From the Virtual World to the Real World:
Exploring the Potentiality of Single-User
Virtual Learning Environments in Improving
the Social Communication Skills of Autistic
Students

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Abstract

This proposed study will explore via an extensive literature review the potential of single-user virtual learning environments in improving the social communication skills of Autistic students in real-world, human interactions. The study will involve the building of a comprehensive corpus of texts, the coding of said corpus using open coding and the textual analysis software Antconc 3.4, and evaluating the findings of such textual analysis by recommending future avenues of research in light of the secondary data examined.
Research Problem and Context

Problem Area

Individuals with Autism-Spectrum disorder (ASD) typically experience a wide spectrum of difficulties in both social interactions and while communicating their thoughts or feelings with others; however, researchers have been investigating whether computer-mediated, role-playing virtual reality technologies could be suitable for treating autistic individuals who struggle with communication-related distress on a daily basis.

My proposed study is primarily descriptive in nature while also correlative because it attempts to describe an already studied phenomenon (virtual reality and its potential effect on the social communication skills of autistic students) while also discussing the theoretical and historical aspects of virtual reality and ASD theories. In regard to the correlational aspect of my study, I will attempt to identify, clarify, and decipher the possible relationships between these two multi-dimensional variables.

ASD theories will also further illuminate the potential relationships between these two variables by providing the framework through which the data collected on these topics will be analyzed. Viewing these theories and proposed ideas from a particular, pre-specified framework will also help me compartmentalize the data in correspondence with the design of my proposed research study. Therefore, my research question includes the following: How can virtual reality (VR), in the form of computer-assisted, role-play technologies, assist autistic students in developing better social communication skills and applying those skills in real-world human interactions?
In conclusion, the overall purpose of this research study is to propose an extensive literature review that investigates the possible correlation or relationship between virtual reality programs and the improvement of the social communication skills of autistic students and their applicability of those skills in authentic, real-world human interactions outside the classroom.

**Operational Definitions**

The following list includes operational definitions for the specific concepts and ideas included in my research question. By operationally defining these terms, readers will gain a more holistic understanding of my intended work and how I plan to approach these concepts in light of my proposed research study.

- **Virtual reality (VR)**: a specialized software that immerses users in a simulated environment via computer programming for the purposes of treating a developmental disorder.

- **Computer-assisted, role-play technologies**: pre-programmed, interactive, artificially intelligent interfaces that allow users to assume the role of an online character/avatar in a simulated environment.

- **Assist**: to provide support or help in achieving a certain objective or goal.

- **Autistic students**: although autistic students exhibit signs of this developmental disorder in different ways, these students generally experience difficulties during social interaction and are often very routine-oriented in nature.

- **Develop**: to grow or to expand upon one’s abilities in a certain area, such as skills in communication.

- **Better social communication skills**: to improve upon and gain confidence in one’s face-to-face interactions or experiences with others; this includes both verbal and non-verbal communication.

- **Applying**: to put certain skills or knowledge to action; to put certain skills to practical use outside of the classroom.

- **Real-world human interactions**: practical, non-synthetic verbal and non-verbal communication encounters with individuals outside of the classroom.
Previous Research

All of the secondary research I have located thus far are scholarly, peer-reviewed articles from credible journals. These journals include, but are not limited to, the following: *Computers in Human Behavior, Journal of Computer Assisted Learning, Journal of Intellectual Disability Research, Journal of Autism and Developmental Disorders*, and *Cyber-psychology, Behavior, and Social Networking*. Currently, these articles focus on important issues in regard to the newly birthed relationship between ASD and the incorporation of VR as a form of treatment, ranging from the level of immersion that must be achieved in order to see improvements in the social communication skills of autistic students to assessments of the prominent theories that dominate both virtual reality and autism. Although I have already located many credible secondary sources for my study, my proposed extensive literature review would allow me to conduct more research to find more peer-reviewed articles where VR was used as a suitable treatment for improving the social communication skills of autistic students and their applying of those skills in practical, human interactions outside of the classroom.

Currently, I have located a handful of peer-reviewed articles that focus on illustrating the complexities of the psychological and behavioral theories of ASD. However, my proposed extensive literature review would allow me to find more peer-reviewed articles that break down these theories even further so I can better assimilate the information for incorporation into my study. Nonetheless, the majority of the peer-reviewed articles I have found discuss the more interactive aspects of VR and how role-playing could simulate real human interactions in a non-threatening, readily adaptable environment for autistic students. For the remainder of this section, I’ll briefly
introduce the three main peer-reviewed journal articles that have not only highly influenced my work so far, but have also provided me with a holistic overview of both VR technologies and the behavioral theories that govern ASD.

In their journal article “The potential of virtual reality in social skills training for people with autistic spectrum disorders,” Parsons & Mitchell (2002) focus on the potential of virtual reality technologies in helping autistic individuals develop social skills in light of important behavioral approaches to this type of training, such as the Theory of Mind hypothesis (ToM). Along with discussing issues of generalization and learning across contexts in these types of studies, Parsons & Mitchell argue role-playing in virtual reality technologies could be a more effective or ideal alternative to social skills training compared to strict operant conditioning techniques or rote drilling of targeted behaviors since the latter permits a more flexible transfer of skills and knowledge between virtual and real-world environments (p. 432). Therefore, the authors encourage the incorporation of role-play in computer mediated virtual reality technologies in teaching social skills to autistic individuals yet also stress the potential limitations of choosing this approach, such as creating an overly comfortable (and even predictable) environment where an over-reliance on the technology could develop (p. 435-36). Autistic individuals may also become accustomed to computer-mediated feedback over time and may start to prefer receiving feedback from non-human sources (p. 437-38). This article provides me with an appropriately broad yet mindful overview on ASD behavioral theories and how researchers must always consider how each autistic person presents an individually unique perspective and approach to how VR technologies could be used to teach social communication skills.
In the journal article “Can I sit here? A review of the literature supporting the use of single-user virtual environments to help adolescents with autism learn appropriate social communication skills,” Irish (2013) provides more of a physiological and behavioral background on ASD, focusing on prominent theories such as ToM and Central Coherence Theory. However, this particular article reveals not only the potential benefits of using VR systems with ASD students, such as providing a safe, increasingly realistic, role-play oriented environment for autistic individuals to improve their social communication skills, but also the potential drawbacks of incorporating these types of technologies, such as how current research studies have only included small sample sizes and therefore cannot be generalized to the ASD population at large (p. A20). One of the most interesting aspects of Irish’s research includes his focus on the difficulties ASD students face when attempting to generalize or transfer the social skills they are learning while engaging in the VR systems (p. A21). This could potentially be due to the autistic individuals simply learning the social skills out of context and not understanding how to transfer those skills in real-world, human interactions outside of the virtual world. Therefore, the author recommends that areas of future research involve conducting longitudinal or follow-up studies with the ASD participants in order to more effectively pinpoint whether VR technologies could be classified as an “evidence-based intervention” (p. A23) for teaching social communication skills to autistic individuals in contexts outside of the classroom.

Similar to the article published by Parsons & Mitchell (2002), Rajendran (2013) in his article “Virtual environments and autism: A developmental psychopathological approach” provides a scholarly introduction to how VR technologies could be a developmentally and psychologically sound approach that could radically benefit individuals with ASD. In addition, this particularly virtual approach opens up a door for this population to become immersed within
an exclusively digital society thanks to research on information and communication technology (ICT) and its unique relationship to those with ASD (p. 334). Regardless of limited research in this particular sector, Rajendran postulates that a greater understanding of the relationship between ICT and autism will allow researchers to develop a more in-depth analysis of human-computer interactivity as a whole (p. 336). Interestingly, the author comments that “ICT can be used to change the world to suit the individual with autism rather than try to change the person with autism to fit into the world” (p. 337). This is crucial to our understanding of the interactions between VR technologies and ASD students since each autistic individual presents a unique and singular approach to how VR technologies should be approached (p. 337). For the remainder of the article, Rajendran discusses different ASD theories, such as Theory of Mind (ToM) and Weak Central Coherence (WCC), and how each theory provides a framework through which researchers can be more inclusive of autistic individuals in exclusively digital environments via VR technologies.

**Behavioral Hypotheses**

Before moving on to my Research Plan, I’ll briefly explain the two behavioral hypotheses that have provided a theoretical lens through which I’ve better understood the secondary data I’ve collected. The first cognitive hypothesis is called Theory of Mind, or ToM. According to Parsons & Mitchell (2002), the ToM theory explores autistic individuals’ “… inability to recognize or think about the mental states of the self and others” (p. 431). The authors explain that the ToM theory was coined in the “mentalizing” research conducted by Premack & Woodruff in 1978 (p. 433). This concept of “mentalizing” refers to the underlying human capability to not only understand one’s own mental state, but to understand and decode the mental states of others one is in communication with (p. 433). Parson & Mitchell (2002) conclude that ToM
could help interpret why individuals with ASD often do not understand that one’s own mental state or the mental state of another could be radically removed from reality itself (p. 433).

Interestingly, Parsons & Mitchell (2002) posit that this particular behavioral theory could explain why so many ASD individuals experience difficulty in generalizing knowledge or transferring the social skills that they learn in VR systems in real-world situations (p. 431). This hypothesis has helped me to understand how autistic individuals view themselves and others in real life and how they would potentially view themselves and others in a virtual environment.

The second cognitive hypothesis is called Weak Central Coherence, or WCC. According to Rajendran (2013), WCC theory explores how autistic individuals: “…process the constituent parts [of information] rather than the global whole” (p. 336). On the other hand, individuals that do not have ASD “…process information by extracting the overall meaning or gist” (p. 336). This hypothesis has helped me to understand how autistic individuals view the world and how they would potentially process information when immersed in a virtual environment. Once we understand how students with ASD view and process the world around them, we can more effectively adjust the ways in which we teach and interact with them so that they can successfully learn to transfer the social communication skills they acquire via VR systems to real-world interactions.

**Research Plan: Data Collection Methods**

The overall purpose of my study is to more thoroughly investigate the theories of ASD and how VR could be identified as a suitable treatment option for helping autistic students improve their social communication skills in real-world, human interactions outside the classroom. More particularly, I’m interested in how these theories could influence or even dictate how VR can be used to accomplish this particular goal and whether or not VR and its propensity for im-
mersive, role-playing environments could be effective treatment formulations for autistic individuals in the first place.

Instead of identifying and recruiting human participants for my study like I would for a more empirical research design, the “subjects” of my research study will include the secondary sources or texts that I choose to investigate and analyze throughout the study. This set-up is appropriate, especially since the primary objective of my study is to explore the research studies that have already been conducted on this topic and how the outcomes of these prior studies could serve as a springboard for outcomes of future studies. My methodology involves the actual building of my “subject,” called a “corpus.” My “corpus” must be a manageable size so I can show I’ve generated a representative sample of texts for my “subject.” The process of building a “corpus” of texts involves three separate yet interrelated steps: setting parameters for text selection, establishing procedures for coding, and finalizing methods of data analysis. I will explain each step detailed in Figure 1 below in the Data Collection Methods section to follow.

![Figure 1: Procedures for Building a Corpus](image)
Text Selection

The first stage of my methodology involves setting parameters for text selection. This stage involves not only selecting the specific key words that I’ll use to search for texts, but also determining which fields of study will influence the selection of texts and which indices I’ll use to compile the text titles. This first stage also involves establishing the scope in years of the texts I’ll be collecting. For example, I’ll need to complete statements such as “The texts I gather will include anything published from this time period to this time period” and then justifying why I wouldn’t extract texts from any other periods of time. Currently, the specific key words that I’ll use to search for texts would include “autism-spectrum disorder” and “virtual reality,” while I would more than likely search the indices Communication and Mass Media Complete, JSTOR, and Psychology and Behavioral Sciences Collection via Clemson University’s Library online database. Since the most relevant research on VR systems and autism has been published since around 2002, I will more than likely gather journal articles published from 2002 to the present. However, since theories of ASD were being defined from the 1940s to the 1980s, I may need to expand my scope in years in order to include these articles in my corpus.

Open Coding

The second stage of my methods involves establishing procedures for coding the texts, which involves determining that the scope of my data analysis process is accurate. Before I can identify the different themes that have emerged in my corpus, I must code for different behaviors I’m interested in or in respect to different disciplines I’m investigating. The most efficient way to code the texts of my corpus will be following the procedures of open coding laid out by scholars such as Grant-Davie, Strauss, and Creswell. According to Grant-Davie’s (1992) work titled “Coding data: Issues of validity, reliability, and interpretation,” open coding and the overall coding
process itself involves “…identifying units of analysis and classifying each unit according to the categories in a coding system – either a preexisting system or one developed for the data in question” (p. 272). In other words, the main purpose of open coding is to not only more fully process and digest the material presented, but to also organize that data in a meaningful and comprehensive manner for the research you are conducting (p. 272). In addition, coding permits researchers to distinguish categories among the texts, to identify and analyze projected themes or interrelationships between the different texts, and to also present the compiled information in a way that your intended audience can easily understand and grasp (p. 272-73). Interestingly, even though most researchers approach their texts with preconceived interpretations or schemas and with a strict coding procedure in mind, they more often than not find themselves discovering different sets of codes or formulating alternative hypotheses based on the texts that they hadn’t anticipated before (p. 273). Coding is a way to more fully understand data, but coding procedures do not interpret or analyze data– that is the sole job of the researcher.

For the purposes of my study, I will perform the traditional coding procedures laid out by Creswell (2009) in his work titled “Research design: Qualitative, quantitative, and mixed methods approaches.” According to Figure 2 on page 13, Creswell’s open coding procedures involve finalizing your texts for coding, making a list of relevant topics discussed in each text, creating “constructed codes” for each text, writing corresponding brief “memos” for each of the codes, breaking the topics down into categories, and then analyzing themes or the interrelationships between texts in response to the coding (Creswell, 2009, p. 192). Concerning episodic boundaries, I’ll code journal articles paragraph by paragraph since I want to understand what the authors are saying in relation to over-arching ideas woven throughout each text (Grant-Davie, 1992, p. 276).
The first step of Creswell’s (2009) open coding procedures (p.192) involves finalizing the texts that will be included in my corpus. This means that I have completed all of the necessary research to collect the most relevant, peer-reviewed journal articles for my extensive literature review. Next, I would carefully read through the texts, making a detailed list of the most relevant topics discussed. For the purposes of my study, relevant topics could include ASD theories and the different types of VR systems. Next, I would group these similar topics together, permitting me to discover some basic underlying relationships between the texts at the preliminary stages of the coding. Once I have grouped these similar topics together, I would create “constructed codes” and write the codes in the margins of the texts whenever they are mentioned. According to Khandkar (2009), constructed codes are typically codes designed by the researcher himself or herself (p. 2). Whenever I make a note of a code in the margin of a text, this is also an opportunity to write a brief “memo” explaining what the code signifies in relation to the text and also in relation to the overall research study itself.

After the codes have been outlined and the memos have been written for each of the different codes, then I would create categories by grouping the similar topics together. One efficient way to accomplish this is by drawing lines or even arrows to show the intended relationships between the different categories. To make it easier on the researcher, abbreviations can be created for the different categories so that the reader does not have to spend too much time writing out full category names throughout each text. Last, once each text is placed in their appropriate category, the preliminary coding results can be determined. Often after this initial analysis has taken place, new codes must be created or original codes or categories must be removed in order to improve the effectiveness of the overall study. Then, interrelated themes or
interrelationships between the different texts can be analyzed further and possible future research procedures or questions can be proposed.

Once the full open coding sequence has been successfully completed, Laurence Anthony’s free-ware corpus analysis tool “Antcon 3.4” can then be downloaded for either MacOS or Windows to search for particular words and to identify patterns in the language of each text. In Figure 3 on page 14, a screenshot of Antconc 3.4’s interface shows the home screen that a typical researcher would encounter once the analytics software has fully initialized. Since I’ll be primarily using the concordance capabilities of the software for my research, all I will need to know will involve uploading my texts as .txt files via the “File” menu and then using the search term dialog box near the bottom of the interface to search for different terms or topics that I want to identify in each particular article. However, since I’m not very familiar with the software currently, I’ve allotted time in my proposed timeline of completion at the end of my pro-
pos for downloading and learning Antconc 3.4 before actually needing to use it to analyze my texts during the final stage of my methodology.

The final stage of my methods involves finalizing methods of data analysis. First, I’ll determine the total count of text titles in my corpus and possibly throw out “false positives,” or articles that ended up talking about a different subject or are simply reprinted in multiple sources. This specific process is called “organizing exclusion principles.” Last, I’ll then account for the construct validity of my study, ensuring my research reliably represents the secondary data I’ve collected and that my methods of analysis measure what I claimed they would measure (Lauer & Asher, 1988, p. 140-45).

One of the most important aspects of research I will need to adhere to is the triangulation of data, particularly theory triangulation. Triangulation encompasses collecting data from a myriad of sources so that the concepts and ideas of a research study can be viewed from a range of different perspectives and viewpoints (Lauer & Asher, 1988, p. 42). In respect to my proposed
research study, theory triangulation involves reading, understanding and analyzing different theoretical perspectives from different angles so that a researcher can view concepts from a much broader, intuitive scope than before.

Even though my research design is not experimental, I’ll still need to establish the credibility of the theoretical nature of my study. I need to assure my readers I’ve adequately understood the different theories that are involved in my study and that I’ve appropriately applied them to the concepts presented within the secondary research I’ll analyze (Goubil-Gambrell, 1992, p. 590). I’ll need to then demonstrate the transferability of my research study, or its ability to be understood and possibly adopted by other researchers as secondary data in their studies. This involves ensuring I have judiciously understood the data I incorporated into my own study and have made appropriate future predictions via that data at my study’s conclusion (Goubil-Gambrell, 1992, p. 590).

Finally, I must account for the dependability of my study, making sure that it reliably and realistically represents the data that is reflected in my own research study and doesn’t inflate or improperly conjecture from the original ideas inherent in said theory/secondary data (Goubil-Gambrell, 1992, p. 590). Similar to establishing credibility, I finally need to document the confirmability of my study, determining that the findings or evaluations present in my study could be confirmed or agreed upon by other researchers (Goubil-Gambrell, 1992, p. 590). Confirmability should be assured so that other researchers will want to peer-review one’s research and possibly consider it a part of the literature of a specific field of study.

**Research Outcomes**

Although one of the primary goals of my study is to construct a publishable paper, there are other reasons why this type of research would prove beneficial in our field of professional
communication. To answer the “So what?” question, my extensive literature review would provide valuable information on the current corpus of research regarding VR treatments and the observable influence they’ve had on the social communication skills of autistic individuals to not only experts in our field, but experts in fields outside the humanities, such as computer science, the behavioral sciences, and psychology. My proposed corpus would provide these researchers with a scholarly compendium on not only pivotal studies that have influenced advancements in VR, but also on theoretical studies that define the myriad of hypotheses on ASD.

Potential Avenues for Future Research

To conclude, I’ve assimilated the following three potential avenues for future research from the secondary data I’ve explored thus far.

The first potential area of future research involves constructing longitudinal studies to determine whether any autistic participants have successfully transferred the social skills learned from virtual environments to reality (Miller & Bugnariu, 2016, p. 252; Irish, 2013, p. A21; Parsons & Mitchell, 2002, p. 432; Rajendran, 2013, p. 340; Parsons, 2016, p. 139). These follow-up studies would guide researchers toward understanding more fully how autistic individuals view the world around them and how VR treatments could be more effectively developed to help those with ASD understand the social implications of their communications with others.

The second potential area of future research involves conducting more studies exploring the relationship between VR treatment and autism with much larger, more representative sample sizes (Irish, 2013, p. A22; Miller & Bugnariu, 2016, p. 253). Past research initiatives have only involved small samples, so, consequently, the results of these studies cannot be generalized to the broader population in question. However, this type of research is critical to the advancement of using VR treatments to further develop and improve the social communications skills of ASD
students in real-world, human interactions outside the classroom. Prioritizing larger sample sizes in future research studies would also increase their credibility and would then permit researchers to generalize the results both inside the field of professional communication and in other multi-disciplinary contexts outside professional communication and the humanities.

The third and final potential area of future research involves developing studies where VR treatments are coupled with effective teaching methodologies to more accurately determine if single-user virtual learning environments could constitute an “evidence-based intervention” (Irish, 2013, p. A23; Rajendran, 2013, p. 337). Currently, there is very little research on VR treatments as evidence-based interventions for improving the social communication skills of students with ASD; therefore, this particular research would permit researchers to more fully understand not only the more cognitive or psychological aspects of using VR treatments with ASD students, but would also give researchers the opportunity to study the unique interrelationship between pedagogy and using VR technologies to not only improve the overall social communication skills of autistic individuals, but to also improve autistic individuals’ transferability of these acquired skills in real-world, human interactions outside of the virtual realm.
References


**Proposed Timeline of Completion**

A proposed timeline of completion for my research study is included in the table below.

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
<th>Resources Needed</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begin collecting texts for corpus</td>
<td>Select key words for search; use fields and indices to search</td>
<td>Library catalog access; laptop access</td>
<td>May 15, 2017</td>
</tr>
<tr>
<td>Continue collecting texts for corpus</td>
<td>Use fields and indices to search; designate scope in years</td>
<td>Library catalog access; laptop access</td>
<td>May 31, 2017</td>
</tr>
<tr>
<td>Finalize texts for corpus</td>
<td>Use fields and indices to finalize searches</td>
<td>Library catalog access; laptop access</td>
<td>July 5, 2017</td>
</tr>
<tr>
<td>Begin coding procedures</td>
<td>Code for behaviors or disciplines; identify episodic boundaries</td>
<td>Library catalog access; laptop access</td>
<td>Aug 18, 2017</td>
</tr>
<tr>
<td>Finalize coding procedures</td>
<td>Finalize episodic boundaries; prepare texts for analysis</td>
<td>Library catalog access; laptop access</td>
<td>Sept 15, 2017</td>
</tr>
<tr>
<td>Download Antconc 3.4</td>
<td>Learn software</td>
<td>Internet access; laptop access</td>
<td>Oct 18, 2017</td>
</tr>
<tr>
<td>Begin text analysis (Antconc 3.4)</td>
<td>Determine total title count; organize the exclusion principles</td>
<td>Internet access; laptop access</td>
<td>Nov 16, 2017</td>
</tr>
<tr>
<td>Finalize text analysis (Antconc 3.4)</td>
<td>Verify construct validity of work</td>
<td>Internet access; laptop access</td>
<td>Dec 5, 2017</td>
</tr>
<tr>
<td>Write research report</td>
<td>Use Microsoft Word to design and write report</td>
<td>Internet access; laptop access; Microsoft Office suite access</td>
<td>Dec 10, 2017-Feb. 10, 2018</td>
</tr>
<tr>
<td>Finalize research report</td>
<td>Use Microsoft Word to write and complete report</td>
<td>Internet access; laptop access; Microsoft Office suite access</td>
<td>March 1, 2018</td>
</tr>
<tr>
<td>Send research report to full committee for review</td>
<td>Send as Microsoft Word doc to full committee via email</td>
<td>Internet access; laptop access; Microsoft Office suite access</td>
<td>March 21, 2018</td>
</tr>
<tr>
<td>MAPC Portfolio Defense</td>
<td>Finalize and review defense details with full committee</td>
<td>Internet access; laptop access</td>
<td>April 4, 2018</td>
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