills Questionnaire-revised; BMMS = Brief money management survey. ESQ-R was reverse scored such that higher value reflect optimal executive functioning.

Analyses**.** Correlations between the individual constructs, autistic trait, executive functioning ability, and money management capacity can be found in Table 2. ASQ is negatively correlated with ESQ-R, suggesting that as the autistic quotient increases, executive functioning decreases. ASQ is also negatively correlated with BMMS, indicating poor money management skills in individuals with a higher autistic quotient. A positive correlation between ESQ-R and BMMS suggests that individuals who report higher executive functioning ability also report better money management skills.

Table 3.

Correlations between ASQ, ESQ-R, and BMMS

	ASQ	ESQ-R	BMMS
ASQ	1		
ESQ-R	-.34**	1	
BMMS	-.19**	.43**	1

Notes. ** = $p < .001$.

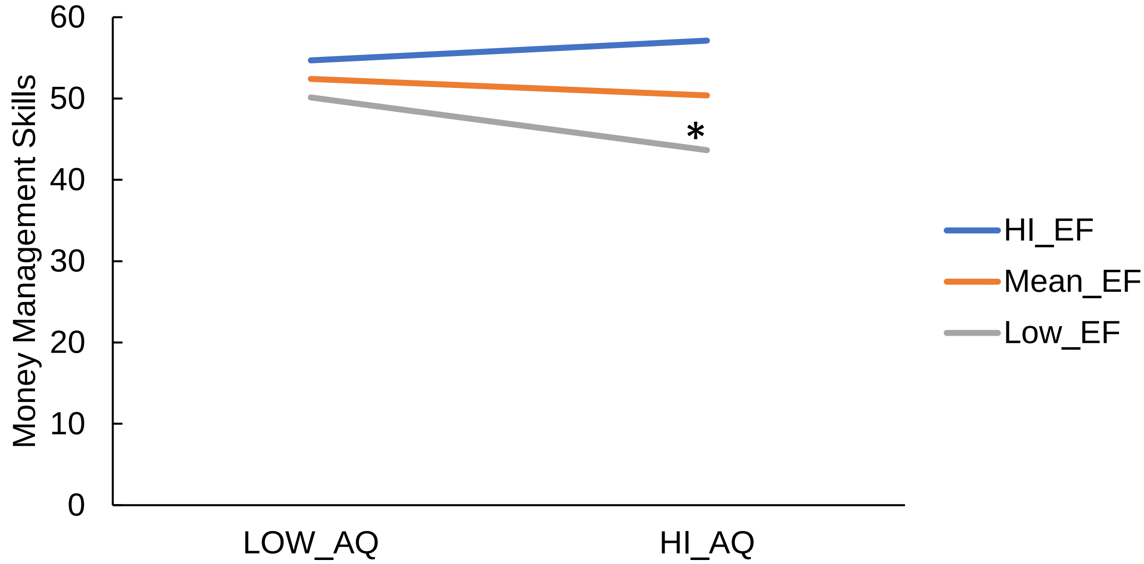
Previous research suggests that poor executive functioning predicts autistic traits. However, research also suggests that executive functioning gets better as people age. Additionally, education and household income also affect certain executive functions such as planning ability and time management. Therefore, all demographical variables were entered into the model as covariates. The results indicate that after controlling for demographics, executive functioning predicted autistic traits, $R^2 = .12$, $\beta = -.34$, $t(2,216) = -5.30$, $p < .001$, indicating that individuals that report having more autistic traits also report having poor executive functioning.

Furthermore, a moderated multiple linear regression was performed to assess the moderating role of executive functioning on money management ability in individuals with autistic personalities after controlling for age, education level, and household income. Executive functioning successfully predicted money management skills such that individuals with good executive functioning reported good money management behavior (β = .33, $p < .001$). Autistic traits did not predict money management skills ($p = .21$). However there was a significant interaction effect suggesting that at different levels of executive functioning, autistic traits do predict money management skills, β = .16, $SE = .01$, $t(215) = -2.53$, $p = .01$, $sr^2 = .02$.

To probe the interaction, the effects of executive functioning on money management ability were examined at high (+1 SD) and low (-1 SD) levels of the autistic quotient. At high levels of executive functioning, autistic quotient was not a significant predictor of money management skills, β = .20, $SE = .17$, $t(215) = 1.59$, $p = .25$. However, at low levels of executive functioning, autistic quotient significantly predicted money management skills, β = -.53, $SE = .22$, $t(215) = -2.47$, $p = .01$. Results suggest that as autism spectrum quotient increases, money management ability decreases when executive functioning is impaired (figure 4).

Figure 4.

At low levels of ESQ-R, higher ASQ individuals struggle with money management.



DISCUSSION

Study 1a confirmed that individuals who report poor executive functions tend to report more autistic traits. Study 1a also confirmed that autistic traits are not related to money management skills as long as executive functioning is not impaired. Results suggest that autistic traits by themselves have no relationship with money management ability. These results clearly distinguish between the financial capability of those with autistic traits and those with autism disorder. Individuals with autistic traits can manage finances as long as executive functioning is not impaired.

One limitation of study 1a is that only one scale per latent variable was used. It could be that the subscales within ESQ-R only captured certain aspects of executive functioning while missing others. Another limitation is that the sample had most adults (above the age of 45) with college degrees. The largest majority of the sample had a household income of greater than $60,000.

STUDY 1B

Study 1a confirmed a relationship between executive functioning and money management ability. However, executive functioning and money management ability are both latent variables. Therefore, it is essential to measure these variables using multiple scales. Thus for study 1b, additional measurements of both variables were included, and confirmatory factor analysis was performed to ensure the validity of the latent variables. Furthermore, study 1b included additional instruments to evaluate the learning style preference and gaming style preference. It is unclear whether there is a relationship between autistic traits and the style of games preferred. According to the experiential gaming model, the player's profile includes personality traits and learning styles so that game can be designed to optimize performance (Kiili, 2005).

METHOD

Participants

Participants (N = 160) were recruited from the University of Texas at Arlington's SONA pool and received 1.5-course credits for completing the online study. Participants signed an online consent form before beginning the study. The study was approved by UTA's Institutional Review board and took approximately an hour to complete. Once the study began, participants had to complete the entire survey as there was no option to save and return to the survey. The consent form informed the students that they could withdraw from the study at any time without implications as their participation was voluntary. There was no monetary incentive given for completing the study. All instructions on how to complete the survey were explicitly provided to the participants.

Participants ranged in age from 18 – 45+, were 70% female, and the largest majority were of Hispanic origin (33.8%); see Table 2 for a complete list of demographic frequencies.

Table 4.
Demographic frequencies for UTA sample

Age	Frequency	Percent
18-24 years old	148	92.5
25-34 years old	8	5.0
35-44 years old	3	1.9
45 years or older	1	.6
Total	160	100.0

Gender	Frequency	Percent
Male	45	28.1
Female	112	70.0
Transgender Female	1	.6
Gender Variant/Non-Conforming	2	1.3
Total	160	100.0

Ethnicity	Frequency	Percent
African American or Black	22	13.8
Asian / Pacific Islander	32	20.0
Hispanic or Latino	54	33.8

White	45	28.1
Global Citizen	2	1.3
Other	5	3.1
Total	160	100.0

Education	Frequency	Percent
High school graduate, GED	129	80.6
Associate degree	29	18.1
Bachelor's degree	2	1.3
Total	160	100.0

Household Income	Frequency	Percent
Less than $19,999	24	15.0
$20,000 to $39,999	23	14.4
$40,000 to $59,999	23	14.4
Above $60,000	55	34.4
Prefer not to say	35	21.9
Total	160	100.0

Materials and Procedure

The study was created using the online survey engine QuestionPro©. Similar to study 1a, a 50-item ASQ scale, 25-item ESQ-R, and an 18-item BMMS scale were used. An additional measurement of executive functioning was added to the study. An executive function index (EFI) is a 27-item questionnaire comprising five subscales that assess an individual's ability on various executive functions such as empathy, planning ability, time management, organization, impulse control, and motivational drive (Appendix D). Cronbach's alpha for the subscales ranged from .76 -.70. Individuals responded to each item on a four-point

Likert scale (0 = never or rarely, 1 = sometimes, 2 = often, 3 = very often), higher score indicates optimal executive functioning (Spinella, 2005). The financial management behavior scale (FMBS) is a 15-item scale comprised of four subscales that measure an individual's ability to manage cash and debt, saving ability, and insurance policy evaluation/selection (Appendix E). Individuals respond to each item on a 5 point Likert scale (1) never, (2) seldom, (3) sometimes, (4) often, and (5) N/A. Higher scores indicate excellent money management, whereas lower scores indicate poor money management behavior (Dew & Xiao, 2011).

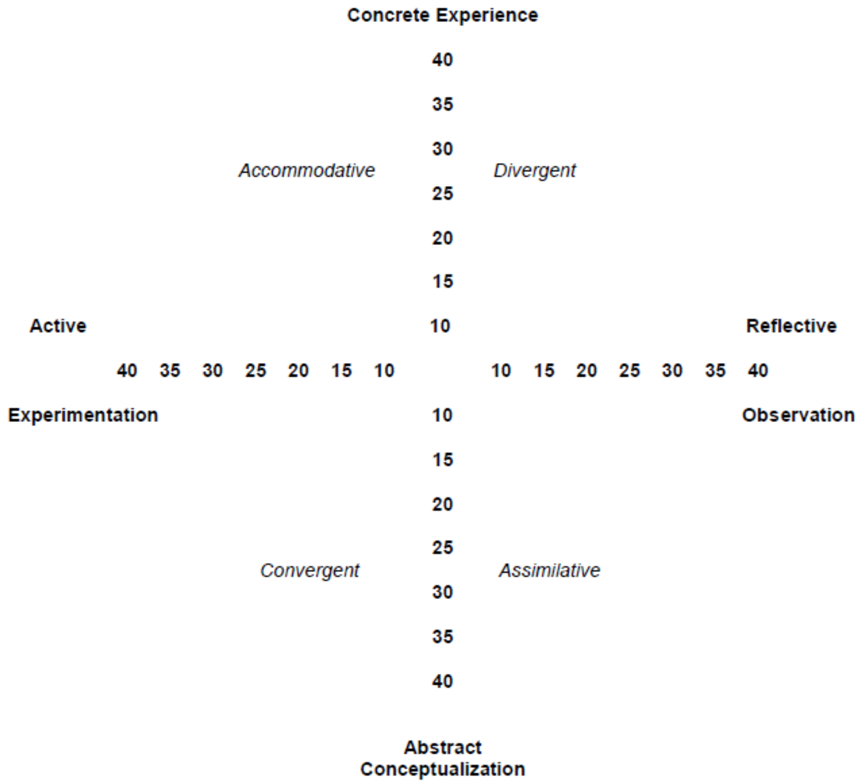
To assess an individual's preference for the preferred style of learning, a learning style inventory-version 3 (LSI-3) was used. Previous research suggests that LSI-3 informs the individual on their particular strengths within the four domains of the learning cycle. LSI-3 consists of 10 sets of four adjectives for each of the four learning modes. Participants are asked to rank these adjectives from most characteristic (4) to least characteristic (1) of their learning style. One example from the assessment is:

> Please rank order your preferred way of learning. Assign a 4 to the word which best characterizes your learning style, a 3 to the following best, a 2 to the next, and a 1 to the least characteristic word.
>
> Feeling (CE) ___ ; Watching (RO) ___; Thinking (AC) ___; Doing (AE) ___.

Each word has been validated as belonging to one of the four styles of learning, that is, learning from concrete experiences (C.E.), reflective observation (R.O.), abstract conceptualization (A.C.), or active experimentation (A.E.). A maximum of 40 points can be scored on each domain, and the sums are then transferred to a learning style profiler (see figure 5). The domain with the highest score is designated as the most preferred style of learning. Students with ASD tend to struggle with abstract conceptualization, and this population learns best from experience and experimentation. LSI-3 results should be interpreted cautiously as these learning preference designations are transitory and change based on individuals' context, age, and intellectual ability over time. Due to copyright reasons, this scale is not published in this dissertation and can be obtained from the following website: https://learningfromexperience.com/themes/kolb-learning-style-inventory-lsi/

Figure 5.

Learning Style Profile



It is yet unclear if individuals with autistic traits have a preference for a specific type of gameplay. A playing style-based questionnaire (PSQ) measures the preferred style of playing video games. Video games have gained popularity in educational settings in the past few years, and research suggests that students tend to be more engaged with the learning process when using technology. Additionally, students with ASD prefer computer interactions with visual representations of content rather than reading from books. Many ASD students, even those classified as high functioning, struggle with reading comprehension. Therefore, using a graphical interface serves the learning needs of these students. However, guidelines for developing educational video games for students with ASD are scant. A 42-item gaming style preference scale (PSQ) was added to this study to fill this knowledge gap. PSQ is a dichotomous scale, and participants respond with (1) Yes or (2) No to the 42 questions (Appendix F). Participants are scored on four domains of playing style: competitor, dreamer, logician, and strategist. Cronbach's alpha for the categories: .64, .80, .79, and .70, respectively, and .70 for the overall scale (Bontchev et al., 2018).

Participants began by filling out the demographical information that included age, gender, ethnicity, education level, and household income. After demographical information was completed, participants completed the seven scales: ASQ, ESQ-R, EFI, BMMS, FMBS, LSI-3, and PSQ. Upon completing the survey, participants were thanked for participation and allotted 1.5 SONA credits.

RESULTS

Data Screening

One hundred and sixty (N = 160) participants completed the study successfully. Before hypothesis testing, the data were screened for outliers and ensured that all the necessary assumptions were met. Inspection of the histogram and Q-Q plot for ASQ, ESQ-R, BMMS, FMBS indicated a normal distribution. The histogram and Q-Q plot for the continuous variable of EFI was slightly positively skewed. Square-root transformation did improve the distribution but did not change the results of analyses, untransformed variable was used for analyses. Descriptive statistics for each of the measures can be found in Table 5. The frequency distribution of learning style preference can be found in figure 6, and gaming style frequency distribution can be found in figure 7.

Table 5.

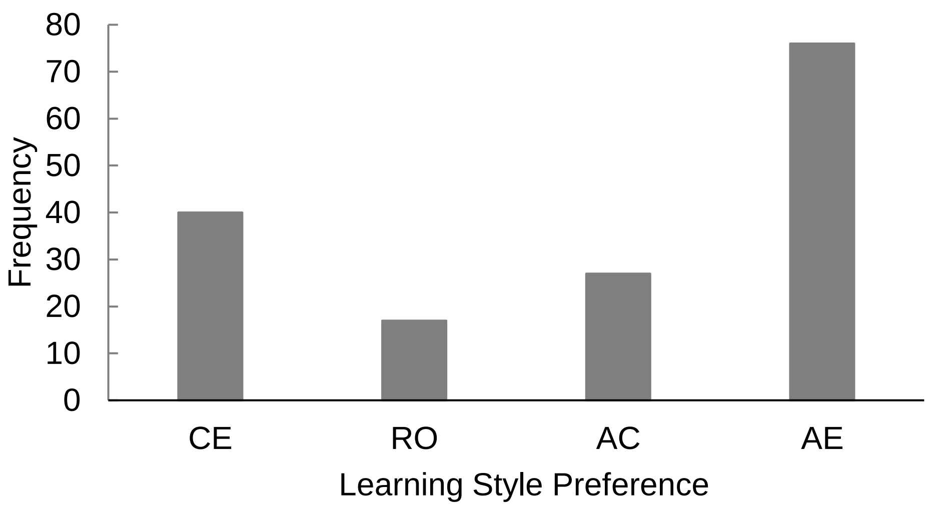
Descriptive Statistics for ASQ, BMMS, FMBS, EFI, ESQ-R

	Mean	SD	Min	Max
ASQ	21.11	5.01	8	34
BMMS	34.68	14.17	10	65
FMBS	30.92	8.48	9	49
EFI	56.24	9.66	28	77
ESQ-R	42.53	10.18	11	64

Note. ASQ = Autism-Spectrum Quotient; BMMS = Brief money management survey. FMBS = Financial management behavior scale; EFI = Executive functioning index; ESQ-R = Executive skills questionnaire-revised; ESQ-R was reverse scored such that higher value reflect optimal executive functioning.

Figure 6.

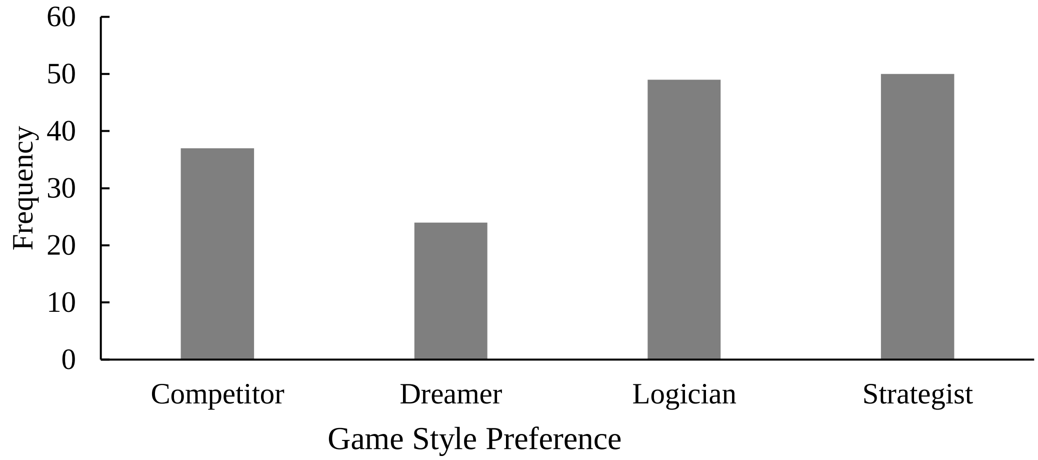
Frequency distribution of learning style preference.



Notes. C.E.: concrete experience, R.O.: Reflective observation, A.C.: Abstract conceptualization, A.E.: Active experimentation. N = 160.

Figure 7.

Frequency distribution of gaming style preference.



Notes. Individuals with high ASQ score highly preferred the dreamer style of playing.

Analysis**.** Two different scales assessed a latent variable of executive functioning. ESQ-R measured an individual's ability to regulate emotions (E.R.), regulate behavior (B.R.), organization (ORG), planning management (PM), and time management (T.M.). EFI measured an individual's ability to empathize with others (EMP), strategic planning (S.P.), organization (ORG), impulse control (IMP), and motivational drive (M.D.). The correlation between ASQ, ESQ-R, EFI, FMBS, and BMMS is shown in Table 6. Results indicate autistic trait to be negatively correlated with both executive functioning scales, same as study 1a. ESQ-R and EFI are positively correlated, which was expected considering both scales measured executive functions. BMMS and FMBS are positively correlated, also expected because both scales measure money management ability. Additionally, both executive functioning scales positively correlated with BMMS. Confirmatory factor analysis indicated a strong correlation (r = .96) between the two executive functioning measurement scales indicating that both scales measured the latent variable of executive functioning (figure 8). Confirmatory factor analysis of BMMS and FMBS also indicated a strong correlation (r = .84) between the two scales indicating that both scales measured the latent variable money management (figure 9).

Table 6.

Partial correlations between subscales of ASQ, ESQ-R, EFI, BMMS, FMBS

Variables	1	2	3	4	5
1 ASQ	--	-.40**	-.42**	-.04	.05
2 ESQ-R		--	.57**	.18*	.12
3 EFI			--	.20*	.07
4 BMMS				--	.84**
5 FMBS					--

Notes. **p < .001; * p < .01. ASQ = autism spectrum quotient; ESQ-R = executive skills questionnaire-revised; EFI = executive functions index; BMMS = brief money management scale; FMBS = financial management behavior scale.

Figure 8.

Factor analysis of EFI and ESQ scales

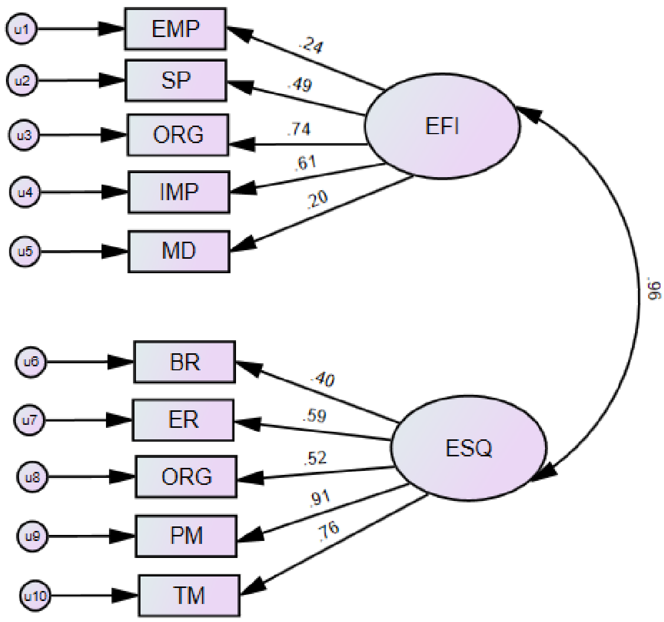
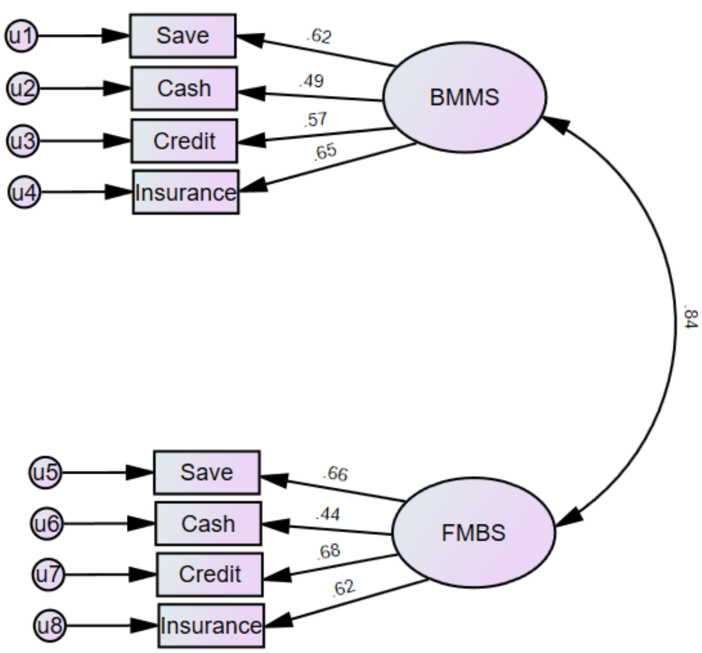


Figure 9.

Confirmatory factor analysis of BMMS and FMBS scales.



A simple linear regression was performed to assess the relationship between autistic traits and executive functions after controlling for age, level of education, and household income. Executive functioning predicted autistic traits, such that people who report poor executive functions tend to have higher autistic-spectrum quotient, β = -.4, $t(159) = -5.38$ $p < .001$.

A moderated multiple regression was performed to assess the role of autistic traits and executive functioning on money management skills. The demographic variables of age, household income, and level of education were entered into the model as covariates. The results of the regression suggest that after controlling for demographics executive functioning predicted money management skills, β = .22, t (153) = 1.38, $p = .008$. Neither autistic traits nor the interaction between autistic traits and executive functioning predicted money management skills. The results confirm that money management ability can be predicted by executive functioning. Additionally, no relationship was established between autistic quotient and money management ability.

To assess the relationship between autistic traits and learning style preference, a partial correlation was performed with all five dimensions of autistic traits. Results indicate that individuals with poor communication skills preferred learning by abstract conceptualization over concrete experiences (Table 7). Additionally, individuals with poor attention switching preferred learning by abstract conceptualization more so than active experimentation. Results also indicate that both measurement scales of executive functioning were positively correlated, and both money management measurement scales were also positively correlated. Furthermore, results indicate that more participants preferred active experimentation learning style over any other category of learning χ^2 (3, *N* = 160) = 49.85, *p* < .001.

Table 7.

Partial correlations between subscales of ASQ and LSI-3

Variable	2	3	4	5	6	7	8	9
1. CE	-.34***	-.49***	-.50	-.03	-.07	-.28**	.01	-.15
2. RO	--	-.18*	-.28**	-.01	.01	.07	-.08	.15
3. AC		--	-.46***	.14	.16*	.25**	-.10	.09
4. AE			--	-.11	-.17*	-.09	.15	.05
5. AD				--	-.09	-.17*	-.05	-.05
6. AS					--	.43***	.17*	.29***
7. COMM						--	.24**	.43***
8. IMG							--	.01
9. SS								--

*Note.***p* < .05. ***p* < .01. ****p* < .001. CE = concrete experiential; RO = reflective observation; AC = abstract conceptualization; AE = active experimentation; AD = attention to detail; AS = attention switching; COMM = communication; IMG = imagination; SS = social skills. Partial correlations were conducted after controlling for age, level of education, and household income.

Linear regression was performed to test the relationship between preferred gaming styles and autistic traits after controlling for demographics. The categorical variable of PSQ was dummy coded with strategist style of playing as a reference group. The model was significant, suggesting a relationship between a particular style of playing and autistic personality, *F*(6,153) = 3.60, *p* = .002. That is, the style of gaming predicted autistic-spectrum quotient.

ASQ = .08 - .28(competitor) + 4.92(dreamer) + .43(logician).

Comparing the strategist style of playing to a competitor style, there was a decrease of .28 points in the autism spectrum quotient, meaning those with more autistic traits prefer to play strategically rather than competitively. Comparing the strategist style of playing to the dreamer style, there was an increase of 4.92 points in the autism spectrum quotient. Meaning those with more autistic traits prefer the “dreamer” style of playing. People that prefer the dreamer style like playing role-play games and thrive in the fantasy world of avatars where they prefer to observe the gameplay. These individuals like guided gameplay and staying at a given game level until they have mastered it sufficiently. Dreamers also prefer playing through explicit game scenarios instead of emergent gameplay. Comparing the strategist style of playing to the logician, there was an increase of .43 points in the autism spectrum quotient. Meaning those with more autistic traits enjoy logic, analysis, and pattern-based approaches. They also possess good spatial awareness and contextual thinking.

A Chi-square test of independence was performed to assess the association between learning style preference and gaming style preference. No statistically significant association was determined, χ^2 (9, *N* = 160) = 7.92, *p* = .54.

DISCUSSION

Study 1b confirmed that executive functioning predicts autism quotient such that poor executive functioning is associated with a higher autism-spectrum quotient. Study 1b also confirmed the results of study 1a that autistic traits are not related to money management skills. Furthermore, there was no relationship between preferred learning style and autistic traits. These findings suggest that individuals with autistic traits may not struggle with transforming concrete experiences to higher-order abstraction. It is still uncertain whether individuals with ASD have a preference towards one learning style over another. Study 1b results only suggest that normal intelligence individuals with autistic traits do not have any specific preference. The results do indicate that college students, in general, tend to prefer learning by active experimentation over any other style. Study 1b also indicated a relationship between autistic traits and the type of gaming preference. Therefore, when designing an educational game for autistic individuals, games with competitive nature should be avoided, and role-playing games should be used. Additionally, games should have set patterns that are predictable so the individuals with ASD can develop plans to accomplish goals within the game.

Results indicate that students performed better on time-based PM than event-based PM, which contradicts previous research findings. One reason for this difference could be that in the D3 game, time-based PM failure received a harsher penalty than a failure of event-based PM. For instance, each bill that was late received a penalty of 50% of the bill amount (e.g., $50 if paid on time and $75 if late). In comparison, the penalty for late delivery was a 25% reduction in payment. The higher penalty would be more salient for two reasons: it is numerically higher, and second, it is deducted from the player’s bank account with notification. In contrast, the student may not have even figured out that late deliveries lead to 25% reduction because the penalty was charged before disbursement into the bank account. The student would have had to calculate the loss themselves.

Furthermore, students with ASD clicked on the phone UI more often than the neurotypical students, indicating that they monitored the due times for tasks and bills more frequently. Increased monitoring would indicate better executive functioning than prospective memory functioning. Both executive functioning and prospective memory functioning depend on the proper functioning of the neurons and connections in the frontal cortex. Therefore any improvement in the cortical functioning will affect both cognitive functions.

The D3 attempted to stimulate the parietal cortex (sensory perception), the frontal cortex (intention formation), and the premotor cortex (intension execution) as it required the player to sense, decide and move to perform actions in the game. Based on the principles of Hebbian law, cortical regions that “fire together wire together,” D3 attempted to increase the firing rate of cortical neurons within these regions. If the parietal cortex and frontal cortex fired together more often while playing the game, network strength would improve between these regions over time (albeit very slowly). However, there is no way of knowing if that actually happened in the experiment. Confirmation by DTI study would have to be conducted after extensive training with the game.

There were several limitations to study 1b. First, there were far more females in the sample than males. This is an issue because the autism spectrum disorder phenotype is differentially greater in males than females. However, it is unknown if there are gender differences as they pertain to autistic traits. The second limitation was that participants were majority college freshmen and had limited experience dealing with financial management, especially regarding insurance policy selection. The third limitation was using self-assessment scales to measure executive functioning instead of behavioral responses to tasks requiring executive controls. Forth limitation had to do with the usage of money management scales. Measuring financial behavior would be a better indicator of money management skills.

Chapter 3
STUDY 2 OVERVIEW

Study 1 replicated previous work that individuals with executive dysfunction struggle with money management (Perna et al., 2012; Del Missier et al., 2012). Previous research also suggests that individuals with ASD have poor executive functioning (Fuster, 2008; Grossberg & Seidman, 2006; Lord et al., 2000; Pennington & Ozonoff, 1996). Since individuals with ASD have poor executive functioning and individuals with poor executive functioning struggle with money management, it stands to reason that individuals with ASD would struggle with money management. Research does suggest that individuals with ASD do indeed struggle with money management (Cheak-Zamora et al., 2017; Hopkins & O'Donovan, 2019; Holden, 2010).

Furthermore, performance on specific phases of the PM process depends on executive functioning (Martin, Kliegel, and McDaniel, 2010). For instance, different executive functioning loads are required for the intention formation and intention execution phases of PM functioning. The reason for including PM tasks in the D3 game was to evaluate the relationship between executive functioning and PM. Does improvement in executive functioning generalize to PM performance? Specifically, I wanted to test if any improvement in planning ability translated to improved event-based PM performance. However, there was no significant improvement in planning ability as indicated by unchanged performance on the Tower of London task. Therefore, it was not possible to attribute any changes in the event-based PM performance to executive functioning.

A Dash-Dash-Delivery (D^3) simulation was designed based on the finding that students with autistic traits prefer games that involve role-playing and repetitive play to teach money management skills. Specifically, the simulation was designed to provide concrete experiences with money transactions. The purpose of this field study was to evaluate the effectiveness of a simulation developed to improve financial decision-making, prospective memory, and executive functioning in adolescents with ASD. More specifically, planning ability and time management were the two aspects of executive functioning that were targeted.

METHOD

A total of 13 autistic and 18 age and grade-matched neurotypical students were recruited for the study, with an average age of 14.8 years. All (N = 31) students used the simulation, and neurotypical students served as a control group. The study was approved by UTA's institutional review board, Arlington Independent School District (AISD), and AISD-Research and Analysis department. Written approval was obtained from each high school and junior high school that participated in the study. Participants were recruited by requesting permission from special education teachers and parents of students in AISD via email. Students were explicitly told that their participation in the study was voluntary and that they could terminate the study at any time.

The study was conducted in a special education classroom during school hours in the spring semester of 2021. The classroom teacher and teacher aides were present during the intervention and assisted with the classroom setup. Each student was provided a laptop issued by UTA to play the game. At the end of each game session, students returned the laptops to the experimenter. School-approved disinfectants were used to clean laptops to prevent the spread of COVID-19. All research assistants wore a mask and maintained social distance. Students were assigned a unique ID number generated by the game. Student names and their respective unique IDs were stored in an excel file. The file was saved in a password-protected OneDrive folder that UTA's IRB approved. To begin a new session, students logged in to the game using their unique ID number. Game-related data files were saved on the UTA laptops and were deleted from the laptop after being transferred to the OneDrive folder. Students were not promised or received any compensation for participating in the study. The study concluded after each student completed five days of intervention and a post-intervention evaluation. The entire course of the study took two weeks.

Materials and Procedure

Students completed a baseline assessment that involved filling out demographical questions about age, gender, and grade level. Ethnicity and household income responses were removed from analyses as many students preferred not to answer ethnicity questions, and no student knew household income. An attempt was made at administering a gaming style preference questionnaire (ADOPTA-PSQ), but due to difficulties with reading comprehension in students with ASD, the attempt was unsuccessful. Likewise, an executive functioning questionnaire (ESQ-R) was an ineffective method with autistic students. Instead, students completed the Tower of London task on a laptop with a high rate of success. Tower of London is an executive functioning test that requires participants to plan their future game moves to complete each level of the task successfully. The level of difficulty increases with each subsequent level. The player is allotted a specific number of moves to match the configuration of disks to a target configuration. If the player makes a wrong move and goes past allotted moves, he/she has an option to reset the level and start over. Every reset of a level leads to point deduction. At the end of the 12 levels, the game score was recorded.

Additionally, students played a prospective memory game called VirtualWeek (V.W.), developed by Rendell and Craik (2000). V.W. is a digital board game that simulates a day from 8 am to 10 pm, during which the player must carry out tasks assigned at the beginning of the virtual day. For example, one task might be to “phone a plumber at 5 pm” or “buy game tickets when visiting a school.” This game was challenging to play for students with ASD as it required constant reading and reading comprehension of instructions. 9 out of 13 ASD students pressed random keys on a keyboard until they got frustrated and wished to stop playing. All neurotypical students were able to finish playing the game, and their data were used in analyses.

A modified version of the one-shot hypothetical debt repayment game from Amar et al. (2011) was completed during the baseline evaluation. Participants were presented with a scenario in which they had to pay back six loans with varying degrees of interest rates using a limited amount of money. They were asked to allocate the funds to whichever loan they wished to pay back. One-shot question:

Suppose you owe money to 6 banks, and each bank charges you a different interest rate. Suppose you received bonus money of $25,000. How would you distribute this money across six loans? Assume there is no minimum payment required per loan. Please fill in the amount of money you would allocate to each loan in the space provided.

Loan 1 is in the amount of $2000 and bank charges you 2.0% interest. _________

Loan 2 is in the amount of $3000 and bank charges you 2.5% interest. _________

Loan 3 is in the amount of $24,000 and bank charges you 3% interest. _________

Loan 4 is in the amount of $43,000 and bank charges you 3.5% interest. ________

Loan 5 is in the amount of $50,000 and bank charges you 4.0% interest. ________

Loan 6 is in the amount of $65,000 and bank charges you 4.5% interest. ________

An optimal solution is first to pay off the loan with the highest interest rate. However, because people prefer to reduce the overall number of loans rather than the loan amount, people choose to pay off lower interest rate loans first ─ a suboptimal solution (Amar et al., 2011).

After completing the baseline assessment, participants started the D^3 experimental game. Students completed a 30-minute session for a total of five days. Due to block scheduling and STAAR exams, five days were not consecutive. Over two weeks, all participating students were able to complete the five-day intervention.

A 30-minute session of D^3 simulates an 8-hour workday in which the player role-plays as delivery personnel in the virtual mall. The player had five daily job assignments they were required to perform during a gameday session. Job assignment involved finding an appropriate store to pick up a special package and deliver it to a drop-off center. For example, when visiting a store x, pick up a delivery package (event-based PM). There were two easy-level job assignments, which required the player to locate one (1) store, pick up the delivery box and deliver it to a central drop-off location. There were two medium-level job assignments, which required the player to locate two (2) different stores and procure the packages. One hard-level job assignment required the player to procure packages from three (3) different stores and deliver them to a central drop-off location. There was only one central drop-off location for all deliveries. The player had 30 minutes of game time (approximately two actual minutes) to complete each job assignment. Participants had an opportunity to complete 25 job assignments over five days. Specifically, there were 45 trials of event-based PM tasks because the medium job assignment required two pick-ups per assignment, and the hard job required three pick-ups. The time constraint of 2 minutes per job assignment necessitated a plan to optimize the route. Additionally, each job assignment assessed spatial memory because the player had to remember where each store in the virtual mall was located.

The D^3 simulation also required the player to pay hypothetical bills at a specified time during the gameday session (time-based PM task). The due times for these bills were randomly distributed across the gameday. The player had a one (1) minute window (real-time) to pay each bill (4 total bills per gameday). The player received the first notification 30 seconds before the payable window. If the player failed to make a payment within 20 seconds of the payable window, a second notification was displayed on the screen. There were four bills per day, and over five days, participants had 20 trials of time-based PM tasks. PM task was considered successful if the bill was paid within the first 20 seconds of the payable window and before the second notification. In other words, bill was paid after a delay of 30 seconds of the initial notification but without any additional cue.

Players earned game money by completing job assignments. More money was earned by completing hard job assignments versus easy jobs.

Bonus money was awarded for early deliveries, and a penalty was applied for late deliveries. The player had to budget the earned money to pay the bills and purchase food for the game character. If the player did not purchase food, the energy levels decreased, and the character could only walk at half the speed, making it harder to complete job assignments on time. Additionally, if the bills were not paid within a payable window, a penalty was applied and money auto deducted from the bank account. Each game day, a player was mandated to take a “financial literacy” test, which earned them bonus money given they answered the three questions correctly (see appendix G for screenshots of D^3).

After each student completed five days of intervention, a post-intervention assessment was performed. Students re-played a Tower of London, VW, and one-shot hypothetical debt repayment game. Also, students completed a 10 question financial literacy test that examined their understanding of cash management, savings, and debt management. Students were allowed to use calculators to solve problems that required computations.

Example questions:

Need vs. Want: Select the items that you would consider a need for survival:

Food, Xbox, House, Clothes, Netflix subscription.

Saving: Suppose you receive an allowance of $50 each month. You spend $40 per month at Starbucks. How many months will it take for you to save enough money to buy a video game that costs $80?

Budgeting: Josh wishes to buy one apple for each day that he will take his lunch to work with him this week. He will work five days, but on one day, his sister is taking him to a restaurant for lunch. If his local grocer sells apples for $0.57 each, how much will he spend on apples for his lunches this week?

Cash management: Suppose you want to buy a sweater that costs $18, you get a 27% discount on a sweater. Sales tax is 8.4%. How much money should you take with you to the store?

Upon completing the post-intervention assessment, students were thanked for their participation.

RESULTS

Before hypothesis testing, the data were screened for outliers and ensured that all the necessary assumptions were met. The scoring of the D^3 game is as follows:

Billing Score: The scoring scheme for bills paid by the player in the D^3 game is as follows:

0-20 seconds → 4 points; 21-40 seconds → 3 points; 41-60 seconds → 2 points;

> 60 seconds → 1 point.

Players earned a minimum of 4 points per day if they failed to pay any bills within the payable window and a maximum of 16 points if they made the payment before receiving a second notification.

Job assignment Score: The player earned 1 point for each on-time delivery. The scoring scheme for tasks in the D^3 game is as follows:

Easy level → 1 point for each on-time task completion. Maximum of 2 points per game day.

Medium level → 2 points for each on-time task completion. Maximum of 4 points per game day.

Hard level → 3 points for on-time task completion. Maximum of 3 points per game day.

Analysis. To test the hypothesis that neurotypical students perform better than autistic students in the time-based PM task, a one-way ANOVA was performed using the continuous variable of “bill score.” The assumption of homogeneity of variance was met by negative Levene’s test (p = .16). No statistically significant difference was found between groups, F (1,29) = 2.51, p = .12. The results suggest that both neurotypical students (M = 55.17, SD = 7.68) and autistic students (M = 49.69, SD = 11.58) performed equally on their ability to pay bills in the game. Therefore, the hypothesis that neurotypical students will perform better than autistic students was not supported.

To evaluate the difference in the progression of performance between neurotypical and autistic students over time, a repeated-measures ANOVA was performed with five days of “bill score” as a within-subject and student group as a between-subject variable. Box’s M was not significant (p = .35), suggesting that the assumption of the equality of covariance was met. There was a significant multivariate effect of time, $F(4, 26) = 24.68$, $p < .001$, $\eta_p^2 = .79$. As expected, timely payment of hypothetical bills increased over time. Performance scores were higher on day five than on any other previous day. Trend analysis confirmed a significant linear fit, $F(1, 29) = 102.66$, $p < .001$, $\eta_p^2 = .78$. Quadratic and cubic models were not significant, suggesting that student performance over the five days improved linearly. Pairwise comparison of performance over time indicates that there was a significant improvement from day 1 to day 2 (p = .002), from day 2 to day 3 (p = .009), from day 3 to day 4 (p = .009). Additionally, an orthogonal-reverse Helmert contrast was performed to assess if the fifth day's performance exceeded that of the previous four-day average. Results support the finding that participants' performance on the fifth day was significantly better than the average of the previous four days $F(1,29) = 62.82$, $p < .001$, $\eta_p^2 = .68$.

Figure 10.

Performance on time-based PM task.

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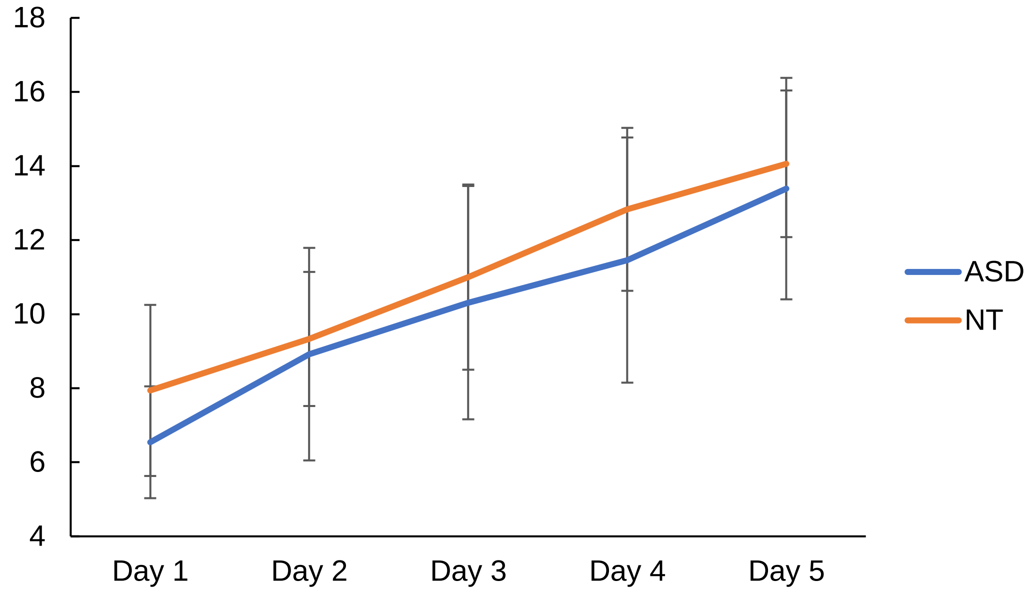
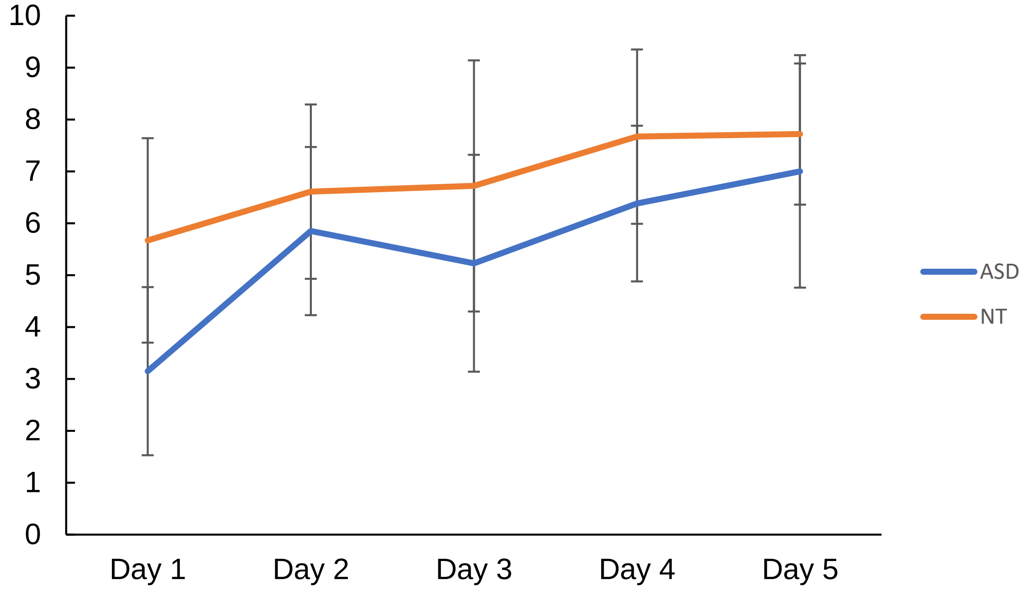


To test the hypothesis that neurotypical students will perform better than autistic students on the event-based PM task, a one-way ANOVA was performed using the continuous variable of “task score.” The assumption of homogeneity of variance was met by Levene’s test (p = .26). There was a statistically significant difference in job performance between neurotypical and autistic students, F(1,29) = 19.95, p < .001. Neurotypical students (M = 34.39, SD = 4.57) performed better at finishing job assignments in a timely manner than autistic students (M = 27.62, SD = 3.52). Therefore, the hypothesis was supported.

To evaluate the difference in performance progression between neurotypical and autistic students over time, a repeated-measures ANOVA was performed with five days of task score as a within-subject and student group as a between-subject variable. Box’s M was not significant (p = .34), suggesting that the assumption of the equality of covariance was met. There was a statistically significant effect of time on game performance, Wilk's λ = .32, F (4,26) = 13.57, p < .001, η_p^2 = .68. There is no significant interaction effect between student group and time, Wilk's λ = .82, F (4,26) = 1.45, p = .25. Assumption of sphericity was met as indicated by non-significant Mauchly's test (p = .09). There was statistically significant difference found between groups, F(1,29) = 19.95, p < .001.

Trend analysis confirmed a significant linear fit, F(1, 29) = 51.11, p < .001, η_p^2 = .63. Quadratic and cubic models were not significant, suggesting that student performance over the five days improved linearly. Additionally, reverse Helmert contrast was performed to assess if the fifth day exceeded that of the previous four-day average. Results support the finding that participants' performance on job assignments was significantly better on the fifth day than the average of the previous four days F(1,29) = 16.91, p < .001, η_p^2 = .37. Autistic students consistently underperformed compared to their neurotypical counterparts.

Figure 11.
Performance on Event-based PM task.



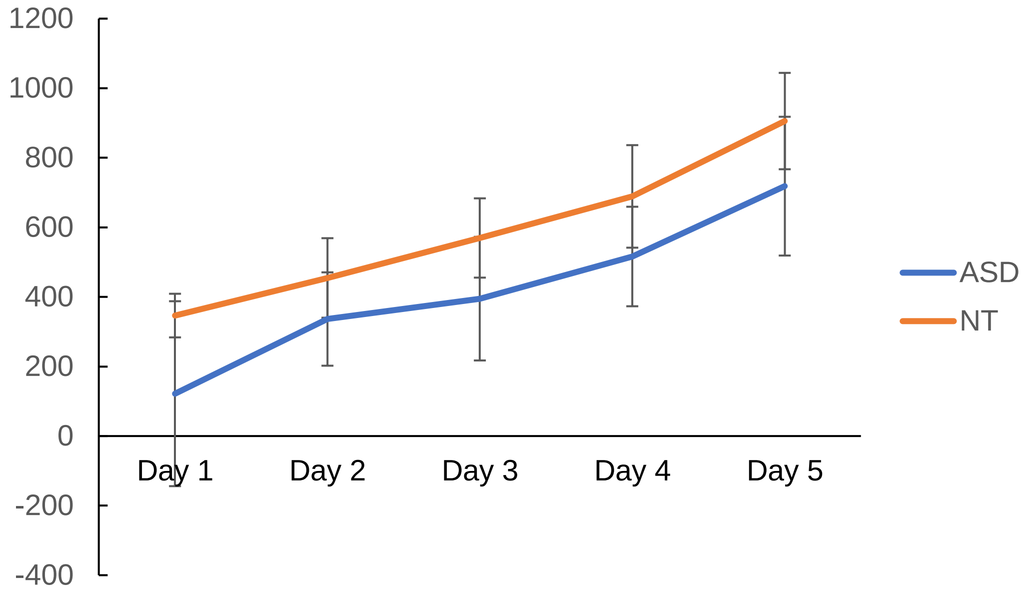
To test the hypothesis that neurotypical students will have better money management skills than autistic students in the D^3 game, a one-way ANOVA was performed using the continuous variable “bank balance.” There was a statistically significant difference on daily bank balance between neurotypical students and autistic students, $F(1,29) = 14.58$, $p < .001$, $\eta_p^2 = .34$. Neurotypical students ($M = 592.95$, $SE = 29.74$) earned and saved more game money than autistic students ($M = 417.56$, $SE = 34.99$).

To evaluate the difference in the progression of game performance between neurotypical and autistic students over time, a repeated-measures ANOVA was performed with five days of ‘bank balance’ as a within-subject and student group as a between-subject variable. Box’s M was significant ($p < .001$), suggesting that the assumption of the equality of covariance was violated. The assumption of sphericity was violated as indicated by significant Mauchly's test (*p* < *.001*). Therefore, Greenhouse-Geisser correction was used for analysis. There was a significant effect of time on money saved, $F(1.99, 57.85) = 156.31$, $p < .001$, $\eta_p^2 = .84$. There was a significant effect of group, $F(1,29) = 14.58$, $p < .001$, $\eta_p^2 = .34$. There was no interaction effect between student group and time, $F(1.99, 57.85) = 1.21$, $p = .33$.

Pairwise comparison indicates that there was a significant increase in the amount of money saved from day 1 to day 2 ($p < .001$), from day 2 to day 3 ($p = .002$), from day 3 to day 4 ($p < .001$), and from day 4 to day 5 ($p < .001$). See table 9 for descriptive statistics. Both neurotypical and autistic students earned and saved money over five days. However, neurotypical students were able to earn and save significantly more than autistic students. One reason for such a disparity in earnings is that the neurotypical students completed more job assignments and earned more. Additionally, autistic students failed to pay all the bills on time and thus incurred more penalties. Trend analysis confirmed a significant linear fit, $F(1, 29) = 259.25$, $p < .001$, $\eta_p^2 = .89$, significant quadratic fit, $F(1, 29) = 6.67$, $p = .015$, $\eta_p^2 = .19$, and a significant cubic fit, $F(1, 29) = 13.12$, $p = .001$, $\eta_p^2 = .31$. However, since the effect size is largest for the linear trend, it is the best fit model suggesting that students save game play money over time. Additionally, reverse helmert contrast was performed to assess if the bank balance on the fifth day was significantly greater than the previous four-day average. Results support the finding that participants' bank balance was significantly higher on the fifth day than the average of the previous four days $F(1,29) = 383.13$, $p < .001$, $\eta_p^2 = .93$.

Figure 12.

Financial management performance.

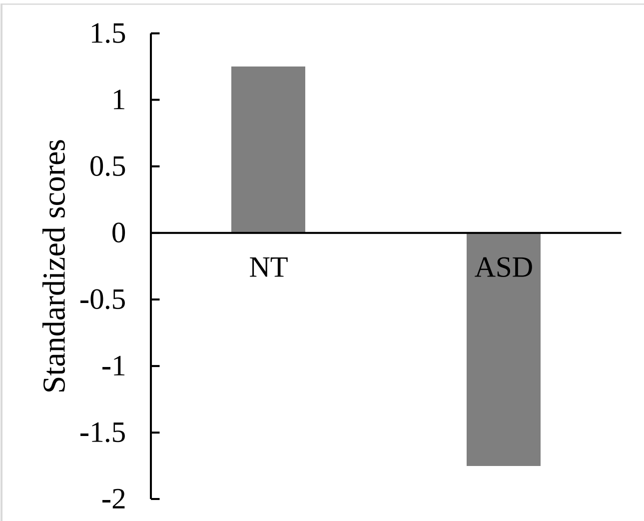


Notes. Few students with ASD had negative bank balance on the first day.

Game variables of bills, job assignments, and bank balance were all *z*-transformed and summed together to create a new “Game Performance” variable. One-way ANOVA indicates a significant difference in overall game performance between autistic students and neurotypical students $F(1,29) = 25.95$, $p < .001$. Neurotypical students ($M = 1.25$, $SE = .36$) performed significantly better than autistic students ($M = -1.75$, $SE = .48$), see figure 9. Autistic students performed close to 2 standard deviations below average.

Figure 13.

Overall game performance

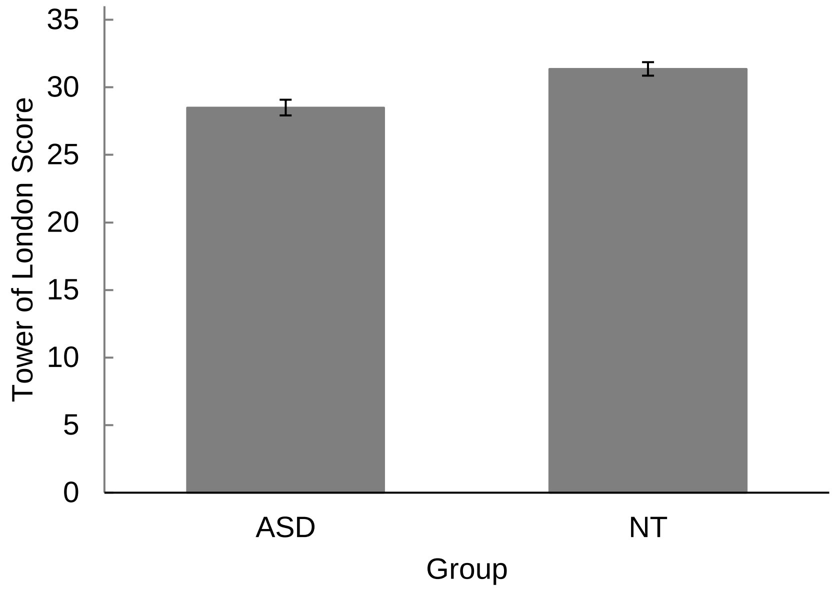


Notes. Neurotypical students performed better on D[3] game than autistic students.

A 2 (group: NT, ASD) X 2 (time: pre, post) ANOVA was conducted to compare executive functioning of students before and after the intervention. There was a significant main effect of group, $F(1,29) = 13.96$, $p = .001$, $\eta_p^2 = .33$. Neurotypical students ($M = 31.36$, $SE = .50$) performed better than students with ASD ($M = 28.50$, $SE = .58$). There was no main effect of time or interaction between group and time.

Figure 14.

Tower of London performance



Note. Error bar represents +/- 1 SE

A paired-samples t-test was conducted to compare prospective memory functioning by neurotypical students before and after the intervention. Performance on the V.W. game was measured by the total percentage of correct responses on time-based and event-based tasks. Participants played version A for two virtual days before the intervention and two virtual days of version B after the intervention. There was not a significant difference in the VW score before (M = 84.26 , SD = 15.63) and after (M = 90.74, SD = 2.42) the intervention, $t(17) = -1.68$, $p = .11$).

No significant difference in the post-assessment evaluation of financial literacy between student groups, $F(1,29) = 1.43$, $p = .24$. Both autistic (M = 8.31, SD = .95) and neurotypical students (M = 8.72, SD = .96) scored above 80% on the test questions.

No significant difference was found in the post-assessment evaluation of the one-shot hypothetical debt repayment game. Neither neurotypical nor autistic groups answered the one-shot question correctly.

DISCUSSION

Study 2 suggests that autistic students successfully learned to perform the time-based PM task as indicated by significant improvement in their ability to pay the hypothetical bills within a payable window. It took 16 trials (4 days) for autistic and neurotypical students to learn how to perform the time-based PM task, as indicated by all four bills paid within the first 20 seconds of the payable window on the fifth day. These results contrast with previous research, which indicated that autistic individuals performed poorly on time-based prospective memory tasks (Williams et al., 2012). Study 2 also suggests no significant improvement in the event-based PM task as indicated by poor performance on job assignment completion. Both neurotypical and autistic students struggled with planning and time management. Although we saw an improvement in the time-based PM task, the results should be interpreted cautiously because performance on a similar PM game (VirtualWeek) did not significantly improve. This could mean that students just learned to play the game, not necessarily improved their PM ability.

In the D3 game, the time-based PM was measured by timely payment of bills per game session. Failure to pay the bill within the payable window was considered a failure in time-based PM. The number of completed job assignments measured event-based PM performance. Failure to deliver a package indicated that the students did not find a specific store to pick up the package (insufficient attention) or forgot to pick up the package (poor event-based PM). Additionally, students may have made a strategic decision to ignore the ongoing task of making deliveries because the penalty was higher for late bill payment, so it would be financially prudent to be late on delivery but not late on bill payment.

Additionally, both neurotypical and autistic students learned to budget (cash and savings) correctly, as indicated by earning enough money to pay the bills, using earned money to buy food, and incrementally increasing bank balance over the five days. Furthermore, in the post-intervention assessment, both neurotypical and autistic students scored above 80% on cash and saving management questions. However, both groups struggled with debt management, as indicated by poor performance on the hypothetical debt repayment game.

There was no improvement in the executive functioning due to the intervention as indicated by unchanged performance on Tower of London before and after the intervention. Study 2 confirmed the findings of study 1 that autistic individuals performed significantly worse on executive tasks than neurotypical individuals.

Chapter 4
GENERAL DISCUSSION

Nearly 1% of the population has a diagnosis of ASD, with approximately 31% of children in the United States suffering from various intellectual disabilities related to ASD (Maenner et al., 2020). According to statistics released by the CDC in 2020, nearly 1 in 54 children born in the U.S. are diagnosed with ASD. Over the next decade, an estimated 700,000 to 1.2 million teens with ASD will enter adulthood and age out of school-based services. The cost of caring for Americans with ASD reached $268 billion in 2015 and is expected to rise to $461 billion by 2025 in the absence of more effective interventions and support across the life span. Currently, there is no clinical treatment for ASD, and the etiology of ASD is still under investigation.

A multidisciplinary approach was taken to develop an intervention suited to increase financial proficiency in adolescents with ASD. Theoretical concepts from psychology, education, and the fine arts were used to create an educational experience. The purpose of the theoretical application was to create an educational experience that is visually engaging and financially educative for students with an autism spectrum disorder. One theoretical model from each field was selected to guide the development of dash-dash-delivery (D3) simulation to optimize the user experience. Specifically, adaptive resonance theory (ART) provided the neurocognitive framework, experiential learning theory (ELT) provided the learning framework, and experiential gaming model (EGM) provided the game development framework for the creation of D3.

Psychological framework: Adaptive Resonance Theory (ART)

ART is a neural theory of cognitive information processing, which states that learning is a resonant phenomenon in neural circuits. ART proposes that a vigilance parameter, the specificity level controller, is fixed at a high level in Autistic individuals resulting in concrete and hyperspecific learning. In comparison, low vigilance leads to broad and abstract learning. However, ART does not make any predictions about vigilance parameter setting for individuals with higher autistic traits who do not meet the clinical diagnostic criteria of autism spectrum disorder. After all, autism is on a continuum, and individuals with average intelligence also share some autistic-like traits. For instance, assessment of non-autistic relatives of autistic individuals has shown that a phenotype with similarities to that of autism cases exists in these relatives, mainly social, communication and language difficulties (Piven et al., 1997; Austin, 2005). The “autistic tendencies” are measured by Autism Spectrum Quotient (AQ). AQ measures the broader autism phenotype of communication ability, social skills, imagination, attention to detail, and attention switching.

According to ART, due to disruptions in the *frontoparietal network*, some individuals with ASD learn specific and concrete details but fail to learn broad and abstract categories. Therefore, if non-autistic individuals with autistic traits also learn concrete details and have difficulties with abstract conceptualization, that would suggest that the vigilance parameter for this population is also set at a higher level. However, there is a great deal of phenotypic heterogeneity within the ASD population. For example, some high-functioning ASD individuals excel in abstraction. This is consistent with AQ research findings that suggest individuals with math and physics preferences score higher on AQ measurement (Baron-Cohen et al., 2001).

Indeed, partial correlation from study 1 suggests that after controlling for age, household income, and level of education, people with impaired communication ability prefer to learn by abstract conceptualization and tend to avoid learning by concrete experiences. These results suggest that the vigilance parameter for individuals with autistic traits may be more flexible. However, a significant limitation of study one was that it only assessed the learning preference, not the learning ability of these individuals. Future studies would need to measure the actual learning ability of individuals with autistic traits to make any definitive conclusion.

Nonetheless, based on ART's proposal that autistic individuals have difficulties with abstraction, the D3 game was designed to maximize concrete experiences with gameplay money. Students learned to perform financial transactions by purchasing items within the game without understanding more abstract financial concepts like debt and investment management. Providing concrete experiences in financial transactions did help the students manage money, as indicated by their in-game merchandise purchase behavior. Students learned that spending money allows them to purchase game objects like shirts, shoes, and logos for character customization. Students also learned that there would be less money left for paying bills if they spent all the money on character customization (i.e., opportunity cost). Furthermore, students learned that they could save money in the bank account to be used later for paying bills and purchasing food for the character (i.e., needs versus wants). Therefore, it is possible that providing experiences in financial transactions can lead to learning abstract concepts like saving and budgeting.

In conclusion, study one indicates that individuals with autistic traits prefer learning by abstraction. Study two shows that in certain domains like money management, concrete experiences with financial transactions can help abstract higher-order concepts like budgeting and saving. Hence there may be a greater heterogeneity in the vigilance parameter in individuals with ASD than predicted by ART.

Educational framework: Experiential Learning Theory (ELT)

ELT proposes a model of learning that explains the transformation of a concrete sensory experience from the environment to an abstract conceptualization of the experience. Additionally, ELT suggests that some people prefer to learn by observation while others prefer active experimentation. Furthermore, the four phases hypothesized by the ELT have distinct neural regions that are crucial for successful learning to occur. For instance, frontal cortical functioning is necessary for abstraction, whereas parietal association functioning is necessary for experiential learning (Zull, 2008). These findings further support that individuals with autism may have difficulty forming abstractions from concrete experiences because of disruptions in the *frontoparietal network*.

The first study indicated that individuals with autistic traits of poor communication prefer learning by abstraction rather than concrete experiences. Results also indicated that, in general, students preferred learning by active experimentation. It is still unclear which learning style is preferred or optimal for individuals with ASD. However, research does support that they tend to be concrete processors. Individuals with active experimentation and concrete experience as a dominant learning style are considered *accommodative learners* by ELT. These individuals learn by doing things, carrying out plans and tasks, and getting involved in new experiences. Based on these findings, D3 was designed to optimize learning financial concepts in students by allowing them to experiment with financial transactions in a simulation.

Active experimentation in D3 with financial choices allows students to become aware of the consequences of their actions. For instance, spending money playing an arcade game instead of on food will result in energy depletion and reduced speed of the game character. The awareness of the consequences could lead to learning the concept of budgeting and saving. Thus, the learning cycle that begins with active experimentation can circle back to abstract conceptualization, modifying yet another active experiment.

Fine Arts framework: Experiential gaming model (EGM)

The playing style questionnaire from study one indicated that individuals with autistic traits tend to prefer role-playing (dreamer style) and pattern-based games (logician style). Thus the D3 game designed for study two was guided by these gaming style preferences. Students role-played as delivery personnel in the virtual mall. The hypothetical bills and the deliveries were consistent over the entire intervention, meaning that the gameplay pattern did not change over time. Every day the students had to complete five job assignments with three levels of difficulty, pay four hypothetical bills, and complete a three-question financial literacy training in the same testing center. The virtual mall had shops, an art gallery, a food court, and a "nature corner," which supported the exploratory nature of people who prefer dreamer playing style and kept the students engaged with the game.

The experiential gaming model (EGM) recommends considering personality traits in game development to optimize the user experience. The model includes big five personality traits but does not consider autistic traits. Research indicates that individuals with autistic traits tend to be high on measurements of neuroticism, low on extraversion, and agreeableness (Austin, 2005).

Three autistic traits were considered in the development of D3. Specifically, individuals with ASD have poor communication skills, including impairments in both expressive and receptive language. To compensate for this impairment, minimal written instructions were used. All job assignments were color-coded for ease of comprehension, and auditory notifications were presented every time students engaged in any financial transaction. To train attention switching, the three financial literacy questions in the game were randomized to present questions that required the player to switch thinking between budgeting, saving, and general financial knowledge. To take advantage of the heightened attention to detail trait, the game included hidden items that could be discovered by the player to keep them engaged (e.g., easter eggs & basketball).

Additionally, EGM does not consider playing styling preference in game development. As explained elsewhere, autistic individuals prefer role-playing and pattern-based games. Future studies should focus on measuring the effects of including playing style profiles on player engagement.

Adolescents with ASD struggle with financially abstract concepts such as budgeting, saving, debt, and investment, but they learn concrete financial transactions such as earning and spending. Impairments in the frontoparietal network may persist throughout the lifetime, and an individual may never learn certain financial concepts. I have argued that providing an opportunity to experience financial transactions can eventually teach some more straightforward financial concepts like budgeting and saving, especially if sound financial decisions are positively reinforced. Simulations make it easier to prime good financial behaviors in a virtual environment before testing real-world scenarios. Therefore, D3 serves as a starting point to begin exploring the effectiveness of concrete financial decisions in individuals with ASD.

Limitations

One of the limitations of this study is that I only measured the debt management aspect of financial literacy before and after the intervention. Two other aspects of financial literacy, mainly budgeting and saving ability, were assessed only in the post-intervention evaluation. Lack of pre-intervention performance on budgeting and saving skills makes it difficult to attribute the financial literacy performance to the D3 game. However, improvement in the budgeting and saving skills can be inferred by the financial decisions students made within the game over five days.

Second, in order to detect a medium-sized effect with the power of .80 and alpha of .05, I would need thirty-four autistic participants. Unfortunately, due to COVID-19, fewer students were attending in-person classes, and due to game delivery restrictions, the experiment could only occur in the classroom. A total of thirteen individuals with ASD were finally selected for the experiment, which made this study underpowered.

Third, due to such a small number of participants with ASD, I did not have a control condition for this experiment. Additionally, due to lack of time, a within-subject counterbalanced design was not feasible. It would have been ideal to have another group of students with ASD in the same school within the same classroom who played another game or continued conventional classroom instructions on financial literacy.

Future direction

D3 is designed with a specific user in mind, mainly adolescents with ASD. However, this game can be modified for students with reading disabilities as the graphical interface and auditory cues are sufficient to play. This game can also be modified to test students on different subject matters than just financial knowledge as the UI in the "testing center" allows for any questions to be asked. D3 can also be used in older adults with spatial memory impairments because the game simulates a mall environment with many stores. Participants have to remember where each store is in order to complete "job assignments."

There are several ways to improve D3; adding a debt management system such as using a "credit card" can be an added feature. Credit card misuse is problematic not only for individuals with ASD but also for the general population. Furthermore, business management strategies can be implemented in the game. For example, a participant can be assigned a "managerial" or an "owner" position within the mall, thereby teaching financial and inventory management. D3 can also be modified to teach “bargain shopping.” For example, the same character customization can be purchased for two different prices at two different stores in the mall.

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Appendix A

Autism-Spectrum Quoitent (ASQ) scale

Please select (1) Definitely agree, (2) Slightly agree, (3) Slightly disagree, (4) Definitely disagree.

I prefer to do things with others rather than on my own.

I prefer to do things the same way over and over again.

If I try to imagine something, I find it very easy to create a picture in my mind.

I frequently get so strongly absorbed in one thing that I lose sight of other things.

I often notice small sounds when others do not.

I usually notice car number plates or similar strings of information.

Other people frequently tell me that what I've said is impolite, even though I think it is polite.

When I'm reading a story, I can easily imagine what the characters might look like.

I am fascinated by historical dates.

In a social group, I can easily keep track of several different people's conversations.

I find social situations easy.

I tend to notice details that others do not.

I would rather go to a library than a party.

I find making up stories easy.

I find myself drawn more strongly to people than to things.

I tend to have very strong interests, which I get upset about if I can't pursue.

I enjoy social chit-chat.

When I talk, it isn't always easy for others to get a word in edgeways.

I am fascinated by numbers.

When I'm reading a story, I find it difficult to work out the characters' intentions.

I don't particularly enjoy reading fiction.

I find it hard to make new friends.

I notice patterns in things all the time.

I would rather go to the theater than a museum.

It does not upset me if my daily routine is disturbed.

I frequently find that I don’t know how to keep a conversation going.

I find it easy to “read between the lines” when someone is talking to me.

I usually concentrate more on the whole picture, rather than the small details.

I am not very good at remembering phone numbers.

I don’t usually notice small changes in a situation or a person’s appearance.

I know how to tell if someone listening to me is getting bored.

I find it easy to do more than one thing at once.

When I talk on the phone, I’m not sure when it’s my turn to speak.

I enjoy doing things spontaneously.

I am often the last to understand the point of a joke.

I find it easy to work out what someone is thinking or feeling just by looking at their face.

If there is an interruption, I can switch back to what I was doing very quickly.

I am good at social chit-chat.

People often tell me that I keep going on and on about the same thing.

When I was young, I used to enjoy games involving pretend play with other children.

I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).

I find it difficult to imagine what it would be like to be someone else.

I like to plan any activities I participate in carefully.

I enjoy social occasions.

I find it difficult to work out people’s intentions.

New situations make me anxious.

I enjoy meeting new people.

I am a good diplomat.

I am not very good at remembering people's date of birth.

I find it very easy to play games with children that involve pretending.

Appendix B

Executive Skills Questionnaire-Revised

Read each item and decide how often it's a problem for you. (0) Never or rarely, (1) Sometimes, (2) Often, (4) Very often.

I act on impulse.

I say things without thinking.

I lose things.

I have a short fuse.

I get upset when things don't go as planned.

I run out of steam before finishing a task.

It's hard for me to set priorities when I have a lot of things to do.

My desk or workspace is a mess.

I have trouble keeping my house or room clean.

I have trouble estimating how long it will take to complete a task.

I'm slow at getting ready for school, work, or appointments.

If the first solution to a problem doesn't work, I have trouble thinking of a different one.

I skip checking my work for mistakes, even when the stakes are high.

I get annoyed when tasks are too hard.

It's hard for me to put aside fun activities to start things I know I need to do.

I have trouble with tasks where I have to come up with my own ideas.

It's hard for me to tell how well I'm doing on a task.

I have trouble reaching long-term goals.

I "go with my gut" when making decisions.

I get so wrapped up in what I'm doing that I forget about other things I need to do.

Little things frustrate me.

I have trouble getting back on track if I'm interrupted.

I have trouble making a plan.

I miss the big picture.

I live for the moment.

Appendix C

Brief Money Management Survey (BMMS)

Please indicate how often you have engaged in the following activities in the past six months. (0) Never, (1) Sometimes, (2) Often, (3) Always, (4)

Set money aside for emergencies.

Saved for a long-term goal such as a car, education, home and so forth.

Regularly set aside money for saving.

egularly set money aside for possible unexpected expenses.

Maintained or purchased adequate property insurance like auto or homeowners insurance.

Maintained or purchased an adequate health insurance policy.

Maintained or purchased adequate life insurance.

Contribute to a retirement savings plan (e.g., 401k).

Review the adequacy of the insurance coverage that I have.

Did not pay the total balance on my credit card but instead just made a partial payment.

Made only minimum payments on a loan.

Maxed out the limit on one or more credit card(s).

Get myself into more and more debt each year.

Spent more money than I have.

Follow a weekly or monthly budget.

Review and evaluate spending on a regular basis.

Kept a written or electronic record of your monthly expenses.

Estimate household income and expenses.

Appendix D

Executive Function Index (EFI)

How characteristics of you are the statements below. (0) not at all, (1) only a little, (2) to some extent, (3) rather much, (4) very much.

Concern for others.

Help others in need.

Takes others' feelings into account.

Protective towards a friend.

Dislikes actions or words hurting others.

Socially aggressive stance.

Organized person.

Save money regularly.

Self-monitor for mistakes.

Plan for the future.

Use of memory strategies.

Anticipate consequences of actions.

Learn from mistakes.

Trouble summing information for decisions.

Distractibility.

Lost track of what I'm doing.

Mix up the sequences of actions.

Trouble doing two things at once.

Socially embarrassing behavior.

Inappropriate sexual behavior.

Use obscenities.

Maladaptive risk taking.

Lose my temper when upset.

Interested in new things.

Energetic person.

Have enthusiasm.

Inactivity.

Appendix E

Financial Management Behavior Scale (FMBS)

Please indicate how often you have engaged in the following activities in the past six (6) months.

Comparison shopped when purchasing a product or service.

Paid all your bills on time.

Kept a written or electronic record of your monthly expenses.

Stayed within your budget or spending plan.

Paid off credit card balance in full each month.

Maxed out the limit on one or more credit cards.

Made only minimum payments on a loan.

Began or maintained an emergency savings fund.

Saved money from every paycheck.

Saved for a long term goal such as a car, education, home, etc.

Contributed money to a retirement account.

Bought bonds, stocks, or mutual funds.

Maintained or purchased an adequate health insurance policy.

Maintained or purchased adequate property insurance like auto or homeowners insurance.

Maintained or purchased adequate life insurance.

Appendix F
ADOPTA-PSQ scale

Please respond to each question. Yes/No

When playing I often take great risks that seem to me reasonable.

I prefer to observe the gameplay instead of controlling it.

I like logic, analysis, and pattern-based approaches for executing any task in the game.

I like resolving complex problems within a game in the most effective way.

I rely mostly on my intuition rather than theoretical analysis.

I like guided gameplay and staying at a given game level until I have mastered it sufficiently.

I have good spatial awareness and contextual thinking.

I do not like acting/shooting without reasonable expectations of good results and benefits in the game.

I find spontaneous actions and strong competition to be the greatest opportunities for discovering new things and ideas in games.

I need to gather different perspectives about a game's missions and to consider them carefully before starting actively playing.

I learn the intricacies of each game rule.

I try to find practical ways to fulfill the game tasks on time.

I prefer to solve problems using trial and error methods rather than first undertaking a deeper analysis.

I do not like fixed time missions and need to think as long as I require.

I try to apply each game rule in a rational and optimum way.

While playing a game, I seek opportunities to apply them for reaching practical outcomes.

I am good in critical situations in gameplay, which requires the preservation of composure and self-control.

When playing, I am quite open about my feelings.

I like exploring the game space and facts in a stepwise, detailed, and precise way.

I think long-term when planning my gaming strategies.

I prefer to manage the gaming process rather than observe it.

I prefer to start active playing as soon as possible, without reading instructions or too much planning.

I prefer to observe and to listen to the arguments of the others before taking decisions in a game.

I like to assemble the gameplay facts into a coherent rational scheme and to use it to come up with game tactics and strategies.

I like decision-making, testing hypotheses and seeing the practical consequences of my experiments and the actions I have taken.

In teamwork gameplay, the others usually regard me as the most active player.

In games, I am fond of social interaction, diplomacy, and negotiation.

In debates with other players, I do not implicitly trust the others' arguments and assumptions but want to check and logically test everything.

I like anything, which works.

I like to share my achievements with the others.

I do not like to play an active part in a discussion.

In discussions with other players, I try to establish and impose rational, time-based approaches.

I try never to abandon my realism.

I do not like debating the appropriateness and consequences of players' actions excessively.

I like considering the actions of the other players while thinking about all possible consequences.

In debates, I like to combine existing opinions and ideas in a logical and uncontroversial way.

I have good management skills and like to coordinate the teamwork while playing a game.

In discussions, I prefer to talk and convince others of my intuition.

I prefer playing through clear game scenarios instead of having an emergent gameplay.

I like to be recognized by the other players as being rational, methodical and objective.

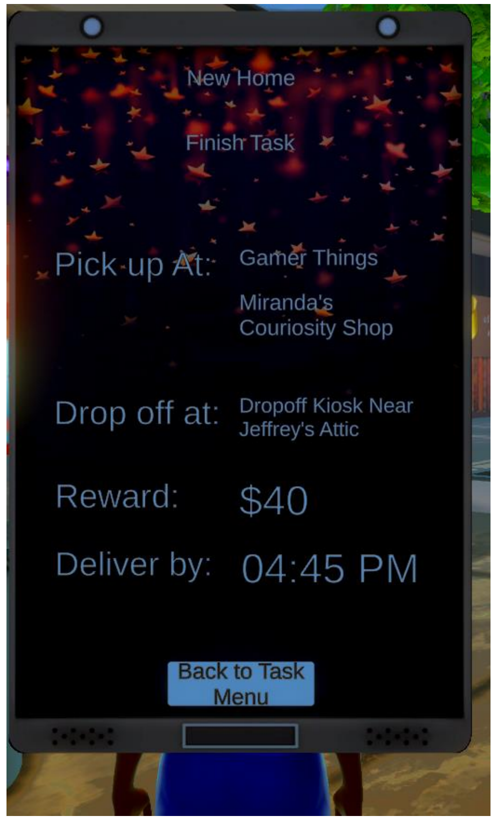
I am probably sometimes impatient about seeing/receiving immediate practical benefit from the results of my actions.

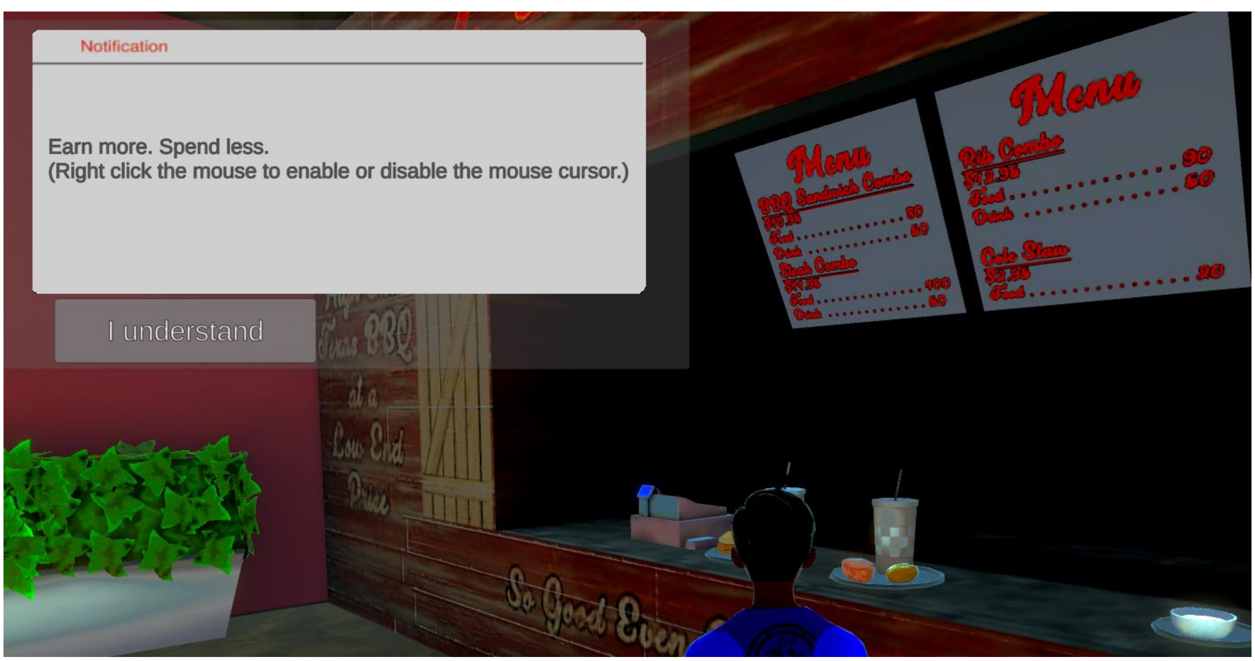
In critical situations in the game, I often lose my composure and self-control.

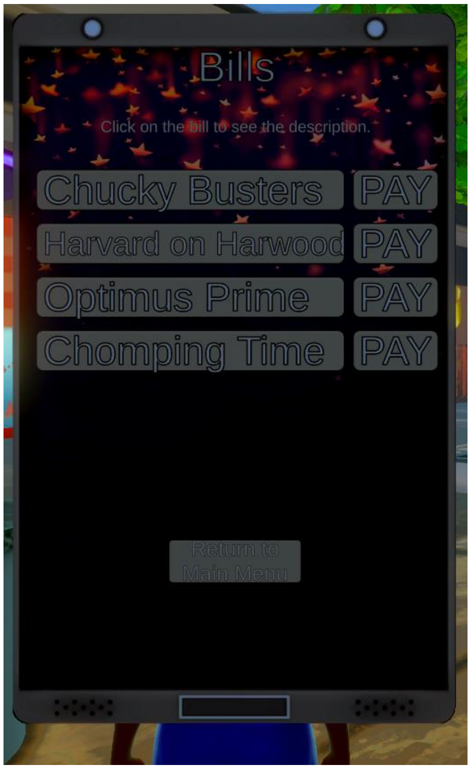
Appendix G

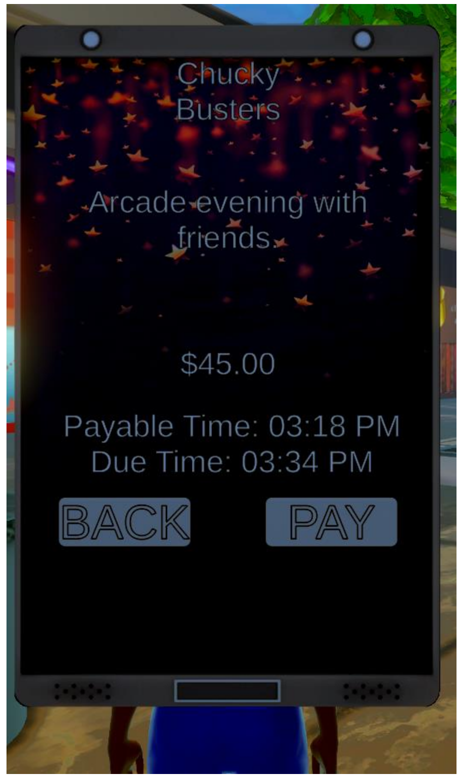
Dash-Dash-Delivery Screenshots


Tasks
Saved By The Ball
A Likely Story
Sole Ventures
Gamer Things
Triple Threat
Back to Main Menu


New Home
Finish Task
Pick up At:
Gamer Things
Miranda's Couriosity Shop
Drop off at:
Dropoff Kiosk Near Jeffrey's Attic
Reward:
$40
Deliver by:
04:45 PM
Back to Task Menu


Notification
Earn more. Spend less.
(Right click the mouse to enable or disable the mouse cursor.)
I understand
Menu
BBQ Sandwich Combo
Menu
Rib Combo
Cole Slaw


Bills
Click on the bill to see the description.
Chucky Busters
PAY
Harvard on Harwood
PAY
Optimus Prime
PAY
Chomping Time
PAY
Return to Main Menu

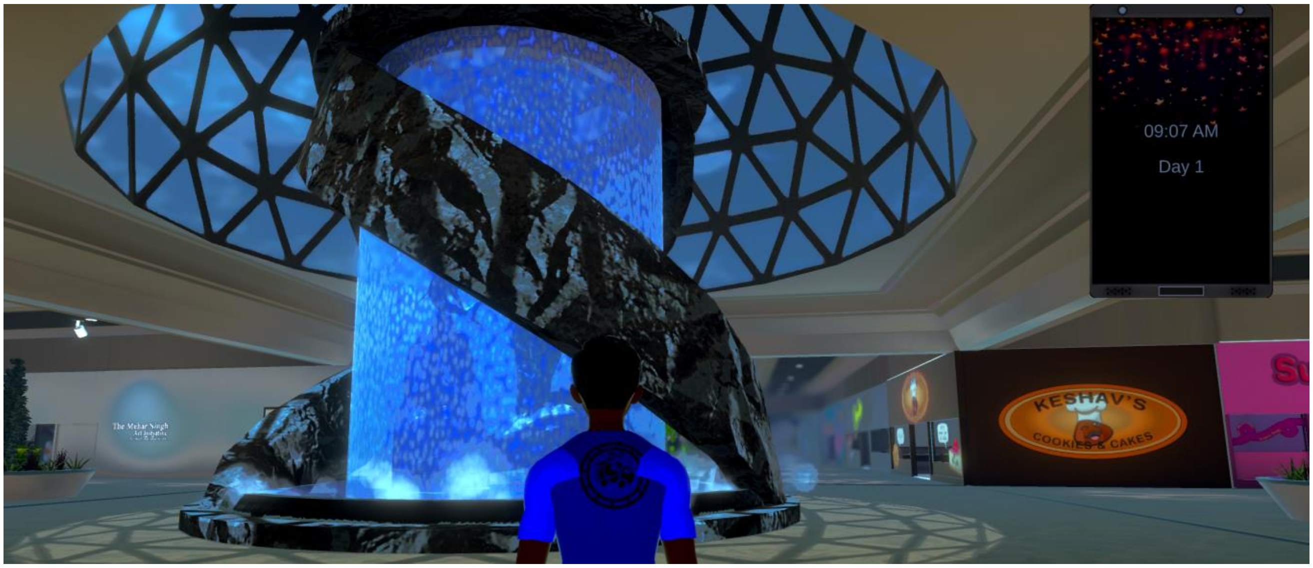

Chucky Busters
Arcade evening with friends.
$45.00
Payable Time: 03:18 PM
Due Time: 03:34 PM
BACK
PAY


Drop Off Packages Here!
Health Screen (change)
Food
Energy
Liquid
Close


Please Left Click to expand the map and then press any button to exit to player view!
10:31 AM
Day 1


Notification
You are tired and can no longer run. Eat or Drink to replenish you Energy
10:46 AM
Day 1
HOT.
STEAMY.
HIP-
PEAS


Notification
Would you like to purchase Rib Combo for $12.95 plus tax?
Yes
No
So Good Even City Slickers Love It!!


09:07 AM
Day 1
KESHAV'S
COOKIES & CAKES