An Exploratory Analysis of Increasing Self-Efficacy of Adults with Autism Spectrum Disorder Through the Use of Multimedia Training Stimuli

Gregory E. Kuper, MSC, Kate Ksobiech, PhD, Jonathan Wickert, PhD, Frederick Leighton, MFA, and Edward Frederick, PhD

Abstract

While some evidence-based vocational studies exist for adults with Autism Spectrum Disorder (ASD), most focus on social interaction. This mixed methods exploratory study investigated a multimedia approach to training ASD adults as a strategy for increasing self-efficacy and producing positive training outcomes during the anticipatory socialization and encounter phases of organizational assimilation. Ten ASD adults, seven men and three women, 19 to 42 years of age, participated in the study, which utilized video and virtual reality to instruct participants on how to wire an electrical socket. Significant increases in the participant’s self-efficacy were found using a modified version of the New General Self-Efficacy (NGSE) scale. In addition, a thematic analysis of post-training comments showed that participants, overall, were engaged and had fun during the training. These findings suggest that a multimedia approach may be an effective strategy for achieving positive outcomes by increasing self-efficacy and engagement when training newly hired employees diagnosed with ASD to perform vocational tasks.

Keywords: virtual reality, vocational training, onboarding, autism, ASD, multimedia training stimuli

Introduction

ASD is a permanent developmental disorder that can create lifelong challenges for those diagnosed. Adult employees diagnosed with Autism Spectrum Disorder (ASD) often have difficulty correcting moment-to-moment emotional experiences and expressions in comparison to their typically developed coworkers in the workplace. Other challenges often include: (a) great attention to detail, but not being able to grasp a bigger picture; (b) an inability to focus; (c) impulsivity; (d) difficulty processing verbal, written, auditory, or experience information; (e) reduced safety awareness; (f) easily distracted by noise, smell, and proximity sensory issues; and (g) difficulty understanding the concept of time and literal understanding. As a result, newly hired employees who are on the spectrum often experience a “clinical level of anxiety,” increasing their uncertainty and decreasing their self-efficacy/confidence during the anticipatory socialization and encounter phases of organizational assimilation.

Modern organizations strive to diversify their workforce and eliminate discrimination throughout the organization, especially during the hiring process. Such organizations (Walgreens, Microsoft, Hewlett Packard, Vodafone, etc.) are making notable efforts to hire more employees with disabilities, including individuals diagnosed with ASD.

Despite these efforts, workforce participation among the ASD community remains a challenge with 90 percent of ASD adults either unemployed or underemployed and 35 percent having never been employed. More than 3.5 million Americans live with ASD, and an estimated 500,000 teens on the spectrum will enter adulthood in the next decade.

Individuals with ASD often experience major barriers when attempting to successfully integrate into an organization’s culture. Among those barriers are impulsivity, an inability to “grasp the big picture,” and difficulty in processing verbal, written, and auditory information. As a result, newly hired ASDs often experience a “clinical level of anxiety,” increasing their uncertainty and
decreasing their self-efficacy/confidence during the anticipatory socialization and encounter phases of organizational assimilation.9,11,12

To date, there has been relatively little research focused on integrating ASD adults into the workplace throughout the onboarding stage of employment. Reducing anxiety and generating positive outcomes through methods that maximize known ASD learning styles might well lead to greater self-efficacy,9 higher job satisfaction, increased commitment to the organization, and a lower turnover rate.10

Using concepts from the theories of organizational assimilation,11,12 social learning,13 and engagement,14–16 this article proposes that the anxiety ASDs experience during the anticipatory socialization and encounter phases of their assimilation can be reduced through utilization of multimedia training stimuli (MTS). New technologies, such as interactive video, augmented reality, virtual reality (VR), and video games, or gamification are being utilized to create edutainment training tools, which engage learners thereby making learning more enjoyable and less threatening.17 While some research has been focused on vocational training for ASDs, most studies have primarily focused on facilitating social interaction.18–21 The use of new technology for task-related training of newly hired ASDs remains virtually uninvestigated, although research found that ASD adults respond well to visual prompts, and one study suggested that ASD adults responded more favorably using an IPod during their training.22,23

The purpose of this exploratory study was twofold: (a) to evaluate if MTS strategies can positively impact the self-efficacy of ASD adults while learning a specific vocational task and (b) to observe and document the reactions, opinions, and emotional responses of ASD adults to MTS. Given previous research on other learning situations, and the theories of social learning, engagement, and organizational assimilation, self-efficacy of ASD adults should increase.9,24,25

Methods

Participants

This study was dependent on securing the cooperation of ASD adults over the age of 18 who were willing to participate in the MTS training and, then, verbally discuss their reactions to this experience. Because of the specific, highly-defined nature of the study’s target population, purposeful sampling and snowballing were used to recruit participants.26,27 Given its exploratory nature, the study was conducted with 10 Caucasian adults recruited through social media, word of mouth, and contact with organizations that specialize in vocational assistance for people with disabilities. There were seven men and three women, ranging from 19 to 42 years of age. Each of the participants had held at least one job before the study, was currently seeking employment, and self-reported their ASD condition; participants were not required to provide proof of their ASD claim. To ensure that the data collected were specific to individuals with ASD, candidates who had a history of any other mental condition, cognitive disability, mental disability, neurological disease, developmental disability, or drug/alcohol abuse were specifically excluded. A $10 gift card was offered as a reward for participation.

Procedure

To accommodate the participants, and to ensure that they were comfortable during the study, the researcher traveled to meet each participant in a place of his or her choice to conduct the study. Locations were mostly the participant’s home, but also included conference rooms within the vocational assistance organizations with which they were affiliated or private library rooms at the university they attended.

The researcher welcomed each participant, informed them of the general nature of the study, and then asked them to read and sign the consent form generated as part of the IRB approval process at the principal author’s university. Immediately thereafter, and before exposure to any visual stimuli, participants completed a modified version of the New General Self-Efficacy (NGSE) scale.28

Participants were then asked to watch a short video, which provided the information necessary to perform the electrical wiring task. After the video, participants took part in the VR portion of the MTS training. They were provided with instructions in text form (see “Appendix 1”) and provided instruction from the researcher as well. This interactive training asked the participant to click onto any of three wires and then click onto the correct screw for attaching that wire. When all three wires were connected, the participant would click “Done.” If all wires were correctly connected, a green “Correct” sign would light up. If the participant had not connected each wire correctly, a red “Try Again” sign was displayed, requiring the participant to continue until the task was correctly completed. There were no limitations on time or the number of tries needed to perform the task. When the training was completed, the participant was asked to complete the modified NGSE scale again, then interviewed, and finally thanked by the researcher.

Informational video

An informational video was created using part of an already existing YouTube video on how to install an electrical outlet. The video was edited by the researcher to conform to the needs of the study (see “Appendix 2”). By watching the video, participants were able to view the process of wiring an electrical outlet and learn which wire is connected to which screw. See Figure 1.

FIG. 1. Informational YouTube Video. Participants viewed this video to learn the process of wiring an electrical outlet correctly. It provides viewers with the information of which colored wire connects to which colored screw.
A VR application was created using Unity 2.0. The application was uploaded onto an Apple iPhone 5c. The application was accessed through a Qualcomm Snapdragon 820 processor and by placing the phone into a cardboard VR viewer. See Figure 2.

To use the VR simulation, participants placed the viewer up to their eyes, much like a pair of binoculars, and then looked through the viewer. While looking through the viewer, the participant saw the VR simulated electrical socket. The view of the VR world changed as the participant moved or changed the position of their head while looking through the viewer. There was a white locator dot, much like a mouse arrow on a computer screen. That locator dot was the participant’s point of origin and moved as the viewer changed position, allowing the participant to place the locator dot in any desired location within the virtual world as they moved their head or body. By participating in the VR simulation, participants were able to experience an MTS learning experience. Combined with the video, this approach was to be more engaging than simply viewing the video, as it required participants to learn in an interactive way. See Figure 3.

**Measurement**

A modified version of NGSE scale was constructed for this study (see “Appendix 3”). NGSE scale was used as a model because it was specifically designed to measure self-efficacy (see “Appendix 4”). Because NGSE scale was created to measure an individual’s general self-efficacy, it was modified for this study to measure the individual’s self-efficacy when performing the specific vocational task chosen for this study.

The modified scale consisted of eight statements, each followed by a 1–10 interval scale, which was designed to offer more variance than 5 or 7 point scales and better assess a participant’s degree of agreement/disagreement with each statement. NGSE scale scores were generated before, and immediately after, training. Scores ranged from 8 to 80.

To provide richer data, and better address the research questions, a mixed method approach was utilized. The impact of MTS training on the participant’s self-efficacy was determined through a comparison of pre- and post-test modified NGSE scale scores.

To assess the quality of the experience participants had when using MTS aids, thematic analysis (TA) was used to examine participant responses to a series of open-ended questions regarding their training experiences from the past and in this study (see “Appendix 5”). TA was selected because of its simplicity and flexibility, allowing assessment of various theories while identifying patterns within the ASD comments.

**Results**

A paired comparison t test was used to compare the pretest and post-test self-efficacy scores of the study’s 10 participants on the modified NGSE scale. Pretest and post-test scores, as well as means and standard deviations, are reported in Table 1. As predicted, participants who received training through MTS showed a significant increase in their perceived self-efficacy to perform the task of wiring an electrical outlet ($t=5.13$, p-level <0.001). Pretest scores ranged from a low of 8 to a high 67 from a participant who reported considerable familiarity with the task. Post-test scores ranged from 29 to 80, with greater change scores for ASDs unfamiliar with the task. These findings support the assertion that training ASDs using MTS strategies increased their confidence to perform a specific task.

TA was utilized to examine the information gathered through semistructured interviews conducted by the primary researcher immediately following completion of the MTS training. These interviews yielded 59 pages of single-spaced, transcribed comments and 12 pages of notes written while participants were observed during the training.

Two main themes clearly emerged: (a) physical concerns regarding MTS training and (b) emotional responses to MTS training. The first category included comments related to the physical comfort/discomfort of the participants during the training, including what is known as “VR sickness,” while the second focused on feelings such as fear, anxiety, enjoyment, excitement, anger, and frustration generated by the training. See Table 2.

---

**FIG. 2.** Cardboard VR Viewer. Participants used this device to view the VR simulation. The button seen on the top of the device is what is pressed to activate the locator dot. VR, virtual reality.

**FIG. 3.** VR Electrical Outlet Simulation. When participants looked into the VR viewer, they saw this electrical outlet. The screws were represented by a gold square to represent the brass screw, a gray square to represent the silver screw, and a green square to represent the green screw. The different colored wires were on the side. Clicking on the wire and then the screw allowed participants to connect wires to screws in the virtual environment.
Physical concerns

Prior research suggested that between 25 percent and 40 percent of VR users experience some type of physical discomfort (e.g., dizziness, nausea, and disorientation).31,32 Most of the participants in this study reported few, if any, physical reactions to the training; however, 2 of the 10 participants commented that the following physical reactions occurred: (a) intensity of the color images was overwhelming, (b) the 3D modeling disoriented them, and/or (c) the “choppy” movement of the VR stimuli caused nausea. This indicates that ASD VR users experience VR sickness in a manner that is consistent, statistically, to non-ASD VR users.

Emotional responses

Emotional involvement has been associated with motivating attention, which is typically a necessary, but not a sufficient, condition for learning.33 The majority of comments in this category were positive. Eight of the 10 participants reported that the MTS training was an enjoyable “fun” experience, reduced their anxiety and uncertainty, and limited their degree of stress and frustration while learning to perform a new task by permitting ease of repetition without embarrassment, thereby alleviating fear of failure and anxiety. These findings are consistent with previous research as an advantage of VR training.34 Several of the participants also indicated that the MTS training made “memorizing” the material easier, which is also consistent with prior research indicating that content delivered through multiple sensory modalities results in greater memory gain.35 Emotional reactions to MTS were not all positive. Two participants were intimidated by the technology and expressed both fear and anxiety when learning that they would be using VR. Their comments related to operating the technology involved and were reflected in assertions that the equipment was not “user friendly.” After completing the training, they were asked if they had changed their minds, and they responded “no” and stated that they would prefer “some other” training method.

Discussion

The main purpose of this exploratory study was to evaluate if MTS strategies positively impact the self-efficacy of adults with ASD while learning a vocational task and to gather reactions, opinions, and emotional responses of ASDs to an MTS vocational training strategy. Results suggest that participants who received MTS training significantly increased their self-efficacy to perform the task of wiring an electrical outlet.

Research objective achievement

This study provides initial evidence to support using MTS strategies to enhance the self-efficacy of newly hired employees with ASD, thereby enhancing the learning environment and promoting positive training outcomes in the workplace.

Overall, participants reported that they enjoyed the training, specifically the VR, stating that it was fun and engaging. A few participants, however, experienced frustration, fear, and even VR sickness. Data gathered from this study suggest that a combination of VR and behavioral modeling through video demonstration offers a potentially effective strategy for training ASD adults. Participants liked this approach because: (a) it allows for repetition without negative consequences and (b) it presents content in a nondistracting, 

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Gender</th>
<th>Race</th>
<th>Pretest</th>
<th>Post-test</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>42</td>
<td>M</td>
<td>C</td>
<td>45</td>
<td>66</td>
<td>+21</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>M</td>
<td>C</td>
<td>46</td>
<td>52</td>
<td>+6</td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>M</td>
<td>C</td>
<td>8</td>
<td>73</td>
<td>+65</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>F</td>
<td>C</td>
<td>11</td>
<td>29</td>
<td>+18</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>F</td>
<td>C</td>
<td>20</td>
<td>66</td>
<td>+46</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>M</td>
<td>C</td>
<td>8</td>
<td>69</td>
<td>+46</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>M</td>
<td>C</td>
<td>29</td>
<td>63</td>
<td>+61</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
<td>M</td>
<td>C</td>
<td>67</td>
<td>80</td>
<td>+34</td>
</tr>
<tr>
<td>9</td>
<td>29</td>
<td>M</td>
<td>C</td>
<td>24</td>
<td>79</td>
<td>+13</td>
</tr>
<tr>
<td>10</td>
<td>22</td>
<td>M</td>
<td>C</td>
<td>17</td>
<td>41</td>
<td>+55</td>
</tr>
</tbody>
</table>

Means = 27.5
SDs = 19.500

Means = 61.8
SDs = 16.48

SD, standard deviation.

Table 1. Pre/Post-Test Self-Efficacy Scores, Means, and Standard Deviations for 10 Study Participants

Table 2. Codes and Themes for Thematic Analysis

<table>
<thead>
<tr>
<th>Codes</th>
<th>Positive</th>
<th>Negative</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enjoymen t</td>
<td>Fear</td>
<td>Comfort</td>
<td>Discomfort</td>
</tr>
<tr>
<td></td>
<td>Engagement</td>
<td>Anxiety</td>
<td>Using device</td>
<td>Using device</td>
</tr>
<tr>
<td></td>
<td>Joy</td>
<td>Frustration</td>
<td>VR sickness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excitement</td>
<td>Anger</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Themes

Emotional experiences

Physical experiences

VR, virtual reality.
nonthreatening, “fun” environment. These results are consistent with concepts and constructs associated with social learning, engagement, and organizational assimilation theory. For example, engagement theory asserts that engagement occurs when problem solving, reasoning, making decisions, and evaluation take place; the comments collected from the participants of this study suggest that those specific learning behaviors were occurring during and immediately after the MTS training utilized here. Some participants actually stated that MTS training was “fun and engaging.”

In a similar manner, the MTS approach developed herein modeled the behaviors taught to ASD adults in a manner consistent with social learning theory and its emphasis on demonstrating desired outcomes in training environments. Evidence gathered here suggests that mediated messaging could model the desired behavior for ASD participants while reducing fear, anxiety, and uncertainty.

Organizational newcomers transition from learners to established members when they feel confident in their ability to perform their organizational roles. Some members may struggle more than others while learning their roles. New technology may be an effective tool to engage learners with ASD and achieve organizational objectives while reducing high anxiety, a variable that contributes to self-perceived performance deficiencies and, ultimately, poor job performance. Participants reported that they learned from the training, felt engaged, and had fun, suggesting that their MTS experience increased their self-efficacy and learning, reduced anxiety, and helped manage task-related uncertainty.

The dizziness, nausea, and disorientation reported were consistent with VR sickness and, at least in one other study, have been shown to dissipate as individuals use VR to a greater extent. In addition, a number of preemptive solutions have been proposed to alleviate VR sickness, including limiting the time spent using VR simulation, limiting user body movements, and/or inserting a virtual nose, known as Nasum Virtualis, which remains in one position on the VR display throughout the simulation.

This study, for various reasons, had several limitations. First, due to limited resources and difficulties in finding and securing the cooperation of a highly-specific group (ASDs), the number of participants was small, making this an exploratory study; clearly, more participants would have allowed for more meaningful statistical analyses, as well as greater generalizability of findings. Second, budget and available equipment capabilities somewhat limited the quality of the VR utilized; perhaps, a more sophisticated VR simulation would have minimized participant concerns regarding color of the stimuli and ease of use. Finally, the study utilized one task, wiring an electrical outlet; the study would have been stronger if multiple VR simulations were available, conducive to participant’s desired career paths or tasks mentioned in prior research that ASDs excel in, such as computer programming, engineering, photography, technical repair, or library utilization.

The preliminary evidence collected from this study suggests that MTS methods may be an effective training approach for newly hired employees with ASD because it increases their self-efficacy. Future studies should consider investigating VR sickness in relation to ASDs. While the number of participants who suffered from VR sickness reported herein was consistent with the general population, sensory sensitivity of ASDs requires further investigation. Similarly, solutions to VR sickness, which work well for the general population, need to be assessed with ASD populations and other user groups. Some of this work has already been initiated.

In conclusion, use of MTS to train ASDs may well be an effective strategy for increasing self-efficacy and producing positive training outcomes during the anticipatory socialization and encounter phases of organizational assimilation. More research is warranted.

Author Disclosure Statement

No competing financial interests exist.

Funding Information

No funding was received for this article.

References


Address correspondence to: Gregory E. Kuper
Department of Communication
University of Wisconsin Whitewater
800 W Main Street
Whitewater, WI 53190
E-mail: gregkuper@hotmail.com

(Appendix follows →)
APPENDIX

APPENDIX A1. LINKS TO ORIGINAL AND EDITED VIDEO ON HOW TO WIRE AN ELECTRICAL OUTLET

<table>
<thead>
<tr>
<th>Link 1</th>
<th><a href="https://youtu.be/ziZA-bOFZi4">https://youtu.be/ziZA-bOFZi4</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Link 2</td>
<td><a href="https://youtu.be/fftRYUckMcE">https://youtu.be/fftRYUckMcE</a></td>
</tr>
</tbody>
</table>

APPENDIX A2. STEP-BY-STEP INSTRUCTIONS FOR VIRTUAL REALITY SIMULATION OF ELECTRICAL OUTLET

1. Watch the how-to video explaining how to perform task.
2. Locate the Electric Socket
3. Orientate your Point of View so that you are facing the Socket
4. Look at one of three areas on the socket, which represent placements for screws which are colored as shown in the video:
   - Silver – upper left
   - Brass – upper right
   - Green – lower left
5. When you direct your view (gaze) at the location, it will highlight and the cursor circle will expand. While the location is highlighted, use the viewer button (upper right on the Cardboard viewer) to indicate that you are selecting that area.
6. When an area has been selected, then:
   a) Turn to your right in the VR setting.
   b) Select one of three wires: Black White Copper
7. Like the screw locations, directing your gaze at a wire will cause the wire to highlight in color and the cursor circle will expand. Select the highlighted wire by pressing the button on the viewer. This will move the selected wire to attach to the location selected on the socket.
8. Attach wires to the other two locations on the socket following the same steps.
9. When you have all three wires attached to the locations you think are correct, look down to find a panel with three buttons: select the DONE button.
10. Look to the left of the socket.
   If you see a green “Correct–Good Job!” sign, you have attached all three wires correctly.
   If you see a red “Incorrect–Try Again” sign, you have attached one more wire incorrectly and can try again.
11. To try again, select the RESET button from the three button panel on the floor, and the wires will now be placed to the right of the electrical socket as when you first started the simulation.

APPENDIX A3. NEW GENERAL SELF-EFFICACY SCALE MODIFIED FOR THIS STUDY NGSE SCALE FOR ADULTS WITH ASD WIRING AN ELECTRICAL SOCKET

1. I will be able to achieve the goal of wiring an electrical outlet.
2. When facing the tasks of wiring an electrical outlet, I am certain that I can accomplish them.
3. In general, I think that I can wire an electrical outlet.
4. I believe I can succeed at wiring an electrical outlet.
5. I will be able to successfully overcome many challenges when wiring an electrical outlet.
6. I am confident that I can effectively perform when wiring an electrical outlet.
7. Compared to other people, I can perform the tasks of wiring an electrical outlet well.
8. Even when things are tough, I can wire an electrical outlet well.

APPENDIX A4. ORIGINAL NEW GENERAL SELF-EFFICACY SCALE NGSE SCALE

1. I will be able to achieve most of the goals that I have set for myself.
2. When facing difficult tasks, I am certain that I will accomplish them.
3. In general, I think that I can obtain outcomes that are important to me.
4. I believe I can succeed at most any endeavor to which I set my mind.
5. I will be able to successfully overcome many challenges.
6. I am confident that I can perform effectively on many different tasks.
7. Compared to other people, I can do most tasks very well.
8. Even when things are tough, I can perform quite well.

APPENDIX A5. OPEN-ENDED EXPERIMENTAL GROUP INTERVIEW QUESTIONS

1. Tell me about a time you were trained for a new job. How did they train you? Was it difficult for you to learn new tasks? What kinds of problems did you encounter?
2. Do you like playing video games? Explain how you think virtual reality training like you received today is like playing a video game. How is it different?
3. What was your general impression of the training you received today? Did you enjoy it? What did you like or not like about the training in comparison to the training you have received from places you have worked at previously, or received training from in the past?
4. Did you feel this training was fun and engaging? Tell me why it was fun or not fun. What could have made this a better experience?
5. What would you have done differently if you were designing the training you received today for yourself or any person who has been diagnosed with ASD?
6. Did you experience any dizziness or any kind of anxiety during the virtual reality experience? Tell me about how you felt.