Virtual Reality Job Interview Training for Individuals With Psychiatric Disabilities

Matthew J. Smith, PhD, LCSW, MPE, Emily J. Ginger, BA,* Michael Wright, BA,* Katherine Wright, MPH,* Laura Boteler Humm, BS,† Dale Olsen, PhD,† Morris D. Bell, PhD,‡ and Michael F. Fleming, MD*§*

Abstract: Services are available to help support existing employment for individuals with psychiatric disabilities; however, there is a gap in services targeting job interview skills that can help obtain employment. We assessed the feasibility and efficacy of Virtual Reality Job Interview Training (VR-JIT) in a randomized controlled trial. Participants were randomized to VR-JIT (n = 25) or treatment-as-usual (TAU) (n = 12) groups. VR-JIT consisted of 10 hours of simulated job interviews with a virtual character and didactic online training. The participants attended 95% of laboratory-based training sessions and found VR-JIT easy to use and felt prepared for future interviews. The VR-JIT group improved their job interview role-play performance ($p \leq 0.05$) and self-confidence ($p \leq 0.05$) between baseline and follow-up as compared with the TAU group. VR-JIT performance scores increased over time ($R^2 = 0.65$). VR-JIT demonstrated initial feasibility and efficacy at improving job interview skills and self-confidence. Future research may help clarify whether this intervention is efficacious in community-based settings.

Key Words: Psychiatric disability, virtual reality training, job interview skills, vocational training

(*J Nerv Ment Dis* 2014;202: 659–667)

More than two thirds of individuals with psychiatric disabilities (*e.g.*, bipolar disorder, schizophrenia) receiving mental health services want to work (Frounfelker et al., 2011; Ramsay et al., 2011). The US employment rate was 90% to 95% during the past 5 years (US Department of Labor, 2013); however, this rate is significantly lower among individuals with psychiatric disabilities (10%–15%) (Rosenheck et al., 2006; Salkever et al., 2007). Supported employment (SE) is an effective method to increase employment among individuals with psychiatric disabilities (Twamley et al., 2012), with an employment rate approaching 60% (Bond et al., 2008). However, there is limited access to SE, and 40% of consumers completing SE and individuals who never enroll in SE still struggle to find work. Thus, this population still faces major barriers to employment (Cook, 2006; Rosenheck et al., 2006).

Moreover, a 10-year follow-up study of SE indicated that only 30% of consumers felt that practicing job interviews was helpful (Salyers et al., 2004), which suggests that SE's approach to improving job interview skills may have limited effectiveness. The SE manual disseminated by the Substance Abuse and Mental Health Services Administration (SAMSHA) provides educational materials to guide employment specialists (*i.e.,* SE administrators) in asking open-ended questions during job interview role-plays that are conducted before scheduled job interviews. However, the manual does not provide guidance on how to conduct role-plays, how to "act" like a human resources representative with different moods or personalities, and how much training is necessary to improve interview skills (SAMSHA, 2009).

Although the effectiveness of clinician-facilitated role-play training in vocational rehabilitation has received minimal empirical attention (Salyers et al., 2004), several interventions have been developed as supplements to enhance SE, including cognitive remediation, cognitive behavioral therapy, performance feedback, and developing work skills (Bell et al., 2003, 2008; Bowie et al., 2012; Lysaker et al., 2009; McGurk et al., 2005; Mueser et al., 2005). As such, perhaps SE or other vocational services can be enhanced by supplementing them with an evidenced-based approach to job interview training.

Few interventions have specifically targeted improving job interview performance for individuals with psychiatric disabilities looking for competitive employment (Bell and Weinstein, 2011). An important first step to gaining employment is successfully navigating the job interview. However, this process may be particularly difficult for individuals with psychiatric disabilities because they are typically characterized by impairments in social cognition (Couture et al., 2006; Dickinson et al., 2007; Lahera et al., 2012; Samame, 2013). Thus, the job interview process may be a critical target for vocational rehabilitation services and, as such, warrants further consideration (Bell and Weinstein, 2011).

Research suggests that navigating the job interview requires individuals to successfully convey job-relevant content during the interview (*e.g.*, experience, core knowledge) and present a convincing performance during the interview (*e.g.*, social effectiveness, interpersonal presentation) (Huffcutt, 2011). Thus, an intervention targeting these constructs could be effective at improving job interview performance for individuals with psychiatric disabilities. In addition, research has demonstrated that one's self-confidence at interviewing has been associated with more effective verbal and nonverbal communication strategies during job interviews (Tay et al., 2006) and that low self-confidence is a barrier to employment among individuals with psychiatric disabilities (Corbiere et al., 2004; Provencher et al., 2002). These findings suggest that improving one's self-confidence might enhance one's job interview performance.

Although training using a traditional clinician-facilitated mock interview or role-play method may have limited generalizability from the clinic to real-world outcomes (Dilk and Bond, 1996), virtual reality (VR) training has demonstrated efficacy at improving interactive behavior and social skills that may transfer to real-life conversations. For example, VR role-play simulations were developed to train federal law enforcement agents to perform interrogation techniques (Olsen et al., 1999), family physicians to perform brief psychosocial interventions (Fleming et al., 2009), and individuals with psychiatric disabilities to engage in more effective social skills (Park et al., 2011; Rus-Calafell et al.,

*Department of Psychiatry and Behavioral Sciences, Feinberg School of Medicine, Northwestern University, Chicago, IL; †SIMmersion LLC, Columbia, MD; ‡Department of Psychiatry, Yale School of Medicine, Department of Veterans Affairs, West Haven, CT; and §Department of Family Medicine, Feinberg School of Medicine, Northwestern University, Chicago, IL.

Send reprint requests to Matthew J. Smith, PhD, LCSW, MPE, Department of Psychiatry and Behavioral Sciences, Feinberg School of Medicine, Northwestern University, 710 N. Lake Shore Dr, Abbott Hall 13th Floor, Chicago, IL 60611. E-mail: matthewsmith@northwestern.edu.

ISSN: 0022-3018/14/20209–0659

DOI: 10.1097/NMD.0000000000000187

2014). Moreover, simulation training has several advantages over traditional learning methods in an educational setting (Cook et al., 2011; Issenberg et al., 2005). These include a) repetitive practice on simulated interactions, b) exercises that allow trainees to practice new skills, c) unique and individualized training experience with each simulated interaction, d) consistent feedback in the moment, e) a stress-free environment to make and learn from errors, f) accurate representation of real-life interactions, g) application of different skills and strategies as the level of difficulty increases (*e.g.*, hierarchical learning), as well as h) access to Web-based didactic material to enhance learning (Issenberg et al., 2005). Hence, VR simulation role-play training is fundamentally different from the traditional clinician-based role-play methods that may be limited at training-sustainable behavior.

Our aim in the present study was to evaluate the feasibility and efficacy of a VR job interview simulation program that was designed to improve job interview skills for individuals with psychiatric disabilities. The intervention, Virtual Reality Job Interview Training (VR-JIT), targets improvement of job-relevant interview content and interviewee performance (Huffcutt, 2011). The VR-JIT prototype was tested on a small group of individuals with psychiatric disabilities to evaluate participant interest and ease of use (Bell and Weinstein, 2011). Thus, the current study sought to examine the feasibility and efficacy of the full version of VR-JIT in a randomized controlled trial.

On the basis of the findings from the evaluation of the VR-JIT prototype (Bell and Weinstein, 2011), we hypothesized that the VR-JIT sessions would be frequently attended and that the intervention would be rated as easy to use, enjoyable, and helpful. We hypothesized that completion of VR-JIT training would be related to improvements in job interview role-play performance and enhanced self-confidence in job interview skills in the VR-JIT group as compared with the treatment-as-usual group. We explored whether job interview role-play performance and self-confidence in one's interview skills during follow-up assessments were associated with each other as well as with demographic characteristics, vocational history, as well as neurocognitive and social cognitive functioning.

METHODS

Participants

Participants included 37 individuals with a psychiatric disability recruited using advertisements at community-based mental health service providers. Participants were required to have a diagnosis of major depressive disorder (MDD), bipolar disorder, schizophrenia, or schizoaffective disorder for study inclusion. A BA/BS- or PhD-level research staff member using the Mini-International Neuropsychiatric Interview determined participant diagnoses (Sheehan et al., 1998). Participants were required to a) be 18 to 65 years old, b) achieve at least a sixth-grade reading level using the sentence comprehension subtest of the Wide Range Achievement Test–IV (Wilkinson and Robertson, 2006), c) be video recorded, d) be unemployed or underemployed, and e) be actively seeking employment.

The study exclusion criteria included a) having a medical illness that significantly affected cognition (*e.g.*, traumatic brain injury), b) uncorrected vision or hearing problem, or c) a current diagnosis of substance abuse or dependence. The institutional review board at Northwestern University Feinberg School of Medicine approved the study protocol, and all participants provided informed consent. Once enrolled, the participants were randomized into the intervention (n = 25) or treatment-as-usual (TAU) groups (n = 12) at an estimated ratio of 2:1 due to limited resources.

Intervention

VR-JIT is a computer-based training simulation designed by SIMmersion LLC (http://www.simmersion.com) to improve job interview skills for individuals with psychiatric disabilities. VR-JIT adopts SIMmersion's patented PeopleSIM technology, which uses video recordings to generate a virtual human character that interacts with trainees. The virtual character, Molly Porter, is a human resources representative at a large department store. Images of Molly and the VR-JIT interface can be found at http://www.jobinterviewtraining.net, a website designed to increase the distribution potential of VR-JIT. Although the product was specifically designed for individuals with a range of disabilities (*e.g.*, psychiatric, physical), integrated customization options allow it to be used by several groups (*e.g.,* military veterans, individuals with prior criminal record).

VR-JIT was designed to improve job interview skills by following the principles outlined by Issenberg et al. (2005) and implementing behavioral learning principles (Cooper, 1982; Cooper et al., 2007) that help promote sustainable changes in behavior (Roelfsema et al., 2010; Vinogradov et al., 2012). Specifically, VR-JIT allows trainees to a) practice interviewing for the same or different jobs repeatedly until they are prepared for a real interview; b) use speech recognition to speak their answers to questions rather than passively learn concepts (*e.g.*, reading sample answers to questions); c) answer questions specific to a job they want based on their own work history and skills; d) learn from an on-screen coach that provides in-the-moment feedback using nonverbal cues and can be asked for additional help and suggestions during practice sessions; e) practice recovering (*e.g.*, apologizing or clarifying) from mistakes or erase them to try again without penalty; f) engage with the interviewer, who has memory and emotion; g) try different approaches to answering questions that get harder as their skill increases (*e.g.*, at a moderate level, the interviewer may ask follow-up questions to clarify an answer, and at the advanced level, she may ask an illegal question); as well as h) learn from didactic electronic learning (e-learning) materials that will help them with interviews and the other steps in finding a job (*e.g.*, creating a resume, researching a position, what to wear, types of questions to ask, selecting a job that meets their needs and deciding whether to disclose a disability). In addition, job interviews are anxiety-provoking situations for most people, including individuals with psychiatric disabilities who may be prone to anxiety (Braga et al., 2013; Pini et al., 1997). Simulated role-play training allows exposure to an anxiety-provoking situation in a safe environment where the trainee can exercise maximum control.

VR-JIT allows trainees to interview for one of eight positions (*i.e.*, cashier, stock clerk, customer service, maintenance/grounds, janitorial, food service, inventory, or security) at the department store each time they play the simulation. They are required to complete an online job application with questions about past education, employment history, and job-related skills. Trainees also have the option to disclose the presence of physical disabilities (*e.g.*, spinal cord injury, visible disability, hidden disability), history of mental illness, military history, past substance abuse, and criminal history. These questions allow Molly to personalize the training experience for each individual trainee by selecting relevant questions from her database of more than 1000 video-recorded questions ranging from general inquiries (*e.g.*, "Tell me about yourself") to specifics about personal history (*e.g.*, I noticed on your application that there are gaps in your work history. Can you tell me about that?) and job duties (*e.g.*, This

position will require you to work closely with other associates. Do you enjoy working as part of a team?).

The nonbranching logic of PeopleSIM creates dynamic links between Molly's questions and the 2000 available responses, allowing trainees to try new approaches to answering questions during each interview. Molly's simulated brain includes memory and a wide range of realistic emotions and personality that allow her to further tailor the interview to each trainee. For example, if someone applies for a customer service position and responds that he or she prefers to work independently, Molly may say, "That job requires that you work closely with others. Are you still interested in it or would you prefer something else?" The combination of trainee customization options and Molly's realistic demeanor ensures that trainees experience a new interview each time they talk with her.

The variation in responses (to Molly's questions) that are available to trainees can enhance or hurt rapport with Molly, which allows trainees to learn from mistakes and creates a naturalistic conversation. VR-JIT also provides trainees with the opportunity to review a transcript of every simulated question and response, which indicates why responses were helpful or hurtful and gives related advice to the trainee. If the trainee is using the speech recognition feature, the transcript will replay a recording of the trainee's voice answering the interview questions. After each simulation, VR-JIT provides trainees with feedback on why certain training objectives received a particular score.

The simulated interviews have three difficulty levels, where Molly is friendly (easy), business oriented (medium), or brusque (hard). For example, the hard level presents a Molly who is unforgiving of errors and may even ask illegal questions. In addition, Molly's demeanor and questions continually evolve depending on the established rapport and the trainee's prior responses. This emotional realism creates a dynamic experience in which trainees observe Molly become nicer when responded to honestly and respectfully, or observe her become curt and dismissive when responded to vaguely or rudely. These features, taken together with the scope of VR-JIT's main components and nonbranching logic, provide a comprehensive and interactive learning experience for practicing and performing a successful job interview.

Training Fidelity

Two research staff members were trained to administer VR-JIT to trainees using a checklist, which covered navigating the graphic user interface, creating a user profile, completing a job application, e-learning materials, starting the simulation, reading transcripts, using in-the-moment feedback and help modules, reviewing transcripts, as well as reviewing summarized interview performance. The staff engaged in practice sessions to prepare to administer VR-JIT to trainees in a standardized fashion. The participants were able to independently navigate VR-JIT after a 30- to 45-minute training session using the aforementioned checklist, and no participants were excluded for an inability to navigate the training.

Study Procedures

The baseline assessments for both groups included a) demographic, psychosocial, and vocational interviews; b) clinical, neurocognitive, and social cognitive assessments; as well as c) two standardized role-plays and a self-report of self-confidence. After the completion of baseline assessments, the TAU group attended their typical outpatient services for 2 weeks, which may have included preparations for job interviews using didactic and role-play methods. The intervention group was asked to complete 10 hours of VR-JIT simulations (approximately 20 trials) during the course of five visits (within a 2-week period). Both groups returned after 2 weeks to complete the follow-up self-confidence measure, the Treatment Experience Questionnaire (TEQ; VR-JIT group only), and two additional standardized role-plays (in that order).

The staff encouraged the participants to review e-learning materials before each simulation, but referencing the e-learning component was not required. To promote hierarchical learning, the participants were required to progress through the three difficulty levels. They were required to complete at least three "easy" interviews. One score of 80 or higher was required on easy to advance to the "medium" level. The participants automatically advanced to medium if they did not score at least 80 before five completed interviews. This process was repeated for the participants at the medium level before advancing to "hard." The remaining trials were completed on the hard level. The staff reviewed the transcript with the participants after each completed simulated interview, which lasted approximately 15 minutes.

Study Measures

Demographic Characteristics and Vocational History

The participants' demographic characteristics (*e.g.*, age, sex, race) and vocational history (*e.g.*, months since prior employment, prior vocational training) were obtained via a self-report interview.

Neurocognitive and Social Cognitive Measures

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) (Randolph et al., 1998) was administered to assess neurocognitive functioning. The total score of the RBANS reflects the following domains: immediate memory (*i.e.*, list learning, story memory), visuospatial capacity (*i.e.*, figure copy, line orientation), language (*i.e.*, picture naming, semantic fluency), attention (*i.e.*, digit span, coding), and delayed memory (list learning free recall, list learning recognition, story memory free recall, figure free recall). Additional details on these tests can be found at http://www.rbans.com/testcontent.html.

We assessed basic and advanced social cognition with two tasks used in prior studies of adults with psychiatric disabilities. We assessed basic social cognition using the Bell-Lysaker Emotion Recognition Task (BLERT) (Bell et al., 1997). The BLERT requires participants to view 21 video-recorded vignettes of an affective monologue and respond to which emotion is prominently displayed. An accuracy rating was computed on the basis of the number of correct responses.

We assessed advanced social cognition using an emotional perspective-taking (EPT) task (Smith et al., 2014). The participants observed 60 scenes of two actors engaged in social interactions. The face of one actor was covered with a mask, and the participants were instructed to select which of two facial expressions would best reflect how the masked character would feel in the interaction. An accuracy rating was computed on the basis of the number of correct responses.

The validities of the BLERT and the EPT task have been reported previously (Derntl and Habel, 2011; Pinkham et al., 2014; Smith et al., 2014), whereas their internal consistencies are $\alpha = 0.66$ and $\alpha = 0.56$, respectively, in the current sample.

Feasibility Assessments

The participants were invited to attend five training sessions during which they could spend up to 2 hours receiving VR-JIT. We recorded participant attendance across the five training sessions and the number of minutes (of a possible 600 minutes) that each participant engaged in the simulations.

The participants completed the TEQ (Bell and Weinstein, 2011) to evaluate the extent they felt VR-JIT was easy to use, enjoyable, and helpful as well as instilled confidence in interviewing and prepared them for interviews. The TEQ's five items were rated on a 7-point Likert scale, with higher scores reflecting more positive views of VR-JIT. The TEQ had an internal consistency of $\alpha = 0.71$.

Primary Efficacy Assessments

Role-play job interviews

Interview role-plays (approximately 20 minutes each) were scored using nine communication skills that contribute to successful job interviews: a) conveying oneself as a hard worker (dependable), b) sounding easy to work with (teamwork), c) conveying that one behaves professionally, d) negotiation skills (asking for Thursdays off), e) sharing things in a positive way, f) sounding honest, g) sounding interested in the position, h) comfort level, and i) establishing overall rapport with the interviewer. These role-play scoring domains matched the feedback domains used in VR-JIT and are consistent with the job-relevant interview content and interviewee performance constructs from the literature (Huffcutt, 2011).

The participants completed two role-plays at baseline and two role-plays at follow-up. They selected four of eight job scenarios and completed a job application to guide their role-play. The scenarios differed from the eight jobs available during the intervention. They included data entry specialist at the Department of Public Health, mail clerk or paralegal at a law firm, medical records clerk at a hospital, inventory manager or stock clerk at a warehouse, sales associate at a home goods store, or reference librarian at the public library. The participants were provided the following instructions before each interview: "You are interviewing for part-time work, particularly because you need to have Thursdays off for personal reasons. You will need to negotiate for a schedule that will accommodate for Thursdays off." Interview role-plays were conducted by standardized role-play actors (SRAs) posing as human resources representatives and trained to ask 13 standardized questions and 3 to 4 random questions from a list of 70 or more questions, in a naturalistic way. The job scenarios were developed by the research team and vetted through a panel of vocational rehabilitation experts. All role-plays were video recorded for scoring purposes.

Role-play videos were randomly assigned to two raters with expertise in human resources and blinded to treatment group status. The raters were trained with 10 practice videos before independently rating the study videos. The raters established reliability with the study data by double scoring approximately 20% of the videos and attained a high degree of reliability (Intraclass Correlation Coefficient, 0.85). To prevent rater drift, both raters met with the research team every 20 videos to review two videos and discuss inconsistencies and reach a consensus score. A total score was computed across nine domains (range of 1–5 per domain, with higher scores reflecting better performance) for each of the two baseline role-plays and then averaged to compute a single score. The same method was used to compute a single follow-up role-play score.

Job interview self-confidence

The participants rated their self-confidence at performing job interviews using a 7-point Likert scale to answer nine questions, with higher scores reflecting more positive views (*e.g.*, "How comfortable are you going on a job interview?" "How skilled are you at making a good first impression?" and "How skilled are you at maintaining rapport throughout the interview?"). Total scores at baseline and follow-up were computed. The internal consistencies at baseline ($\alpha = 0.92$) and follow-up ($\alpha = 0.92$) across all subjects were strong.

Process Measure

VR-JIT performance

The participants' VR-JIT performance score for each trial and time spent engaged with the simulated interviews were recorded in the laboratory. The VR-JIT program scored each simulated interview from 0 to 100 using an algorithm programmed into the software on the basis of the appropriateness of their responses throughout the interview in the following eight domains: negotiation skills (asking for Thursdays off), conveying you are a hard worker (dependable), sounding easy to work with (teamwork), sharing things in a positive way, sounding honest, sounding interested in the position, acting professionally, and establishing overall rapport with the interviewer.

Data Analysis

Between-group differences for demographics, vocational history, global neurocognition, and social cognition were assessed with analysis of variance (ANOVA) and chi-square analyses. We characterized VR-JIT feasibility with descriptive statistics of session attendance, the mean number of minutes required to complete the simulated interviews, total completed trials, and mean responses to the TEQ. We used a time-by-group interaction from a repeated-measures ANOVA (RM-ANOVA) to evaluate whether the primary outcome measures (role-play performance and job interview self-confidence) for the VR-JIT group significantly improved between baseline and follow-up as compared with the TAU group. Cohen's *d* effect sizes were generated to characterize the within-subject differences between baseline and follow-up scores as well as between-group differences at follow-up.

We evaluated VR-JIT performance across trials as a process measure by computing linear regression slopes for each subject on the basis of the regression of their performance scores on the log of trial number. The group-level performance mean for each successive VR-JIT trial was plotted with a report of the R^2 from the regression of mean performance on the log of trial number.

We computed partial correlations in an effort to explore whether role-play and self-confidence scores at follow-up as well as VR-JIT performance slopes were associated with each other as well as with age, sex, months since prior employment, global neurocognition, as well as basic and advanced social cognition (while covarying for baseline outcome scores).

The data were normally distributed, and no transformations were necessary. Although the participants were instructed to negotiate for Thursdays off during each role-play, they forgot during 16% of the role-plays despite prompting from the SRAs. The mean value of the other scores for this item was imputed for the missing variable (Myers, 2000; Sterne et al., 2009). No other role-play ratings were missing.

Data were collected and managed using Research Electronic Data Capture (REDCap) electronic data capture tools hosted at the blinded institution (Harris et al., 2009). REDCap is a secure, Web-based application designed to support data capture for research studies.

RESULTS

Between-Group Characteristics

The VR-JIT and TAU groups did not differ with respect to age at baseline, race, parental educational attainment, neurocognitive and social cognitive functioning, the number of months since

TABLE 1. Characteristics of the Study Sample

	TAU Group (n = 12)	VR-JIT Group (n = 25)	χ^2/T-Statistic
Demographics			
Age, mean (SD)	44.3 (10.3)	50.0 (11.6)	−1.5
Sex (male), %	16.7	64.0	7.3*
Parental education, mean (SD), yrs	12.5 (2.4)	14.1 (3.0)	−1.6
Race, %			
Caucasian	50.0	44.0	
African-American	41.7	52.0	2.8
Asian	8.3	0.0	
Latino	0.0	4.0	
Clinical history, %			
MDD[a]	25.0	56.0	3.1**
Bipolar disorder type I or II	50.0	32.0	1.1
Schizophrenia or schizoaffective disorder	25.0	12.0	1.0
Vocational history			
Prior full-time employment, %	75.0	88.0	1.0
Prior paid employment (any type), %	100.0	96.0	0.5
Prior participation in vocational training program, %	25.0	32.0	0.2
Months since any prior employment, mean (SD)	47.2 (60.5)	42.1 (43.4)	0.3
Cognitive function			
Prior participation in cognitive remediation, %	0.0	12.0	1.6
Global neurocognition, mean (SD)	91.3 (15.4)	95.2 (19.9)	−0.6
Basic social cognition, mean (SD)	0.75 (0.13)	0.70 (0.16)	1.0
Advanced social cognition, mean (SD)	0.79 (0.09)	0.79 (0.07)	0.2

[a]One patient in the TAU group has PTSD and MDD and one patient in the VR-JIT group has PTSD and MDD.

*$p \leq 0.01$.

**$p \leq 0.10$.

prior employment, previously held full-time employment, as well as prior participation in cognitive remediation or vocational rehabilitation (all $p > 0.10$). Despite random assignment, the VR-JIT and TAU groups differed by sex ($p \leq 0.01$) and the proportion of individuals with an MDD ($p = 0.08$) (Table 1).

VR-JIT Feasibility

The VR-JIT sessions were well attended and the participants reported that VR-JIT was easy to use, enjoyable, and helpful; increased their self-confidence in job interview skills; as well as improved their readiness for interviewing (Table 2).

Job Interview Role-Play Performance

The results of the primary outcome RM-ANOVA analyses are presented in Table 3. The RM-ANOVA revealed a significant group-by-time interaction ($F[1,35] = 5.1$, $p \leq 0.05$) but not a significant group effect at baseline ($p > 0.10$). The VR-JIT group improved on the total role-play assessment score between baseline and follow-up ($d = 0.57$), whereas the TAU group did not ($d = -0.22$) (Fig. 1A). The follow-up role-play performances did not differ between groups at posttest ($d = 0.02$). The distributions of sex and MDD (or psychotic disorders) differed by group. Hence, they were evaluated independently as fixed-effects covariates. Neither variable had a significant main effect, time-by-sex or MDD interaction, or time-by-group-by-sex or MDD interaction (all $p > 0.10$). Because of the observed nonsignificant effects, these variables were not included as covariates to maximize statistical power.

Job Interview Self-confidence and Process Measure

The RM-ANOVA revealed a significant group-by-time interaction ($F[1,33] = 4.1$, $p \leq 0.05$) but not a significant group effect ($p > 0.10$) (Fig. 1B). Although the interaction was significant, both the VR-JIT and TAU groups demonstrated increased self-confidence characterized by large effects ($d = 1.18$ and $d = 0.81$, respectively). Two subjects (1 TAU, 1 VR-JIT) did not complete the follow-up self-confidence measure.

Our process measure indicated that VR-JIT performance scores seemed to improve linearly with a dip approximately halfway through the hard trials, which suggests that trainees may have spent a few trials learning about less appropriate responses (Fig. 2). Specifically, the slope (mean, 3.2; SD, 3.8) suggests that

TABLE 2. Feasibility Characteristics of VR-JIT Training

Attendance measures	
Session attendance, %	95.2 (0.1)
Elapsed simulation time, min	564.6 (78.5)
Simulated interviews (count)	14.5 (3.2)
Training Experience Questionnaire	
Easy to use	6.1 (0.9)
Enjoyable	6.4 (1.0)
Helpful	6.3 (1.1)
Instilled confidence	6.0 (1.2)
Prepared for interviews	6.0 (1.0)

Values are mean (SD).

TABLE 3. Change in Role-Play Performance and Job Interview Self-confidence

	TAU Group			VR-JIT Group		
	Baseline Mean (SD)	Follow-up Mean (SD)	Cohen's *d*	Baseline Mean (SD)	Follow-up Mean (SD)	Cohen's *d*
Role-play performance	36.9 (3.4)[a]	36.2 (4.0)	−0.22	34.2 (5.3)[a]	36.3 (4.0)	0.57
Job interview self-confidence	38.4 (13.2)[b]	44.5 (8.2)	0.81	37.5 (12.5)[b]	51.8 (8.9)	1.18

[a]Baseline role-play performance did not differ between groups ($p > 0.10$).

[b]Baseline job interview self-confidence did not differ between groups ($p > 0.10$).

performance improves 3.2 points for every 1-point increase in the natural log of the trial number ($R^2 = 0.65$).

The exploratory correlations between the self-confidence, role-play, and process measures as well as with baseline variables within the VR-JIT group alone were not significant (all $p > 0.10$), with the exception of age. VR-JIT performance scores were significantly correlated with age ($r = -0.66$, $p \leq 0.01$), which suggests that younger participants have greater increases in VR-JIT performance scores per trial run.

DISCUSSION

In this study, we examined whether VR-JIT demonstrated preliminary feasibility and efficacy in a small, randomized controlled trial of individuals with a psychiatric disability. The results suggest that VR-JIT can be feasibly implemented in a laboratory setting for individuals with a psychiatric disability as evidenced by completion of more than 95% of training sessions and more than 550 minutes of training (of a maximum of 600 minutes). The participants reported that the intervention was easy to use, highly enjoyable, and helpful as well as instilled them with confidence and made them feel well-prepared for future interviews. The results also suggest VR-JIT may be efficacious given that the VR-JIT group had significantly higher scores on the role-plays at follow-up compared with baseline, increased their self-confidence in their interview skills, and demonstrated significant improvement on their simulated role-play performances across increasing levels of difficulty. Although prior studies suggest that higher self-confidence may be related to better interview performance (Corbiere et al., 2004; Tay et al., 2006), we did not observe this relationship in the correlation analyses. This could be explained by a lack of power due to the small sample size or by limitations in the validity of the self-reported self-confidence measure given that both groups reported a large effect size increase in self-confidence. Hence, it is possible that both groups overreported their confidence in the ability to succeed at a job interview.

The observed improvement in job interviewing skills (medium effect size) between the baseline and follow-up assessments is consistent with a recent study demonstrating improved job interview skills among individuals with autism spectrum disorders while using VR-JIT and role-play assessments (Smith et al., in press). Our results were also consistent with recent studies demonstrating that VR training using animated avatars can be used to improve vocational and social skills for individuals with psychiatric disabilities (Park et al., 2011; Rus-Calafell et al., 2014; Tsang and Man, 2013; Zawadzki et al., 2013). Moreover, VR-JIT provided in-the-moment feedback, was rewarding, and was designed using behavioral learning principles with repetitive practice that allowed participants to build mastery as the simulated interviews progressively increased in difficulty. These design elements are critical features for interventions to train sustainable behavior (Kopelowicz et al., 2006; Roelfsema et al., 2010; Vinogradov et al., 2012).

The findings must be interpreted while considering some limitations. This sample was small, and a larger sample could provide greater statistical power. For instance, we observed between-group differences in sex and diagnosis, which indicate that, perhaps, women or individuals with psychosis (*i.e.*, bipolar or schizophrenia) may not benefit from the intervention. Although we observed these variables to be nonsignificant covariates, the study was underpowered. The baseline performance in the TAU group seemed higher (although nonsignificant) than in the VR-JIT group, and the observed improvement in performance between baseline and follow-up in the intervention group could be interpreted as a regression to the mean given the small effect size difference between groups on posttest scores. It is important to note that one subject in the VR-JIT group scored 3.0 SD below the mean on their baseline role-play score. If this potential outlier is removed from the analysis, then the interaction in Figure 1 Panel A remains

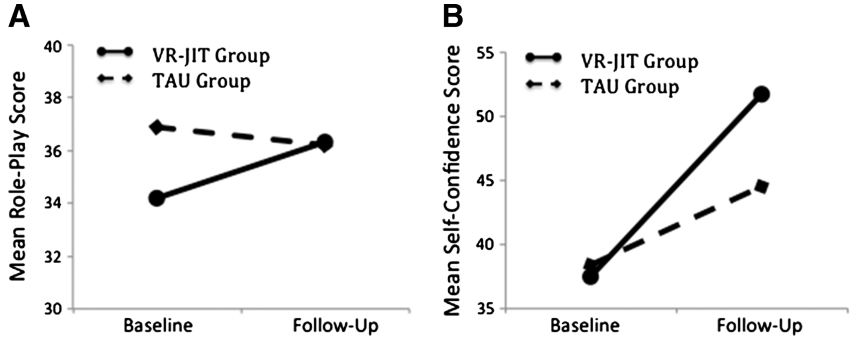

FIGURE 1. Primary outcomes. Panel A plots the significant time-by-VR-JIT group interaction with regard to baseline and follow-up role-play scores. Panel B plots the trend-level time-by-VR-JIT group interaction with regard to baseline and follow-up self-confidence scores.

FIGURE 2. VR-JIT learning curve in adults with a psychiatric disability. This figure plots the mean score for each successive VR-JIT simulated interview trial. Trials 1 to 3 at easy, trials 4 to 6 at medium, and trials 7 to 17 at hard. Model fit, $R^2 = 0.65$.

significant (VR-JIT slope shifts upward) and the baseline difference is reduced. Although the subjects were randomly assigned and multiple baseline measures were obtained in an effort to prevent such threats to internal validity (Barnett et al., 2005), this finding must be interpreted with caution. Thus, it is possible that VR-JIT does not have a strong effect; however, future research with a larger sample would be needed to evaluate this issue more carefully.

In addition, the sample was older and the study was conducted in a laboratory setting. Further research is needed to gather data from a younger sample in a community setting to better establish the effectiveness of VR-JIT training. The specific outpatient services received by the TAU group were not identified, which may have contributed to their observed increased self-confidence ratings. Alternatively, the observed increase could be due to completion of the role-plays.

This study suggests that VR-JIT might be feasible and efficacious across individuals with MDD, bipolar disorder, and schizophrenia. However, further research is needed to examine the impact of VR-JIT on each of these groups independently. We recruited participants who were actively seeking employment or competitive volunteer work. This approach may have created a self-selection sampling bias, but our participants represent the individuals most likely to use the software. Given that the heterogeneity of the sample may be a limitation, future research could assess whether VR-JIT may be efficacious for particular disorders. Future studies could also assess whether symptoms, pharmacological treatment, motivation, and length of time seeking employment impact the results of VR-JIT because these measures were not collected in the current study.

We did not track the use of the e-learning component or use of speech recognition, which could impact the utility of training and influence the participant's learning, role-play performances, or VR-JIT performance scores. By tracking these data in future studies, we could more thoroughly assess how participants use and benefit from VR-JIT. Furthermore, recent studies have demonstrated that interventions can be administered to psychiatric populations using mobile devices (Ben-Zeev et al., in press, 2013). Thus, future research could examine whether VR-JIT can be modified for use as a mobile device application in an effort to increase accessibility to trainees. Although we do not currently have employment outcome data for the participants in this study, future studies will examine whether VR-JIT is related to an increase in job interview frequency and finding a job.

CONCLUSIONS

In conclusion, VR training is a strategy that the field is developing to improve social cognition and assess community-based outcomes (Rus-Calafell et al., 2014; Zawadzki et al., 2013). This study demonstrated preliminary evidence that a VR approach to training job interview skills might be a feasible and efficacious tool to improve job interview performances and self-confidence in job interviewing for individuals with psychiatric disabilities. Along these lines, future research could assess whether VR-JIT could effectively enhance SE (the criterion standard for vocational rehabilitation) (Becker et al., 2011; Bond et al., 2008) as well as help individuals who do not have access to evidence-based vocational interventions. VR-JIT can reach a wide range of consumers of mental health services based on its use of a computerized platform (Internet or desktop) to deliver VR simulations.

ACKNOWLEDGMENTS

The authors thank Dr Zoran Martinovich for his consultation on the statistical analyses, the research staff at Northwestern University's Clinical Research Program for data collection, and our participants for volunteering their time.

DISCLOSURES

This study was supported by a grant to Dr Dale Olsen (R44 MH080496) from the NIMH to develop VR-JIT, and funds were subcontracted to Dr Michael Fleming at Northwestern University Feinberg School of Medicine to support the NU team to complete the study.

Dr Olsen and Laura Boteler Humm are employed by and own shares in SIMmersion LLC. They contributed to the article but were not involved in analyzing the data. Dr Bell was a paid consultant by SIMmersion LLC to assist with the development of VR-JIT. Dr Bell and his family do not have a financial stake in the company. The remaining authors report no conflicts of interest outside their salary support to complete the study. The authors have declared that there are no conflicts of interest in relation to the subject of this study.

REFERENCES

Barnett AG, van der Pols JC, Dobson AJ (2005) Regression to the mean: What it is and how to deal with it. *Int J Epidemiol*. 34:215–220.

Becker DR, Drake RE, Bond GR (2011) Benchmark outcomes in supported employment. *Am J Psychiatr Rehabil*. 14:230–236.

Bell MD, Bryson GA, Lysaker P (1997) Positive and negative affect recognition in schizophrenia: A comparison with substance abuse and normal control subjects. *Psychiatry Res*. 73:73–82.

Bell MD, Lysaker P, Bryson GA (2003) A behavioral intervention to improve work performance in schizophrenia: Work behavior inventory feedback. *J Vocat Rehabil*. 18:43–50.

Bell MD, Weinstein A (2011) Simulated job interview skill training for people with psychiatric disability: Feasibility and tolerability of virtual reality training. *Schizophr Bull*. 37(suppl 2):S91–S97.

Bell MD, Zito W, Greig T, Wexler BE (2008) Neurocognitive enhancement therapy with vocational services: Work outcomes at two-year follow-up. *Schizophr Res*. 105:18–29.

Ben-Zeev D, Brenner CJ, Begale M, Duffecy J, Mohr DC, Mueser KT (in press) Feasibility, acceptability, and preliminary efficacy of a smartphone intervention for schizophrenia. *Schizophr Bull*.

Ben-Zeev D, Kaiser SM, Brenner CJ, Begale M, Duffecy J, Mohr DC (2013) Development and usability testing of FOCUS: A smartphone system for self-management of schizophrenia. *Psychiatr Rehabil J*. 36:289–296.

Bond GR, Drake RE, Becker DR (2008) An update on randomized controlled trials of evidence-based supported employment. *Psychiatr Rehabil J*. 31:280–290.

Bowie CR, McGurk SR, Mausbach B, Patterson TL, Harvey PD (2012) Combined cognitive remediation and functional skills training for schizophrenia: Effects on cognition, functional competence, and real-world behavior. *Am J Psychiatry*. 169:710–718.

Braga RJ, Reynolds GP, Siris SG (2013) Anxiety comorbidity in schizophrenia. *Psychiatry Res*. 210:1–7.

Cook DA, Hatala R, Brydges R, Zendejas B, Szostek JH, Wang AT, Erwin PJ, Hamstra SJ (2011) Technology-enhanced simulation for health professions education: A systematic review and meta-analysis. *JAMA*. 306:978–988.

Cook JA (2006) Employment barriers for persons with psychiatric disabilities: Update of a report for the President's Commission. *Psychiatr Serv*. 57:1391–1405.

Cooper JO (1982) Applied behavior analysis in education. *Theory Into Practice*. 21:114–118.

Cooper JO, Heron TE, Heward WL (2007) *Applied behavioral analysis*. London: Pearson.

Corbiere M, Mercier C, Lesage A (2004) Perceptions of barriers to employment, coping efficacy, and career search efficacy in people with mental illness. *J Career Assess*. 12:460–478.

Couture SM, Penn DL, Roberts DL (2006) The functional significance of social cognition in schizophrenia: A review. *Schizophr Bull*. 32(suppl 1): S44–S63.

Derntl B, Habel U (2011) Deficits in social cognition: A marker for psychiatric disorders? *Eur Arch Psychiatry Clin Neurosci*. 261(suppl 2):S145–S149.

Dickinson D, Bellack AS, Gold JM (2007) Social/communication skills, cognition, and vocational functioning in schizophrenia. *Schizophr Bull*. 33:1213–1220.

Dilk MN, Bond GR (1996) Meta-analytic evaluation of skills training research for individuals with severe mental illness. *J Consult Clin Psychol*. 64: 1337–1346.

Fleming M, Olsen D, Stathes H, Boteler L, Grossberg P, Pfeifer J, Schiro S, Banning J, Skochelak S (2009) Virtual reality skills training for health care professionals in alcohol screening and brief intervention. *J Am Board Fam Med*. 22:387–398.

Frounfelker RL, Wilkniss SM, Bond GR, Devitt TS, Drake RE (2011) Enrollment in supported employment services for clients with a co-occurring disorder. *Psychiatr Serv*. 62:545–547.

Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG (2009) Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 42:377–381.

Huffcutt AI (2011) An empirical review of the employment interview construct literature. *Int J Sel Assess*. 19:62–81.

Issenberg SB, McGaghie WC, Petrusa ER, Lee Gordon D, Scalese RJ (2005) Features and uses of high-fidelity medical simulations that lead to effective learning: A BEME systematic review. *Med Teach*. 27:10–28.

Kopelowicz A, Liberman RP, Zarate R (2006) Recent advances in social skills training for schizophrenia. *Schizophr Bull*. 32(suppl 1):S12–S23.

Lahera G, Ruiz-Murugarren S, Iglesias P, Ruiz-Bennasar C, Herreria E, Montes JM, Fernandez-Liria A (2012) Social cognition and global functioning in bipolar disorder. *J Nerv Ment Dis*. 200:135–141.

Lysaker PH, Davis LW, Bryson GJ, Bell MD (2009) Effects of cognitive behavioral therapy on work outcomes in vocational rehabilitation for participants with schizophrenia spectrum disorders. *Schizophr Res*. 107:186–191.

McGurk SR, Mueser KT, Pascaris A (2005) Cognitive training and supported employment for persons with severe mental illness: One-year results from a randomized controlled trial. *Schizophr Bull*. 31:898–909.

Mueser KT, Aalto S, Becker DR, Ogden JS, Wolfe RS, Schiavo D, Wallace CJ, Xie H (2005) The effectiveness of skills training for improving outcomes in supported employment. *Psychiatr Serv*. 56:1254–1260.

Myers WR (2000) Handling missing data in clinical trials: An overview. *Drug Info J*. 34:525–533.

Olsen DE, Sellers WA, Phillips RG (1999) *The simulation of a human subject for law enforcement training*. Washington, DC: Office of National Drug Control Policy.

Park KM, Ku J, Choi SH, Jang HJ, Park JY, Kim SI, Kim JJ (2011) A virtual reality application in role-plays of social skills training for schizophrenia: A randomized, controlled trial. *Psychiatry Res*. 189:166–172.

Pini S, Cassano GB, Simonini E, Savino M, Russo A, Montgomery SA (1997) Prevalence of anxiety disorders comorbidity in bipolar depression, unipolar depression and dysthymia. *J Affect Disord*. 42:145–153.

Pinkham AE, Penn DL, Green MF, Buck B, Healey K, Harvey PD (2014) The Social Cognition Psychometric Evaluation Study: Results of the Expert Survey and RAND Panel. *Schizophr Bull*. 40:813–823.

Provencher HL, Gregg R, Mead S, Mueser KT (2002) The role of work in the recovery of persons with psychiatric disabilities. *Psychiatr Rehabil J*. 26:132–144.

Ramsay CE, Broussard B, Goulding SM, Cristofaro S, Hall D, Kaslow NJ, Killackey E, Penn D, Compton MT (2011) Life and treatment goals of individuals hospitalized for first-episode nonaffective psychosis. *Psychiatry Res*. 189:344–348.

Randolph C, Tierney MC, Mohr E, Chase TN (1998) The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): Preliminary clinical validity. *J Clin Exp Neuropsychol*. 20:310–319.

Roelfsema PR, van Ooyen A, Watanabe T (2010) Perceptual learning rules based on reinforcers and attention. *Trends Cogn Sci*. 14:64–71.

Rosenheck R, Leslie D, Keefe R, McEvoy J, Swartz M, Perkins D, Stroup S, Hsiao JK, Lieberman J (2006) Barriers to employment for people with schizophrenia. *Am J Psychiatry*. 163:411–417.

Rus-Calafell M, Gutierrez-Maldonado J, Ribas-Sabate J (2014) A virtual reality-integrated program for improving social skills in patients with schizophrenia: A pilot study. *J Behav Ther Exp Psychiatry*. 45:81–89.

Salkever DS, Karakus MC, Slade EP, Harding CM, Hough RL, Rosenheck RA, Swartz MS, Barrio C, Yamada AM (2007) Measures and predictors of community-based employment and earnings of persons with schizophrenia in a multisite study. *Psychiatr Serv*. 58:315–324.

Salyers MP, Becker DR, Drake RE, Torrey WC, Wyzik PF (2004) A ten-year follow-up of a supported employment program. *Psychiatr Serv*. 55:302–308.

Samame C (2013) Social cognition throughout the three phases of bipolar disorder: A state-of-the-art overview. *Psychiatry Res*. 210:1275–1286.

Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, Hergueta T, Baker R, Dunbar GC (1998) The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for *DSM-IV* and ICD-10. *J Clin Psychiatry*. 59(suppl 20):22–33; quiz 34–57.

Smith MJ, Ginger EM, Wright K, Wright MA, Taylor JL, Boteler Humm L, Olsen D, Bell MB, Fleming MF (in press) Virtual reality job interview training in adults with autism spectrum disorder. *J Autism Dev Dis*.

Smith MJ, Horan WP, Cobia DJ, Karpouzian TM, Fox JM, Reilly JL, Breiter HC (2014) Performance-based empathy mediates the influence of working memory on social competence in schizophrenia. *Schizophr Bull*. 40:824–834.

Sterne JA, White IR, Carlin JB, Spratt M, Royston P, Kenward MG, Wood AM, Carpenter JR (2009) Multiple imputation for missing data in epidemiological and clinical research: Potential and pitfalls. *BMJ*. 338:b2393.

Substance Abuse and Mental Health Services Administration (SAMSHA) (2009) In US Department of Health and Human Services (Ed), *Supported employment: training frontline staff*. Rockville, MD: Center for

Mental Health Services, Substance Abuse and Mental Health Services Administration.

Tay C, Ang S, Van Dyne L (2006) Personality, biographical characteristics, and job interview success: A longitudinal study of the mediating effects of interviewing self-efficacy and the moderating effects of internal locus of causality. *J Appl Psychol*. 91:446–454.

Tsang MM, Man DW (2013) A virtual reality-based vocational training system (VRVTS) for people with schizophrenia in vocational rehabilitation. *Schizophr Res*. 144:51–62.

Twamley EW, Vella L, Burton CZ, Becker DR, Bell MD, Jeste DV (2012) The efficacy of supported employment for middle-aged and older people with schizophrenia. *Schizophr Res*. 135:100–104.

US Department of Labor (2013) In Bureau of Labor Statistics (Ed), *Labor Force Statistics From the Current Population Survey*. Retrieved from http://data.bls.gov/timeseries/LNS14000000. Accessed April 21, 2014.

Vinogradov S, Fisher M, de Villers-Sidani E. (2012) Cognitive training for impaired neural systems in neuropsychiatric illness. *Neuropsychopharmacology*. 37:43–76.

Wilkinson GS, Robertson GJ (2006) *Wide Range Achievement Test 4 Professional Manual*. Lutz, FL: Psychological Assessment Resources.

Zawadzki JA, Girard TA, Foussias G, Rodrigues A, Siddiqui I, Lerch JP, Grady C, Remington G, Wong AH (2013) Simulating real world functioning in schizophrenia using a naturalistic city environment and single-trial, goal-directed navigation. *Front Behav Neurosci*. 7:180.