

# Using virtual interactive training agents with adults with autism and other developmental disabilities

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## ABSTRACT

Conversational Virtual Human (VH) agents are increasingly being used to support role-play experiential learning across a range of use-cases and populations. This project examined whether use of the Virtual Interactive Training Agent (VITA) system would improve job interviewing skills in a sample of persons with autism or other developmental disability. The study examined performance differences between baseline and final interviews in face-to-face and virtual reality conditions, and whether statistically significant increases were demonstrated between interviewing conditions. Paired samples t-tests were utilized to examine mean changes in performance by interview stage and in the overall difference between baseline and final interview stages. The preliminary results indicated that VITA is a positive factor when preparing young adults with autism or other developmental disability for employment interviews. Statistically significant results were demonstrated across all pilot conditions and in all but one post-assessment condition.

## 1. INTRODUCTION

### 1.1 Adults with Autism Spectrum Disorder and Employment

While it is recognized that many persons with autism spectrum disorder (ASD) and other developmental disabilities have the necessary capabilities for success in employment, adults with ASD are noticeably underrepresented in employment when compared to the general population (Taylor & Seltzer, 2011). According to the United States Bureau of Labor Statistics (2014), the general population's employment rate was nearly 65%, which stands in sharp contrast to the employment rate of adults with ASD which was just over 17%. Taylor, Henniger, and Mailick (2015) conducted a study over a 12-year period that investigated post-secondary education and employment of adults with ASD. They found that while two-thirds of study participants were engaged in competitive employment and/or post-secondary education during at least one point during the longitudinal study, only 25% of the adults studied were steadily engaged in competitive employment and/or post-secondary education during the longitudinal study.

One step in attaining employment is participating in a job interview. Job interviews can be a significant source of anxiety for many adults in the general public (Rynes, Bretz, & Gerhart, as cited in McCarthy and Goffin, 2004). This is especially true for adults with autism who typically struggle with social anxiety (Maddox & White, 2015). This anxiety may limit their success in job seeking activities, including interviews.

McCarthy and Goffin posit that interview anxiety can be differentiated from typical anxiety tendencies. Interview anxiety may result in reduced confidence in the candidate's self-efficacy with interviewing (Tross & Maurer, 2008). Therefore, training to improve interviewing skills is warranted. Tross and Maurer found that training or coaching had a positive effect on subsequent individuals' interview performance.

## 1.2 Virtual Reality Technology

Ground-breaking advances in technology may provide a solution for addressing issues that inhibit adults with ASD from entering the work force. Virtual reality technology has long been used to treat anxiety disorders and other clinical health conditions. For example, Virtual Reality Exposure Therapy (VRET) uses a computer generated “virtual environment” (p. 251) to gradually expose clients to fear producing stimuli and contexts in a safe, contained setting that aims to promote extinction of fear and anxiety in persons with phobias and posttraumatic stress disorder (PTSD). In 2008, Parsons and Rizzo reviewed the literature on the use of VRET for reducing anxiety. The results of their meta-analysis showed that the VRET had a positive impact on reducing anxiety. This was supported in an independently conducted meta-analysis published around the same time by Powers and Emmelkamp (2008), in which the authors concluded that VRET is very effective in treating anxiety disorders, and in a more recent report (Opris et al., 2012).

As a result of cutting-edge progress in virtual reality (VR) technologies, the creation of low-cost systems that can run on a personal computer have been developed. This technology is becoming more accessible to the public at large and this trend is expected to continue. One example of this progress is in the creation of conversational virtual humans (VHs) capable of engaging in face-to-face dialogues with real users. Virtual humans have been used in a variety of situations for: training clinical skills (Rizzo, Kenny, & Parsons, 2011), addressing anxiety disorders (Parsons & Rizzo, 2008; Powers and Emmelkamp, 2008), improving body image in persons with eating disorders (Riva, 2011), and for supporting anonymous access to coaching support in persons with PTSD (Rizzo et al., 2015). This emerging use of VR technology sets the stage for the application of VHs to support the practice of vocational interviewing in a safe, virtual environment in order to improve social and communication skills. This may help to reduce anxiety by repeated exposure to the challenges perceived by participants in a real life job interview and provide users with realistic practice in the construction of interview responses.

A previous effort to use technology to improve interview skills in persons with ASD involved the JobTIPS web-based program (<http://do2learn.com/JobTIPS>). JobTIPS is an online multimedia program that provides a variety of vocational training resources including video models and interactive avatar-based practice (VH interviewer driven by a live clinician) for employment interview training using a platform similar to 2<sup>nd</sup> Life (Venugen, 2010). In a study of 22 participants, ages 16 to 19 with ASD, Strickland, Coles, and Southern (2013) found that the JobTIPS program along with a virtual reality practice session improved participants’ ability to provide appropriate verbal responses to interview questions. However, delivery skills, defined by Strickland et al. as responses that measure posture, eye contact, and facial expressions, did not improve at the same level. Nevertheless, the study did show the benefit of using a home computer in practicing the employment-related interviewing skills needed for improving opportunities for employment. Similar encouraging results have been reported using another avatar-based interview training system (Kandalaf et al., 2013) and in two studies where ASD users responded to video clips of a human job interviewer via selection from a multiple choice menu of responses (Smith et al., 2014, 2015).

Similar to the above, the Virtual Interactive Training Agent (VITA) system was designed to give users on the autism spectrum the opportunity to practice job interview responding with a VH interviewer. The use of a 3D graphic VH approach was made to foster flexibility in the range of VH characters that could be delivered with the same underlying software and to support variations in VH personality and level of provocativeness. This is in line with the design perspective detailed by Lange et al. (2012), which described the essential features of rehabilitation tasks that also seem to hold true for skill-building. Lange deems these tasks *good* if they offered the ability to adjust difficulty levels, can be administered repeatedly, provided feedback, were quantifiable and relevant to the real world, and motivated the user. The VITA system supports all of these characteristics. The VITA system creates a virtual reality experience that provides a comprehensive and hierarchical set of job interview practice experiences with VH interviewers that users can interact with as part of the interview training process. VITA provides a platform where participants can practice job interviewing with VH agents that are capable of asking a variety of questions in an assortment of settings. This opportunity for users to repeatedly practice job interviewing can be adjusted across a spectrum of challenges. It was hypothesized that users with a developmental disability would significantly improve their interviewing skill with repeated practice in this type of training.

## 1.3 Virtual Interactive Training Agent

The Virtual Interactive Training Agent (VITA) is an interactive VR job interview practice system for building competence and reducing anxiety in young adults with autism spectrum disorder (ASD) and other developmental disabilities. The VITA system was originally commissioned by The Dan Marino Foundation (DMF: <http://www.danmarinofoundation.org/portal/>) as a research project in conjunction with the Florida Department of Education’s Department of Vocational Rehabilitation and was developed at the University of Southern California’s Institute for Creative Technologies (ICT). It is currently being used at DMF’s innovative post-

secondary institution and its use is now an integral part of the DMF Inclusive Transition and Employment Management (ITEM) program.

In order to produce a variety of experiences, six different VHS were created: three male and three female of varying ages and ethnic backgrounds (see Figure 1). Each VH can exhibit three behavioral dispositions: soft-touch, neutral, and hostile and is capable of asking 10 to 12 interview questions. Seven different interchangeable backgrounds set situational context that closely aligns with participants' specific employment interests. Hotel lobby, business office, and warehouse breakroom are among the settings available from the initial menu interface. The system provides a wide variety of distinct training opportunities for a range of job interview interactions that can progress in difficulty level and be adjusted to the specific needs of the user. The list of interview questions was derived from the agency's experience with vocational job interviews and by searching predictable interview questions on the internet. All VITA interviews were video recorded to provide an opportunity for student-led feedback sessions as part of the classroom curriculum.



**Figure 1.** User interacting with components of the VITA system.

#### 1.4 VITA Curriculum

In order to address the employment interview preparation needs of young adults with autism and other developmental disabilities, the ITEM program was implemented. Through this project, the VITA system was created to provide practice in job interview skills across a variety of easy to challenging interview conditions. Participants also engaged in coursework developed by DMF staff. This was based on the perceived need for participants to learn core interviewing and other employment skills prior to and during the VITA interventions. Lessons were also created that addressed interview etiquette such as greetings, acceptable small talk, and closing or thanking the interviewer.

The curriculum also included instructional strategies that taught ways to respond to a variety of questions typically asked during interviews. The instructors and curriculum developers of the course determined that interview questions commonly take a predictable structure. This interview structure, or arc, informed the development of the curriculum and was later used to create the VH's script used during all interviews. This offered a level of cohesiveness and fidelity throughout the study. The interview arc used throughout the course, as well as throughout the VITA system, is a set of 10-12 questions that (a) ask participants to engage in social mores and introductory statements; (b) emphasize participants' strengths and self-advocacy; (c) provide opportunities for self-promotion; (d) allow for a situational or behavioral example; (e) focus on general housekeeping; and (f) alert the participant that the interview is coming to a close.

Additionally, the course focused on explicitly teaching participants how to make a good first impression, provide clear and concise responses, self-promote by identifying individual strengths, engage in active listening, and convey interest using verbal and non-verbal communication. In order to capture students' performance of these skills, a standard in-house interview performance measure was created by the DMF staff. The Marino Interview Assessment Scale (MIAS) is designed to measure the degree to which the participant utilized these skills in an interview setting. Participants scored a 1 if they did not use a strategy that was called for given a specific question. A score of 2 indicated that skill was still in the beginning stages of implementation while a 3 indicated that the skill was developing; 4s indicated that the interviewee adequately used the skill or strategy.

The highest score, 5, indicated that the participant was accomplished at the strategy. This project sought to examine whether use of the VITA system provided a statistically significant increase in mean MIAS scores from baseline interviewing in both face-to-face and VR conditions to final face-to-face interviews, and whether a statistically significant increase was demonstrated between interviewing conditions.

## 2. METHODS

### 2.1 Participants

The ITEM program and a simultaneous project, entitled The Jobs Development Program, were housed at the newly constructed, state-of-the-art Marino Campus facility located in downtown Fort Lauderdale. These projects recruited local Vocational Rehabilitation clients who utilized DMF as their local vendor. Additionally, the project included participants from local public high schools as part of a community based instructional (CBI) site. The participants ranged in age from 18 to 28 years old with the mean age of 23; 77% were male, 23% female. All participants had a documented disability as evidenced by psychological reports provided by the participants and/or their families; 63% were diagnosed with ASD while the remainder had other developmental disabilities. There were 96 participants at the start of the study. Some of the original participants either gained employment or left the program for other reasons. In those instances, participants' data were removed from the study. In all, data were analyzed from over 64 participants' interview performances.

The following year, 16 students from an exceptional student education program at a local high school participated in a post-pilot study. The students ranged in age from 17 to 22 years old; 69% were male, 31% female. Specific disability diagnoses were not collected.

### 2.2 Procedures

Before engaging in the VITA curriculum or using the VITA system, participants took part in a face-to-face interview conducted by a DMF staff member. During the interview session, a researcher captured the degree to which the interviewee met specific interviewing criteria as indicated on the MIAS. The sum of each individual's score was recorded. Shortly after the baseline face-to-face interview, an initial VITA session was conducted to determine the baseline score for each individual. Performances from this baseline VITA interview were also scored using the MIAS.

In all, there were six stages of data collection during the study: baseline face-to-face interview, baseline VITA session interview, three VITA intervention sessions, and a final face-to-face interview. At each stage, researchers observed the interview sessions and scored participant performances using the MIAS. The sums from each MIAS score were then averaged to determine not only individual progress but to determine group means as well.

Participants met for coursework twice each week over the course of the 14 week program. The final 5 weeks were dedicated VITA as an intervention in conjunction with course work. The curriculum focused explicitly on teaching participants interviewing skills that they could use when practicing with VITA and in a real interview. Individual lessons centered on making a good first impression, providing clear and concise responses, self-promoting by identifying individual strengths, engaging in active listening, and conveying interest using verbal and non-verbal communication.

In the post-pilot study, the students participated in a similar curriculum twice each week for 10 weeks, approximately 20 hours of curriculum. As in the pilot study, baseline and final face-to-face interview data were collected. However, only two VITA intervention sessions were conducted due to time constraints. At each stage, researchers observed the interview sessions and scored participants' performances using the MIAS.

### 2.3 Data collection

Prior to course work, all participants were observed during a baseline traditional interview (face-to-face). Performances were recorded using the MIAS developed to measure participant interview performance. The initial scores were recorded as Baseline 1.

In late March of 2014, the virtual reality hardware and software program was installed at the campus. Throughout April and May of 2014, all participants interviewed with the VITA system. Participants completed four VITA interviews; the first one is considered the baseline with three additional sessions. The researchers observed each interview and scored the interview performance using the MIAS. Finally, all participants were interviewed face-to-face and MIAS scores were collected. These interviews were conducted to see if there was an improvement between the two traditional (face-to-face) interviews, baseline and final, with the VITA system used as an intervention. These face-to-face interviews are to be considered the participants' pre- and post-

assessments. In the post-pilot, pre/post interview data and two VITA session data were collected using the MIAS.

### 3. RESULTS

#### 3.1 VITA Intervention

Paired-samples *t*-tests were conducted to compare MIAS scores from the final face-to-face interview to previous interviewing conditions and baselines in the pilot study. As expected, there was not a significant difference in face-to-face baseline scores ( $M=1.989, SD=.599$ ) and ( $M=1.996, SD=.509$ ) the VITA baseline,  $t(90)=-.112, p=.911$ . There was a significant difference in the scores for VITA baseline scores ( $M=1.996, SD=.509$ ) and ( $M=2.69, SD=.735$ ) the first VITA interview,  $t(88)= -9.255, p =0.00$ . A statistically significant difference in the scores from the first VITA interview ( $M=2.70, SD=.734$ ) and the second VITA interview ( $M=3.20, SD=.724$ ),  $t(86)= -9.814, p =0.00$ , was realized, demonstrating an improvement between those two conditions.

An improvement between conditions continued to materialize as demonstrated by a statistically significant difference in the scores between the second VITA interview ( $M=3.28, SD=.682$ ) and the third VITA interview ( $M=3.64, SD=.856$ ),  $t(65)= -4.247, p =0.00$ . When the third VITA interview ( $M=3.53, SD=.838$ ) was compared to the final face-to-face interview ( $M=3.76, SD=.942$ ), a statistically significant result remained,  $t(56)= -2.173, p=0.034$ .

The improvement of participants' interviewing competency over the course of this program was crystalized when the baseline and final scores were taken into account. The difference between both conditions was significant at  $p=0.00$ , providing evidence for the effectiveness of utilization of VITA for vocational interviewing with adults with autism and other developmental disabilities. Paired sample correlations are displayed in Table 1 and *t*-tests are displayed in Table 2.

A year following the initial VITA pilot, a smaller ( $n=16$ ) post-pilot examined baseline interviewing skills. Paired-samples *t*-tests were conducted to compare the final face-to-face interview to previous interviewing conditions and baselines in the pilot study. There was no difference between the results of the first face-to-face interview and the first VITA interview. There was, however, a significant difference in the scores from the first VITA interview ( $M=2.313, SD=.624$ ) and the second VITA interview ( $M=3.062, SD=.610$ ),  $t(15)= -4.226, p=0.01$ . A statistically significant difference in the scores between the face-to-face baseline interview ( $M=2.31, SD=.202$ ) and the second VITA interview ( $M=3.06, SD=.152$ ),  $t(15)= -4.139, p =0.01$ , was shown, demonstrating an improvement from baseline.

When the second VITA interview ( $M=3.06, SD=.152$ ) was compared to the final face-to-face interview ( $M=3.09, SD=.204$ ), there was not a statistically significant result,  $t(15)= -.190, p=0.852$ . The difference between the face-to-face baseline ( $M=2.31, SD=.202$ ) and face-to-face final interview ( $M=3.09, SD=.204$ ) was statistically significant,  $t(15)= -3.411, p=.004$ , signaling a substantial improvement over the course of the VITA intervention. Paired sample correlations are displayed in Table 3 and *t*-tests are displayed in Table 4.

**Table 1. Paired Samples Correlations – Pilot.**

	N	Correlation	Sig.
Pair 1 Face-to-face baseline & VITA_Baseline	91	.493	.000
Pair 2 VITA_Baseline & VITA1	89	.410	.000
Pair 3 VITA1 & VITA2	87	.787	.000
Pair 4 VITA2 & VITA3	66	.632	.000
Pair 5 VITA3 & FF Final	57	.621	.000
Pair 6 Face-to-face baseline & FF Final	57	.660	.000
Pair 7 VITA_Baseline & FF Final	57	.365	.005

**Table 2. Paired Samples t-test – Pilot.**

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval				
					Lower				Upper
Pair 1	Face-to-face baseline - VITA_Baseline	-.00659	.56289	.05901	-.12382	.11063	-.112	90	.911
Pair 2	VITA_Baseline - VITA1	-.68989	.70325	.07454	-.83803	-.54175	-9.255	88	.000
Pair 3	VITA1 - VITA2	-.50115	.47630	.05106	-.60266	-.39964	-9.814	86	.000
Pair 4	VITA2 - VITA3	-.35455	.67827	.08349	-.52129	-.18780	-4.247	65	.000
Pair 5	VITA3 – Face-to-face final	-.22456	.78017	.10334	-.43157	-.01755	-2.173	56	.034
Pair 6	Face-to-face baseline – Face-to-face final	-1.7579	.70886	.09389	-1.94598	-1.56981	-18.723	56	.000
Pair 7	VITA_Baseline - FF Final	-1.8281	.88110	.11670	-2.06186	-1.59428	-15.664	56	.000

**Table 3. Post-Pilot – Bivariate Correlations.**

		N	Correlation	Sig.
Pair 1	FF_Baseline & VITA_1	16	-.275	.303
Pair 2	FF_Baseline & VITA_2	16	.509	.044
Pair 3	VITA_1 & VITA_2	16	.338	.201
Pair 4	VITA_2 & FF_Final	16	.765	.001
Pair 5	FF_Baseline & FF_Final	16	.375	.152

**Table 4. Post-Pilot Paired Samples t-test.**

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval				
					Lower				Upper
Pair 1	FF_Baseline - VITA_1	.00000	1.15007	.28752	-.61283	.61283	.000	15	1.000
Pair 2	FF_Baseline - VITA_2	-.75000	.72480	.18120	-1.13622	-.36378	-4.139	15	.001
Pair 3	VITA_1 - VITA_2	-.75000	.70993	.17748	-1.12829	-.37171	-4.226	15	.001
Pair 4	VITA_2 - FF_Final	-.02500	.52599	.13150	-.30528	.25528	-.190	15	.852
Pair 5	FF_Baseline - FF_Final	-.77500	.90885	.22721	-1.25929	-.29071	-3.411	15	.004

#### 4. DISCUSSION

These preliminary results indicate that the VITA system is a positive factor for preparing young adults with autism and other disabilities for employment interviews. Participant baseline interviews and VITA baseline interview scores showed no significant difference, which may indicate that participants interviewing skills were captured similarly in both the traditional face-to-face style of interview and the VITA virtual reality interview.

This is important because improved VITA interview performances led to improved face-to-face interview outcomes.

Statistically significant results were demonstrated across all pilot conditions, and in all but one condition in the post-pilot study. The exception is a demonstrable improvement between the second VITA interview and final face-to-face measurement, signaling that all relevant skills were gained in the first VITA post-pilot interview and no further practice was necessary before the final face-to-face interview. This could be due to fewer VITA sessions conducted or the shorter time frame for project implementation and data collection during the post-pilot study.

Improvement was demonstrated across all other conditions, suggesting that in the pilot stages, each new encounter and practice session with VITA created a statistically significant improvement. The improvement in the final stage exceeded all previous stages in the pilot condition, demonstrating that the program, in its current format, can create a measureable and significant improvement in the interviewing skills of participants. While the results from this study show that VITA is influential in improving interviewing skills of young adults with autism and other developmental disabilities, further investigations could determine the impact of the companion curriculum. The results from this study cannot determine the effectiveness of the VITA system alone; however, results do indicate that the VITA system, in conjunction with explicit training and teaching, is a powerful intervention. With consistent use, this tool could be a positive influence in increasing the number of adults with disabilities in gaining meaningful employment.

## 5. CONCLUSIONS

VITA provides a platform where job interviewing skills can be practiced using VHS to provide the interview questions for participants to practice their responses. As a result of their participation in this study, participants enhanced their skill with interviewing by improving the manner in which they respond to typical interview questions. Data indicate that participants developed their ability to identify individual strengths, engage in self-promotion, engage in self-advocacy, answer situational questions, and respond to behavioral or social questions and to self-promote as measured by multiple evaluations using the MIAS. The result of the practice using VITA was improved job interviewing skills for individuals with developmental disabilities.

The VITA curriculum may be useful with regard to gaining prior knowledge and extending the participants' understanding of interview etiquette and interview expectation. Further research can be extended to investigate whether VITA would be as effective without the embedded curriculum or how much benefit VITA adds to it. The current study utilized three VITA intervention sessions. Additional research could help determine the quantity, duration, and frequency of VITA interventions that provide the most effective results. Finally, new research is planned to determine the degree to which the participants believe that they have the skill and confidence during an interview setting and whether that self-efficacy has an impact on interview performance as a result of training with VITA.

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