

# Enhancing individual placement and support (IPS) - Supported employment: A Type 1 hybrid design randomized controlled trial to evaluate virtual reality job interview training among adults with severe mental illness

Matthew J. Smith<sup>a,\*</sup>, Justin D. Smith<sup>b,c,d</sup>, Michael F. Fleming<sup>b</sup>, Neil Jordan<sup>b</sup>, Eugene A. Oulvey<sup>e</sup>, Morris D. Bell<sup>f</sup>, Kim T. Mueser<sup>g</sup>, Susan R. McGurk<sup>g</sup>, E-Shawn Spencer<sup>h</sup>, Kimberly Mailey<sup>i</sup>, Lisa A. Razzano<sup>i,j</sup>

<sup>a</sup> School of Social Work, University of Michigan, USA

<sup>b</sup> Department of Psychiatry and Behavioral Sciences, Northwestern University, USA

<sup>c</sup> Department of Preventive Medicine, Northwestern University Feinberg School of Medicine, USA

<sup>d</sup> Department of Pediatrics, Northwestern University Feinberg School of Medicine, USA

<sup>e</sup> Illinois Department of Human Services, Division of Rehabilitation Services, USA

<sup>f</sup> Department of Psychiatry, Yale School of Medicine, USA

<sup>g</sup> Boston University, USA

<sup>h</sup> Adams and Associates, Inc., USA

<sup>i</sup> Thresholds Inc, USA

<sup>j</sup> Chicago Department of Psychiatry, University of Illinois, USA

## ABSTRACT

Individual Placement and Support (IPS) is the evidence-based model of supported employment that increases employment rates in adults with severe mental illness (SMI). Although IPS is largely successful, over 80% of adults with SMI remain unemployed. An enhancement to high fidelity IPS could be an evidence-based job interview training component. To meet this training need, our group recently completed a series of randomized controlled efficacy trials funded by the National Institute of Mental Health to develop and test virtual reality job interview training (VR-JIT) in a lab setting. The results demonstrated that the intervention was efficacious at helping trainees improve their job interview skills and receive job offers within six months of completing VR-JIT compared to non-trainees. The overarching goal of this study is to evaluate the effectiveness of VR-JIT as an enhancement to IPS when delivered in a large community-based mental health service provider via a randomized controlled trial and initial process evaluation. Our aims are to: evaluate whether IPS services-as-usual in combination with VR-JIT, compared to IPS services-as-usual alone, enhances IPS outcomes for adults with SMI; evaluate mechanisms of employment outcomes and psychological distress; and conduct a multilevel, multidisciplinary, and mixed-method process evaluation of VR-JIT adoption and implementation to assess the acceptability, scalability, generalizability, and affordability of VR-JIT.

## 1. Introduction

Approximately 10–15% of the nine million adults with severe mental illness (SMI) are employed [1–3], which is associated with reduced psychological distress [4] and improved economic well-being [5]. However, employment rates increase to 50–60% in adults with SMI enrolled in Individual Placement and Support (IPS) [6], which is the standardized version of supported employment. IPS provides comprehensive individualized services to a high degree of fidelity (monitored by state agencies) that include systematic job development, rapid job search, competitive employment, benefits planning, worker preferences, time-unlimited supports, zero exclusion, and is integrated with other mental health services [7,8]. A recent framework evaluating

supported employment (not high fidelity IPS) outcomes observed that active job-seeking behavior (e.g., completing job interviews) is an essential treatment target to enhance access to employment [9], and the chances of finding a job could be moderated by intrapersonal barriers such as poor self-efficacy and anxiety about interviewing [9]. In turn, this framework serves as a guide to evaluate these potential intrapersonal barriers for obtaining employment among individuals engaged in high fidelity IPS. Moreover, these targets are underdeveloped because a literature predating IPS services suggests that adults with SMI in general have poor interviewing skills and expressed a desire for interview training to alleviate their fears and poor self-efficacy [10–13]. Currently, IPS teams frequently rely upon role-play training conducted by vocational counselors, called employment specialists, as one strategy

\* Corresponding author at: School of Social Work, University of Michigan, 1080 South University Avenue, Room 3796, Ann Arbor, MI 48109-1106, USA.  
E-mail address: [mattjsmi@umich.edu](mailto:mattjsmi@umich.edu) (M.J. Smith).

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to enhance interview skills [14,15]. Along these lines, few clients engaged in supported employment (not high fidelity IPS) services reported that having someone help them practice job interviewing was helpful [16] leading to a critical gap in supported employment and IPS services.

To address this gap, our team developed Virtual Reality Job Interview Training (VR-JIT) and evaluated VR-JIT efficacy in a series of five, lab-based, randomized controlled trials (RCTs). These studies demonstrated that VR-JIT trainees with SMI or other disabilities improved their interviewing skills and interviewing self-efficacy compared to a control group [17–21]. VR-JIT trainees also had an increased likelihood of getting job offers [17,19,22–24]. However, the apparent efficacy of this approach among individuals with SMI (of which only 30–40% were receiving some form of vocational services) requires replication in more representative samples of persons with SMI enrolled in IPS. We proposed to evaluate VR-JIT as an enhancement to IPS based on IPS developers identifying the integration of new technologies into IPS as a top research priority [25]. Thus, VR-JIT is an ideal intervention to evaluate as an effective enhancement to IPS.

There are several important steps the proposed research will take to evaluate whether VR-JIT is effective at improving employment outcomes for individuals with SMI who are enrolled in IPS. The first step will test how enhancing the IPS job interview training with VR-JIT affects client-level outcomes (e.g., interview skills, employment rate) and system-level outcomes (e.g., staff efficiency, cost-effectiveness) of IPS. The second step will evaluate the initial implementation of VR-JIT within IPS focusing on outcomes most salient to this stage, including adoptability, acceptability, scalability, feasibility, and implementation costs [26]. Lastly, the third step will use the adapted framework from Corbière et al. [9] to guide our exploration of the potential mechanisms for enhanced IPS outcomes.

## 2. Methods

### 2.1. Study design

This study is a two-arm randomized controlled trial in which clients 18–55 years old with a history of SMI and enrolled in IPS services are randomized to receive IPS services-as-usual (i.e., control group) or IPS in combination with VR-JIT (i.e., intervention group). Interview training in the IPS services-as-usual arm involves an employment specialist who facilitates mock interviews. Those participants in the VR-JIT arm will not participate in mock interview training with an IPS employment specialist, but can discuss their interview skills and VR-JIT experiences with the employment specialist. All study procedures and materials were approved by the Institutional Review Board at Northwestern University's Feinberg School of Medicine (at the time the trial began) and at the University of Michigan (after the Principal Investigator [PI] [MJS] changed institutions). The study uses a Hybrid Type I (HT1) effectiveness-implementation design to evaluate the effectiveness of VR-JIT while collecting data on the delivery of VR-JIT in real-world IPS programs [27]. Here are the specific aims of the study:

**Aim 1.** Evaluate whether IPS services-as-usual in combination with VR-JIT (IPS + VR-JIT), compared to IPS services-as-usual alone (IPS-only), enhances IPS outcomes for adults with SMI.

**Aim 1 Hypotheses.** At a person level, we *hypothesize (H)* that IPS + VR-JIT trainees, compared to IPS-only participants, will have higher employment rates (*H1*), see greater improvement in job interview skills (*H2*), get jobs sooner (*H3*), and have reduced psychological distress (*H4*) by six-month follow-up. At a system level, we hypothesize that IPS + VR-JIT will be more cost-effective than IPS-only (*H5*).

**Exploratory Subaim 1a.** Explore whether VR-JIT enhances general social skills by evaluating whether VR-JIT training relates to improved social competence and longer job tenure for clients (person-level), and whether IPS staff spend fewer hours coaching communication at work (system-level);

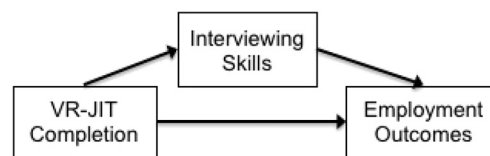


Fig. 1. We will test whether interviewing skills mediate the relationship between VR-JIT completion and employment outcomes.

**Exploratory Subaim 1b.** Explore whether IPS + VR-JIT staff have increased efficiency compared to IPS-only staff (e.g., IPS + VR-JIT staff spend more time helping clients with applications [person-level] and networking with employers [system-level]).

**Aim 2.** Evaluate mechanisms of employment outcomes and psychological distress.

**Aim 2 Hypotheses.** Based on Corbière's framework for obtaining employment [9], we hypothesize that interview skills, measured independently during role-play, will mediate the effect of virtual interview training on employment outcomes (*H6*) (Fig. 1).

**Exploratory Subaim 2a.** Explore whether post-training levels of interviewing self-efficacy, motivation, and anxiety (i.e., intrapersonal barriers) mediate the relationship between VR-JIT training and interviewing skills, and whether this mediation is moderated by pre-training levels of interviewing anxiety, motivation, and self-efficacy (Fig. 2).

**Exploratory Subaim 2b.** Explore whether employment outcomes mediate the relationship between interviewing skills and psychological distress at six-month follow-up (Fig. 3).

**Aim 3.** Conduct a multilevel, multidisciplinary, and mixed-method process evaluation of VR-JIT adoption and implementation to assess the acceptability, scalability, feasibility, and affordability (cost) of VR-JIT. We will use focus groups and semi-structured interviews (with clients, staff, and leaders) to identify facilitators and barriers to implementing VR-JIT. We will use budget-impact analysis to estimate the cost of implementing VR-JIT at Thresholds, Inc.

### 2.2. Eligibility criteria

Participants will be recruited from existing IPS caseloads at Thresholds, Inc., which is the largest community-based mental health service provider in Illinois, and a leader in IPS services nationally. Study inclusion criteria include being an individual: 1) 18–55 years old; 2) diagnosed with schizophrenia, schizoaffective disorder, major depressive disorder, or bipolar disorder (types I & II); 3) fluent in English; 4) reading at or above a sixth-grade level; 5) recently enrolled in IPS (within the previous two weeks); and 6) planning to interview for a job within the next four weeks; and 7) willing to provide a collateral contact (friend or family member to help prevent loss-to-follow-up). Participants will be excluded if they: 1) have documented developmental or learning disabilities; 2) have no verifiable contact information; 3) have a documented medical illness that may significantly compromise cognition that might interfere with using VR-JIT (e.g.,

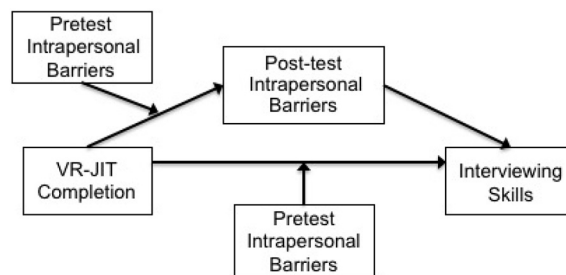
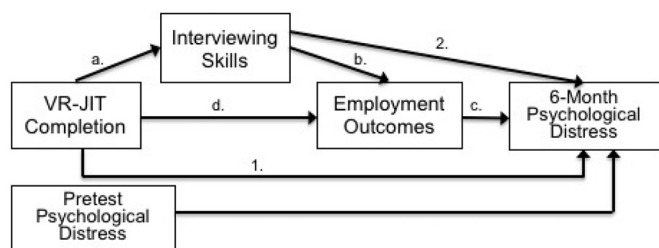


Fig. 2. We will explore whether there will be a moderated mediation effect in which VR-JIT completion will improve interview skills by modifying interviewing self-efficacy, motivation, and anxiety (i.e., intrapersonal barriers).



**Fig. 3.** Exploratory model on the decomposed effects of VR-JIT completion on psychological distress. We will explore whether the a-b-c pathway provides the strongest relationship between training and reduced psychological distress, while the d-c pathway provides the weakest. Pathways 1 & 2 are not hypothesized in this framework.

Parkinson's disease, Alzheimer's disease); 4) have uncorrected vision or hearing problems that prevent them from using VR-JIT; or 5) are actively suicidal (having met criteria for suicidality over the past 30 days).

### 2.3. Recruitment and screening

The target sample of 180 clients will be enrolled during a 24-month recruitment period from three IPS teams (additional teams will be recruited if needed). All IPS teams in this study were reviewed for model fidelity using current program standards and review procedures [8,28]. Two teams placed within the category for Good Fidelity (i.e., 100–114), with the third team scoring in the “exemplary” Fidelity category (i.e., 115–125). Assuming 10% loss to follow-up, this approach will enable us to obtain a final sample of  $n = 162$  participants with 6-month outcome data. Each IPS team will consist of approximately 75 clients served by three employment specialists with caseloads that turn over approximately every sixth months, creating a sampling pool of approximately 300 clients. An employment specialist will provide services (e.g., job interview training, job development) directly to clients in the community.

Screening and recruitment will involve four steps. In step 1, the research team will obtain a list of clients from one IPS team and pre-screens clients based on inclusion/exclusion criteria. In step 2, the research team will email the list of eligible participants to each employment specialist, and the employment specialists will give each eligible client a study flyer and briefly explain the study. In step 3, the potential participant will independently call the research team and complete a phone screening to confirm inclusion/exclusion criteria; then the research team will schedule visit 1. In step 4 (at visit 1), the potential participants will provide informed consent and complete a reading assessment and clinical interview to confirm the remaining inclusion criteria. The research team will place reminder calls to each potential participant the day prior to visit 1. Based on the demographics of clients enrolled in IPS at Thresholds, the gender and racial/ethnic composition of the targeted enrollment population are projected to be 62% male, and 54% Black/African-American, 41% Caucasian, and 5% other; as well as 10% will be Latino/Hispanic.

### 2.4. Randomization and blinding

The study coordinator (who will not assess outcomes or conduct data analyses) will conduct the randomization using a Web-based system that will generate randomization blocks of 10 participants [29]. Participants will be randomly assigned to the IPS + VR-JIT or IPS-only groups in a 1:1 ratio. Participants and treatment providers will be informed of the intervention group assignment, but assessors will be kept blind to treatment assignment as will research team members performing the statistical analyses.

### 2.5. Participation in usual care

Our recruitment will target participants enrolled in IPS for less than two weeks in order to minimize the participants' exposure to IPS services. Notably, VR-JIT will replace the employment specialists' active engagement in mock job interview practice for participants randomized to IPS + VR-JIT. However, the employment specialist and participants may still discuss interview skills and the participants' use of the VR-JIT tool. This approach will support a more integrated use of VR-JIT compared to removing all job interview training services. Moreover, all other clinical and psychosocial treatments will be provided as usual.

### 2.6. Study intervention

#### 2.6.1. Delivery of IPS-only services

Employment specialists trained per the standardized IPS fidelity guidelines [8]. The employment specialists will engage in an initial process of meeting with the client to begin an ongoing, work-based vocational assessment (called a career profile) to learn more about the client (e.g., preferences, experiences, skills, current adjustment, strengths) that is updated after each work experience. Then employment specialists and their clients will proceed to a rapid job search process where the employment specialist and/or the client make contact with an employer within the first month after intake. Of note, the IPS manual states that “Supports for education and training are consistent with good fidelity even if completing an educational program postpones the job search. IPS specialists help with education and training programs that are related to a career goal and are available to the public (not set aside for people who have disabilities.” Based on the individualized approach of IPS, employment specialists reported that their experiences have been that clients frequently request assistance in preparing for job interviews. It is very common that persons with histories of mental illness who have been out of the workforce for long periods or have experienced what they perceive as failure in employment express high levels of anxiety about the job interview process, and as such, they frequently request support to prepare for an interview. To assist in this preparation, the employment specialists reported to us that they commonly conduct approximately two job interview role-plays, each lasting anywhere from 25 to 35 min, with each client prior to the client attending each real-life job interviews. As such, we propose that the employment specialists will track and record the total number of role-plays completed with each participant during the study, which will be used as a covariate.

#### 2.6.2. Framework for VR-JIT

SIMmersion, LLC, previously created interactive trainings using proprietary software that allows trainees to have a virtual conversation with, and influence the behavior of, a simulated character [30–32]. We developed and evaluated VR-JIT through Phase I and Phase II Small Business Innovation Research grants from the NIMH awarded to SIMmersion. Phase I and II results suggest that VR-JIT was engaging and after completing 1–2 virtual interviews trainees could use the tool independently [17–21,33]. SIMmersion simulations far exceed typical interview training by combining video, voice recognition, and non-branching logic (described below) to create an interactive environment in which trainees encounter complex social cues and realistic interpersonal exchanges. A key feature of VR-JIT is the use of electronic learning (e-learning) content to educate trainees in the basics of interviewing as well as on how to effectively disclose their disability or request accommodations (if they choose to do so). Another key feature of VR-JIT is that trainees experience the “presence” of a virtual character that simulates real-world experience. In the process, they build skills, clarify concepts, and increase retention. This “presence” is established using footage of an actor in the role of a hiring manager, which makes the simulation more realistic. Trainees conduct face-to-face conversations with the character using a microphones to communicate, which

**Table 1**  
Principles and strategies used in virtual reality job interview training.

1. Practice interviewing for the same job or different jobs repeatedly until they are prepared for a real interview.
2. The use of speech recognition to directly answer questions rather than passively learning concepts (e.g., reading sample answers to questions).
3. Answering questions specific to a job they want based on their own work history and skills.
4. Asking an on-screen coach for help and suggestions during practice session.
5. Practicing to recover from mistakes in responses to interview questions or erase them to try again without penalty (e.g., apologizing, clarifying).
6. Engaging an interviewer who has memory and emotion.
7. Trying 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).
8. Didactic electronic learning (e-learning) materials that will help trainees with interviews and the other steps in finding a job (e.g., creating a resume, researching a position, asking appropriate questions, selecting a job that meets their needs and deciding whether to disclose a disability, etc.).

allows them to participate in an interactive environment and react to complex social cues.

VR-JIT was designed to improve interview skills using behavioral learning principles [34,35] and the Issenberg et al. [36] principles for designing effective simulations, which contribute to sustainable changes in behavior [37,38]. Table 1 identifies the specific learning principles that our team adapted from behavioral learning theory and Issenberg to guide VR-JIT. Notably, job interviews can be anxiety-provoking situations for adults with SMI, who may be more prone to anxiety than individuals without these diagnoses [39,40]. As an enhancement to IPS, VR-JIT may help desensitize trainees by exposing them to an anxiety-provoking situation in a safer environment where the trainee can exercise maximum control over the process, including changing his or her behaviors during the interview.

**2.6.2.1. VR-JIT interface and Molly Porter.** After using the e-learning modules, trainees will navigate VR-JIT to simulate job interviews with a virtual hiring manager named Molly Porter who works for a fictional company named “Wondersmart.” Molly is in her office, and the trainee joins her for an interview. When Molly speaks, there is an option for the program to go into full-screen mode so that she is speaking directly to the trainee without any onscreen distractions. When Molly finishes asking each question, the program returns to the interface view shown in Fig. 4.

Molly has three difficulty levels: easy (friendly), medium (direct), and hard (stern), with an emotional model that drives her behavior as she “remembers” the trainee’s responses, which influence her future questions. For example, Molly may become dismissive and end the interview due to inappropriate responses, whereas if the trainee continually answers appropriately, Molly may become friendlier and encouraging. Based on the trainee’s statements, VR-JIT chooses a reply for Molly. This selection is based on three factors: 1) difficulty, 2) the conversation history, and 3) Molly’s evolving relationship with the trainee, including her “emotional state,” which is driven by the trainee’s responses. These factors help VR-JIT compute conditional probabilities for each possible reply. Molly stays true to her difficulty level and the emotional state created during the trial; thus, she may behave differently during each trial.

Fig. 4 also displays the layout of the VR-JIT interview interface. The buttons at the top of the screen control the interface. The yellow text displays options for spoken responses to Molly’s questions. The interview transcript can be accessed through a tab. Trainees may change topics using buttons on the left. The white box allows trainees to take notes, while below, two gray boxes present the previous question and response.

**2.6.2.2. Nonverbal coach.** The trainee receives immediate feedback

from an on-screen coach (Fig. 5) who provides nonverbal cues about the trainee’s choice of responses. If more clarification is needed, trainees can click “help” buttons that clarify interview questions or response options. For example, the coach gives the trainee a “thumbs down” for an inappropriate response. If the trainee is unclear about the negative feedback, the help button provides trainees with a more-detailed explanation about why the statement was inappropriate (e.g., “This statement focuses on a negative character trait; try focusing on your strengths”).

**2.6.2.3. Scripted statements and speech recognition.** A panel of vocational experts reviewed hundreds of responses to standard interview questions written by professional scriptwriters. Trainee statements include a wide variety of natural choices with 5 to 15 possible responses that range in the appropriateness of their content. This approach enables trainees to learn from a variety of responses. VR-JIT uses voice recognition so trainees can practice verbalizing scripted responses to difficult questions in a more comfortable environment. Then, in a real interview, trainees can use the answers they practiced during the simulation.

**2.6.2.4. Non-branching logic.** SIMmersion’s proprietary PeopleSIM™ technology uses non-branching logic, which allows trainees to speak freely within the confines of a simulation. In contrast, most simulations use branching logic, in which trainees select a response from a few options; the simulation terminates when all options are used. These systems have limited usefulness. By integrating video and non-branching logic, SIMmersion’s technology enables virtual characters to vary their behavior and provides them with personality, memory, and emotions. This variability provides naturalistic interactions and encourages repeated practice.

**2.6.2.5. Personalized customization.** Before beginning VR-JIT interviews, trainees will complete an online job application within the VR-JIT tool as practice, which include questions about their employment history and general background (e.g., educational attainment, military history, justice-involvement). Trainees will also be asked to specify one of eight different jobs at Wondersmart (the fictional company in VR-JIT) they are interested in (e.g., cashier, stock clerk, customer service). The Wondersmart application is consistent with the online applications used by many large chain stores. This practice prepares trainees to complete the online applications used in real-world settings. Moreover, the application data will inform the list of questions from which Molly draws. For example, a trainee may apply for a customer service position but identify prior work experience in inventory on his or her application. Then, Molly may say, “I see from your resume that you have experience in inventory and are applying to work in customer service. Why are you looking to make that change?” This feature of VR-JIT allows trainees to customize their interview experiences to better prepare them for future interviews. Of note, the VR-JIT tool will not act as a substitute for the Employment Specialist career profile conversation with clients. The VR-JIT tool will simply be used as an enhancement to existing high fidelity IPS services (e.g., career profile).

VR-JIT also gives trainees the option to identify that they have mental illnesses or other disabilities, which helps them learn when it may be helpful to disclose this information and how to request accommodations. VR-JIT e-learning and simulated interviews also help trainees learn when it is a good time to make such a disclosure. When these disclosures occur, Molly explains that her company complies with the Americans with Disabilities Act (ADA) and makes reasonable accommodations. Next, she may ask what accommodations the trainee thinks may be necessary. Such dialogue options are unique to this software and provide trainees with the opportunity to decide whether disclosure makes sense for them and, if so, to learn an effective way to do it.



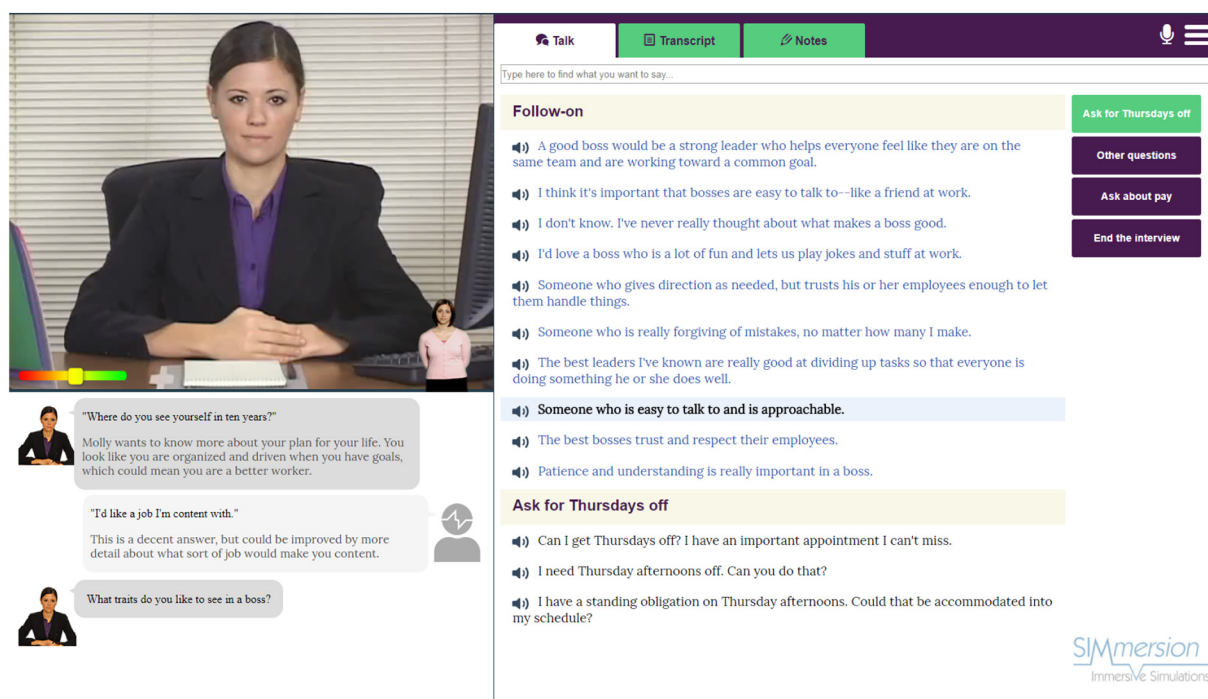


Fig. 4. VR-JIT interviewing interface.



Fig. 5. Nonverbal coach.

**2.6.2.6. VR-JIT transcripts.** Transcripts can be accessed during or after the interview. Trainees can replay individual exchanges or the entire conversation. If they are using the speech-recognition feature, the interactive transcript will also replay the recorded voice, which enables trainees to reflect upon Molly's tone of voice. The transcripts are color-coded, with green reflecting appropriate/helpful responses, red reflecting inappropriate/hurtful responses, and black reflecting neutral responses. Trainees can click on a response to receive detailed feedback about why that response helped or hurt their interview and overall score. They also receive feedback about how Molly understood their responses and insights into Molly's questions.

**2.6.2.7. Scoring and summary feedback.** After each VR-JIT trial, trainees will be scored on eight domains (hard worker, sounding easy to work with, sharing things in a positive way, sounding professional, sounding honest, showing interest in the position, negotiation, and overall rapport). The domains were chosen from a literature review and feedback provided by a panel of vocational experts who worked with adults with severe mental illness [33,41]. The scoring ranges from 0 to 100, using an algorithm that accounts for the types of responses provided by the trainee throughout the interview. Trainees will have

access to this feedback, and if they score 90+, they will be informed, "You got the job!" Trainees will also receive feedback summaries regarding what they did well and where they could improve. This feedback helps trainees understand the subtleties of interview-based interactions.

### 2.6.3. Delivery of IPS + VR-JIT

Participants will complete an initial 5–10 h of VR-JIT and continue to use VR-JIT as-needed until the six-month follow-up or they find a job. The research team will train three employment coordinators to administer VR-JIT in a computer lab at a Thresholds location. Each employment coordinator will be primarily responsible for building relationships with large community employers in an effort to place multiple clients into employment simultaneously. However, the employment coordinators' job duties will be expanded to supervise the rooms where VR-JIT is delivered. The rooms are already outfitted with computers for existing services. Employment coordinators will complete a fidelity checklist indicating that they have instructed the VR-JIT trainees on how to use the intervention. This checklist will serve as written assurance that VR-JIT was delivered with high fidelity. The PI will meet with the site PI weekly to verify that procedures are regularly observed and provide bimonthly supervision to monitor VR-JIT fidelity.

We will recommend that trainees complete a minimum of 15 virtual interview trials within 10 consecutive working days at Thresholds. VR-JIT trainees will be encouraged to train for two hours each visit, which is consistent with the pilot studies, in which trainees used e-learning and completed an average of 15 trials across 7–10 h of training. A trial will be one complete VR-JIT interview, which takes approximately 20–30 min to complete, and will be recorded by the VR-JIT system. Two trials per hour also include time for VR-JIT trainees to review feedback to improve their performance. Although VR-JIT is intended to be self-guided, the employment coordinators can spend 10–15 min (if needed) reviewing the recorded transcript of each trial with trainees to gain insight into why particular responses may or may not be effective. During the pilot studies, this process required 2–3 trials before trainees worked independently to review feedback.

Employment coordinators will adjust the VR-JIT difficulty level using a hierarchical learning approach. Trainees will begin with

“Friendly Molly” (easy) until they score at least 90 of 100 points or complete five “easy” trials (A minimum of three trials at the “easy” level will be required before advancing). Trainees will then advance to “Business Molly” (medium) and continue until they score 90 of 100 points or complete five “medium” trials. A minimum of three trials at the “medium” level will be required before advancing. Finally, trainees will advance to “Stern Molly” (hard) and continue stay there until completing the training.

## 2.7. Retention strategies

To maintain high follow-up rates with research participants, the Thresholds research department will foster strong relationships with both the employment specialists and the participants' primary clinical treatment teams to stay current with the participants' status and current contacts. If anything changes with regard to the participants and their participation, both clinical and employment services staff will alert the research department and the study staff.

## 2.8. Study measures

### 2.8.1. Background, clinical, and cognitive measures

Trained research staff will assess DSM-IV diagnoses using the Mini-International Neuropsychiatric Interview (MINI) [42] and chart reviews. Vocational history will be assessed using a brief interview that will include competitive work history data: length of time since last full-time (or any) employment, number of days employed in the past five years, history of prior interview training, and number of job interviews completed in the past three months. Other psychosocial data will include current housing status, income, and criminal justice/addiction history. The Wechsler Test of Adult Reading (WTAR) [43] will be used to assess premorbid IQs and current reading levels. The NIH Tool Box [44] will assess neuropsychological status, including executive function, attention, episodic memory, language, processing speed, and working memory. The battery will allow comparison to other clinical and normative populations. The Bell Lysaker Emotion Recognition Task [45] and a cognitive empathy task [46] will assess social cognition using video clips and static emotional scenes.

### 2.8.2. Primary outcomes

The primary outcomes are: 1) employment rate at six-month follow-up; 2) time-to-employment; 3) job interview skills; and 4) psychological distress at six-month follow-up. The employment rate and time-to-employment outcomes will be assessed via a vocational history self-report at monthly follow-up calls and again at a six-month follow-up visit. Additional data will be obtained for descriptive purposes, including types of jobs obtained, hours worked, money earned, and job terminations within the six-month follow-up. Job types will be coded using the Dictionary of Occupational Titles [47]. Competitive work, as defined by SAMHSA [48], pays at least minimum wage, occurs in an integrated community setting, and is not set aside for persons with disabilities. Reasons for job termination will be classified as “satisfactory” (e.g., transfer) or “unsatisfactory” (e.g., quitting) [49]. Lastly, we will collect information about length of job tenure to explore whether enhanced skills from VR-JIT can be generalized to a longer duration of employment as social difficulties may lead to poorer vocational outcomes [50,51].

To assess interview skills, we will use the Mock Interview Rating scale that we created and tested during the pilot studies [18–21] and includes nine items (i.e., comfort level; hard worker, sounding easy to work with, sharing things in a positive way, sounding professional, sounding honest, showing interest in the position, negotiation, overall rapport) scored on a 5-point scale. The anchors can be reviewed here [20]. Participants will complete two role-plays at the pre-test visit and two role-plays at the post-test visit. The role-plays will require the participant to complete a typical job application, select two fictional job

openings (listed below), and participate in two job interview role-plays with two trained role-play interviewers. The interviews will be video recorded, and the videos will be scored by raters who are blinded to condition and time-point.

The scientific team will train raters to an acceptable degree of reliability and then regularly meet with raters to view and score videos. Discrepancies in scores will be discussed to prevent drift. Participants will be instructed not to disclose their group assignment (IPS + VR-JIT or IPS-only) to interviewers, but such disclosures are possible. If this occurs, interviewers will notify research staff and the video will be edited to mute the disclosure to maintain rater blinding. The mock interview role-play will include 13 required job interview questions plus three additional questions (randomly selected from a list of 25 optional questions). The actors will be blind to group assignment, and participants will interview with a different actor each time. Role-plays will be digitally recorded and rated for fidelity to a standard job interview by the scientific team. Fidelity to the standard interview requires the role-play actor to ask 100% of the required questions during the interview and at least three follow-up questions. In addition, the actors will be trained to be engaging and make small talk.

Lastly, participant psychological distress will be assessed by having research staff administer the Brief Symptom Inventory (BSI) [52,53], a self-report of psychiatric symptoms that generates a global severity index and is generalizable across disorders.

### 2.8.3. Secondary outcomes

The secondary outcomes are: 1) general social skills; 2) job interviewing self-efficacy; and 3) job interviewing anxiety. To assess the generalizability of VR-JIT to social skills, we will administer a validated conversational probe using two three-minute, audio-recorded, social interactions with a research assistant. The recordings will be blindly rated on a 5-point scale for fluency, clarity, meshing, involvement, and overall social skills [54,55]. Interviewing self-efficacy will be measured via nine items on a 7-point Likert-type scale validated in the VR-JIT efficacy studies [18–21]. Job interviewing anxiety will be measured by adapting the Personal Report of Public Speaking Anxiety [56]. “Public speaking” terms will be replaced with “job interview” terms and called the “Personal Report of Job Interview Anxiety.” This assessment will contain 34 items reported on a 5-point Likert scale.

### 2.8.4. Potential mechanisms of employment and psychological distress

We will explore how treatment effects occur by evaluating the interviewing self-efficacy, motivation, and anxiety measures as potential mechanisms of interview skill. We will also evaluate age, gender, neurocognitive and social cognitive ability as potential moderators. Finally, we will evaluate the attainment of employment as a potential mechanism for reduced psychological distress after the completion of VR-JIT. All measures have been previously described.

### 2.8.5. Process measures

Based on our Hybrid Type 1 effectiveness-Implementation trial design, we will use mixed methods to conduct a multilevel, multirater, and mixed-method process evaluation of VR-JIT adoption and implementation to assess the acceptability, scalability, and feasibility of VR-JIT in community-based IPS. The mixed-method process evaluation will consist of focus groups, semi-structured interviews, and quantitative surveys. First, we will conduct focus groups with clients to assess acceptability of the VR-JIT program. We will ask about barriers (e.g., use of technology, transportation) and facilitators (e.g., accessibility, satisfaction) to the use of VR-JIT. Two rounds of focus groups will be conducted after recruiting the first third and second third of the RCT sample. Round 1 will assess perceptions of initial VR-JIT implementation, with results guiding immediate modifications to VR-JIT delivery. Round 2 will assess perceptions of changes made to VR-JIT delivery and elicit new barriers/facilitators (e.g., changes in VR-JIT accessibility), with results guiding potential new modifications to VR-JIT delivery for

**Table 2**  
Summary of the proposed multi-level, mixed methodology for the initial process evaluation of VR-JIT adoption.

Process evaluation domain	Type of method, source of data, examples	
	Quantitative data	Qualitative data
Acceptability (client)	Training Experience Questionnaire (example questions: How easy was the training to use?; How helpful was this training in preparing you for a job interview?)	Focus Group with IPS clients (example questions: In what ways was VR-JIT helpful to your employment training?)
Acceptability (staff)	Intervention Delivery Experience Questionnaire (example questions: how acceptable is the time required to deliver VR-JIT; how disruptive is VR-JIT to the services you provide?)	Semi-structured interviews with IPS staff (example questions: Can you share your thoughts on what was appealing about teaching clients how to use VR-JIT?; How did VR-JIT influence your other services?)
Scalability (Leaders)	–	Semi-structured interviews with IPS leaders (example questions: What are some potential challenges to scaling up the delivery of VR-JIT? What adaptations may be needed to the existing implementation strategy for VR-JIT to make it more scalable?)
Feasibility (client)	We will administratively monitor: adherence to training visits; reasons for missed visits; number of completed virtual interviews	Focus group with IPS clients; (example questions: In what ways would you change the way you access VR-JIT to make it easier for you to practice? What difficulties did you experience when trying to use VR-JIT?)
Feasibility (staff)	We will administratively monitor the time required to train staff to deliver VR-JIT; fidelity of VR-JIT delivery; fidelity checklist completion rates; staff time allocated to VR-JIT implementation	Semi-structured interviews with IPS staff; (example questions: What would need to change in an employment specialists job to be the primary person delivering VR-JIT to your clients 2–3 times per week?; What was your experience completing the fidelity checks?)
Cost (Leaders)	We will monitor the time staff spent on their regular duties before and during the VR-JIT delivery.	Semi-structured interviews with IPS leaders; (example questions: To what extent does the cost of offering VR-JIT to your clients affect your decision to use it? Do you expect cost to be a major factor in continuing to use VR-JIT?)

the remaining third of the sample. We will track which participants receive a modified delivery of VR-JIT, to be evaluated as a possible covariate. In total, three to five focus groups (60 min, 6–8 clients each) will be conducted. Second, we will conduct semi-structured interviews with Thresholds staff and leaders using the (1) Structured Interview for Evidence Use (SIEU) [57], a 45-item survey that assesses engagement level in acquiring, evaluating, and delivering VR-JIT, and the Consolidated Framework for Implementation Research (CFIR) interview to assess acceptability, scalability, and feasibility (e.g., barriers and facilitators to implementing VR-JIT) [58,59]. The PI will present results at Thresholds team meetings and to the community advisory board. These data will enable leaders to optimize delivery and make decisions regarding local VR-JIT sustainability. A summary of our mixed methodology can be found in Table 2.

## 2.9. Data collection schedule

The schedule of assessments for this trial is as follows (See Table 3). First, all participants will complete the pretest assessments that take place during visit 1 and visit 2 (T1 data points). VR-JIT will be delivered during visits 3–8. Then all participants will complete the posttest (T2 data points) assessments that occur during visit 9, followed by monthly check-in calls and a six-month follow-up visit (T3 data points).

## 2.10. Data analyses with power estimates for aim 1 hypotheses

### 2.10.1. Hypothesis 1: IPS + VR-JIT trainees will have higher employment rates than IPS-only by T3

To test Hypothesis 1, we will use multiple logistic regression and a Wald chi-square test to compare the adjusted employment proportions (attained a job = 1 vs. failed to attain a job or censored with a job = 0) in the two arms between T1 and T3. We calculated power using simulation in R, correcting for small samples and multiple testing with false discovery rate for the four primary tests. While conservative, this power analysis includes Bonferroni corrections for all tests. Accounting for 10% missing data, recruiting 80 participants in each arm will provide 80% power for a two-sided  $\alpha = 0.05/4 = 0.0125$  level test when the odds ratio (OR) = 3.2, with IPS + VR-JIT effectively doubling the rate from 25% to 53% employment. We estimated the employment rate for IPS only at 6 month follow-up will be 25% based on the literature indicating IPS employment rates at 12 months follow-up are 50–60%

[6]. Based on our earlier study where we found an OR = 9.6 [22], or effectively tripling the employment rate, and a power of 0.99 at this magnitude of effect, we feel confident that we will have sufficient power in this study.

### 2.10.2. Hypothesis 2: IPS + VR-JIT trainees will have greater improvement in job interview skills than IPS-only by T2

To test Hypothesis 2, we will conduct a repeated measures analysis of variance (RM-ANOVA) with pre- and post-interview scores as the repeated measures and treatment group as the fixed factor. Based on our pilot data [17–21], we expect  $r = 0.70$  between T1 and T2 scores, and an effect size of  $d = 0.67$  between pre- and post-interview role-play scores using VR-JIT. Assuming a small-to-moderate effect within IPS-only (e.g.,  $d = 0.25$ ), our best power estimate assumes a medium effect size contrasting IPS-only with IPS + VR-JIT ( $d = 0.67 - 0.25 = 0.42$ ). This effect size and correlation imply an expected 6.9% reduction in within-subject error for the treatment by time interaction effect. Thus, 80 participants with  $\alpha = 0.0125$  will yield 82% power to detect this effect. For the ANOVA model, 160 participants will be sufficient to detect a reduction of within-subject error of 4.7% with 80% power. Assuming a full sample effect size of  $d = 0.46$  ( $(0.67 + 0.25)/2$ ), this reduction in error corresponds to an effect size of  $d = 0.62$  for the IPS + VR-JIT group and  $d = 0.30$  in the IPS-only group (a difference of  $d = 0.32$ ).

### 2.10.3. Hypothesis 3: IPS + VR-JIT trainees will get jobs sooner than IPS-only by T3

To test hypothesis 3, we will use a Cox proportional (or non-proportional) hazards regression model [60] to assess the adjusted hazard rate for time-to-employment for IPS + VR-JIT vs. IPS-only, adjusting for potential covariates (e.g., completed interviews). For the power analysis, we assume a constant hazard rate for the distribution of time-to-employment in both groups. We also assume that 20% of the participants in the IPS-only group will find a job by T3 (i.e., a hazard rate of 0.0085 for IPS-only). This analysis is estimated based on limited pilot data and log-rank power tables [61]. Thus, 160 participants provide 80% power with  $\alpha = 0.0125$  for comparing time-to-employment in the two arms to detect a hazard ratio of 2.0 for IPS + VR-JIT vs. IPS-only.

**Table 3**  
Schedule of assessments.

Study measures	Instrument	Collection method	Timing		
			T1	T2	T3
Background, clinical and cognitive measures					
DSM-IV diagnoses	Mini-International Neuropsychiatric Interview	Interview	X		
Vocational history	Employment History Interview	Interview	X		
Psychosocial data <sup>a</sup>	Housing status, income, criminal justice/addiction history	Self-Report	X		X
Premorbid IQ and reading Level	Wechsler Test of Adult Reading	Interview			
Neuropsychological status	NIH Tool Box	Interview	X		
Social cognition	Bell Lysaker Emotion Recognition; cognitive empathy task	Computer-based	X	X	X
Psychiatric symptoms <sup>a</sup>	Brief Psychiatric Rating Scale	Interview	X	X	X
Primary Outcomes					
Employment rate	Employment History Interview	Interview	X		X
Time-to-employment	Employment History Interview	Interview	X		X
Job interview skill	Mock Interview Rating Scale	Interview Role-Plays	X	X	X <sup>a</sup>
Psychological distress	Brief Symptom Inventory	Self-Report	X		X
Secondary Outcomes					
General social skill	Social Skills Performance Assessment	Role-Plays	X	X	X <sup>a</sup>
Job-Interviewing self-efficacy	Job Interview Self-Efficacy Survey	Self-Report	X	X	X
Motivation <sup>a</sup>	Intrinsic Motivation Inventory	Self-Report	X	X	X
Job interview anxiety	Personal Report of Job Interview Anxiety	Self-Report	X	X	X
Exploratory Outcomes					
Perceived discrimination for having SMI <sup>a</sup>	Employment History Interview	Self-Report	X		X
Alcohol use <sup>a</sup>	Alcohol Use Disorders Identification Test	Self-Report	X		X
Drug abuse <sup>a</sup>	Drug Abuse Screening Test	Self-Report	X		X
Quality of life <sup>a</sup>	World Health Organization Quality of Life	Self-Report	X		X
Living arrangements <sup>a</sup>	Employment History Interview	Interview	X		X
Hospitalization/emergency room visits <sup>a</sup>	Employment History Interview	Interview	X		X
Medication adherence <sup>a</sup>	Employment History Interview	Interview	X		X

<sup>a</sup> Note: Though it was not an outcome included in the original grant application, this measure was added in response to reviewers.

#### 2.10.4. Hypothesis 4: IPS + VR-JIT trainees will have greater reductions in psychological distress than IPS-only between T1 and T3

To test hypothesis 4, groups will be contrasted on change via RM-ANOVA with time as a repeated measure and group as the main effect. Power analyses for RM-ANOVA focused on contrasts between T1 and T3. A correlation of  $r = 0.50$  between T1 and T3 was assumed. Power was estimated for a range of relative effect sizes ( $d = 0.20$  to  $d = 0.80$ ; difference between IPS-only and IPS + VR-JIT) for RM-ANOVA time-by-treatment interaction effects. Assuming an overall reduction in distress of  $d = 0.50$  (across both groups), all relative effect sizes were centered on this average (e.g., a relative difference in  $d = 0.80$  corresponds to  $d = 0.90$  for IPS + VR-JIT and  $d = 0.10$  for IPS-only, yielding an average  $d = 0.50$  overall). For ANOVA change contrasts of IPS-only vs. IPS + VR-JIT between T1 and T3, 160 participants will be sufficient to detect  $d = 0.50$  ( $d = 0.75$  vs  $0.25$ ) with 80% power at  $\alpha = 0.0125$ . ANCOVA will test for differences in T3 distress while covarying for T1 distress. T1 individual differences (e.g., cognition) will be tested as covariates.

#### 2.10.5. Hypothesis 5: IPS + VR-JIT will be more cost-effective than IPS-only

To test hypothesis 5, we will conduct a cost-effectiveness analysis (CEA) to assess the short-term cost-effectiveness of IPS + VR-JIT relative to IPS-only using a societal perspective, which includes intervention costs and client costs provided by the IPS program director [62]. Intervention costs include variable costs (e.g., time spent by employment coordinators) and fixed costs (e.g., costs supporting hiring, training, and coordination). Client costs will include time using VR-JIT and travel costs. We will use standard approaches to identifying and assigning unit costs for each cost component [62]. We will use the job attainment rate as our measure of effectiveness. The main step will be to calculate an incremental cost-effectiveness ratio (ICER), which is defined as the difference in total costs between the IPS + VR-JIT and IPS-only groups, divided by the between-group difference in job attainment rate. Confidence intervals will be calculated around the ICER

using bootstrapping and Fieller's theorem [63,64]. We will conduct sensitivity analysis by deriving cost-effectiveness acceptability curves that display the probability of IPS + VR-JIT being cost-effective at various threshold values [65].

#### 2.10.6. Person-level exploratory analyses

To study the generalizability of VR-JIT to social skills, we will evaluate whether more VR-JIT training (i.e., greater number of trials) is associated with a longer job tenure (i.e., number of weeks) and enhanced social skills using linear regression. We will include covariates (e.g., demographic, cognitive, and vocational characteristics) that differentiate the two study arms.

#### 2.10.7. System-level exploratory analyses

We will use inferential statistics to explore if, as a result of VR-JIT, employment specialists reallocate their time spent conducting mock job interviews with clients into other job duties (e.g., building larger employer networks, completing more job applications with clients, and engaging in more hours of coaching work-communication with clients).

#### 2.11. Data analyses with power estimates for aim 2 hypotheses

##### 2.11.1. Hypothesis 6: Improved interviewing skills will mediate the relationship between VR-JIT completion (i.e., the number of completed virtual interviews) and obtained employment

To test hypothesis 6, we will first evaluate whether there is a significant IPS + VR-JIT impact on interview skills compared to IPS-only, then check for treatment-by-mediator interaction [66], and then check on the product of the two coefficients [67] with bootstrapped confidence intervals [68]. We simulated power for this test, finding 80% power when the effect size for skills is small ( $d = 0.20$ ) and the odds for skills leading to a job is  $OR = 1.8$ ; thus we expect to have sufficient power. These older mediational models are informative but incomplete, and they will be followed by computing the *causally interpretable average natural indirect effect* [69]. We plan to conduct sensitivity analyses on



the assumption of “no exposure induced mediation-outcome confounding.” For the exploratory moderated mediation model, we will use approach 1 of Vanderweele et al. [69] to account for the combined mediated (indirect) effect of changes in self-efficacy, anxiety, and job interview skills, as suggested in Corbière et al. [9].

### 2.11.2. Person-level exploratory analyses

To test the moderated mediation (mediated effect varies as a function of a baseline variable), we will first conduct a standard model of post-intervention anxiety/self-efficacy serving as a mediator of the relationship between VR-JIT and interviewing skills (Fig. 2) using the “product of coefficients method” [70]. Mediation tests will be based on whether the confidence interval for the product of coefficients includes zero. This approach addresses the known non-normality of the test statistic [70]. To this standard mediation model we will add an interaction of baseline (pre-intervention) anxiety/self-efficacy to interact with VR-JIT on post-intervention anxiety/self-efficacy. Similarly, we will include a baseline-by-intervention interaction on interviewing skills (Fig. 2). The Johnson-Neyman approach will assess where mediation occurs as a function of pretest levels [71]. We will test whether employment outcomes mediate the relationship between interviewing skills and psychological distress at six-month follow-up (Fig. 3), using the same approach outlined for hypothesis 6.

## 2.12. Data analyses for aim 3

### 2.12.1. Mixed-methods qualitative analyses

We will transcribe focus group and open-ended interview data, and analyze the data iteratively using thematic analysis and the constant comparative approach [72,73] to identify emergent themes regarding the acceptability, scalability, and feasibility of implementing VR-JIT. Data will be coded using the CFIR Codebook (<http://www.cfirguide.org/CFIRCodebook> Template10.27.2014.docx). Two research staff will analyze the data using Ethnograph, a qualitative data analysis package. Staff will independently analyze a subset of transcripts to iteratively develop new codes inductively as they emerge and deductively based on topics covered in the CFIR Codebook. After the team agrees on a set of final codes and inter-coder reliability is achieved, the codes will be applied to all transcripts [74,75]. We will use framework analysis to evaluate clients', staffs', and leaders' perceptions of VR-JIT acceptability, scalability, feasibility, and cost (e.g., barriers and facilitators) to VR-JIT implementation [76]. To facilitate comparison, for example, a matrix of themes will be developed: participant type (x-axis) vs. barriers and facilitators (y-axis). Matrices will identify y-axis themes common to all groups and features specific to particular subgroups [77]. For example, the experience of implementing VR-JIT for clients may be related to organizational themes not evident among staff or leaders.

### 2.12.2. Cost analyses

We will conduct a budget impact analysis (BIA) to assess the costs of implementing VR-JIT. A BIA will yield two critical kinds of data: (1) an estimate of the cost of implementing VR-JIT at Thresholds, and (2) a spreadsheet model that other community mental health agencies can use to input site-specific parameters in order for them to estimate the costs of implementing VR-JIT. Following current best practices for BIA [78], we will use the perspective of the implementing organization and enumerate costs to Thresholds of implementing VR-JIT. Beyond the VR-JIT costs mentioned in the CEA from *Hypothesis 5*, we will track the time spent by employment coordinators and employment specialists on training and maintaining the VR-JIT lab, and also software costs. All project staff will be provided with an Excel-based template to record time spent on each VR-JIT-related activity [79]. Total costs for each arm will be aggregated and compared. Sensitivity analysis will be used to vary different cost component input values (e.g., number of trials per study participant) to determine the range of estimated total costs for each arm.

## 2.13. Quality assurance and quality control

### 2.13.1. Data management

All participants will be recruited using strategies, documents, and text approved by the Northwestern University Feinberg School of Medicine Institutional Review Board (IRB) and University of Michigan IRB after the PI's institutional move. The research team holds weekly meetings to discuss the effectiveness of approved recruitment strategies and whether new strategies should be reviewed by the IRB and then implemented. The study coordinator screens participants for eligibility using formal study forms. The PI and site PI regularly audit accrual to ensure that participants meet eligibility criteria and that the study enrollment is consistent with the projected enrollment targets agreed upon with the study sponsor (i.e., the National Institute of Mental Health). The study coordinator audits all study files to ensure that all required study data are completed on each form. If the study coordinator identifies missing data, he or she will contact the staff member who collected the data to review data collection procedures and identify an individual plan for contacting the participant to obtain the missing data. Data will be double entered on online data entry forms created via Research Electronic Data Capture (REDCap [29]) to maintain the validity and integrity of the collected data. The first entry will take place at Thresholds by subcontracted Thresholds staff (for Thresholds-based visits) or at NU by NU project staff (for NU-based visits), while the second entry will take place at NU by NU project staff (for all visits). The REDCap system is accessible via a virtual private network that is password protected and behind firewalls. The hard data files will be transported from Thresholds to NU in a locked storage box. To protect confidentiality, all data will be numerically coded using a personal identification numbers (PINs), and information linking each PIN to the participant's name will be kept in a secured file cabinet and office. All audio and video files will be encrypted prior to being stored electronically. Computer data files will be stored on password-protected computers, and communication among the staff will use PINs, not names. No information concerning data will be presented with participant names attached. The biostatistician and project coordinator will also perform all necessary checks and controls to ensure the reliability and validity of the data, including monitoring data collection and collection procedures, data storage, data management, and data analysis.

### 2.13.2. Data collection fidelity

It is critical to maintain a high level of fidelity when collecting clinical, cognitive, and role-play data. We will implement the following best practices for training research staff. For clinical data collection, research staff will receive training from a licensed clinician (the PI) who has expertise administering the Mini-International Neuropsychiatric Interview (MINI) [42]. The training will consist of first observing the trainer administer the MINI to at least three individuals. The trainer and trainee will score the MINI individually based on the interview and then review their scores while discussing and reaching consensus on discrepancies in their scores. Next, the trainee will administer the MINI to at least three individuals with the trainer observing, and then each trainee will score the interview prior to discussing their scores. All training sessions will be audio recorded for quality control. Once the trainer determines the trainee is ready to administer the MINI independently, the trainee will audio record at least two MINI administrations per month and the trainer will review one random recording per month to assess for potential drift.

For cognitive data collection, research staff will receive training with a licensed neuropsychologist (consultants: Bell or McGurk) who has expertise administering the Wechsler Test of Adult Reading (WTAR) [43] and the NIH Tool Box [44]. The training will consist of first observing the trainer administer the WTAR and NIH Tool Box to at least three individuals. The trainer and trainee will score the WTAR and NIH Tool Box assessments individually and then review their scores while discussing and reaching consensus with the trainer on discrepancies in

their scores. Next, the trainee will administer the WTAR and NIH Tool Box assessments to at least three individuals with the trainer observing, and then each individual will score the assessments prior to discussing their scores. All training sessions will be audio recorded for quality control. Once the trainer determines that the trainee is ready to independently administer the WTAR and NIH Tool Box, the trainee will audio record at least two WTAR and NIH Tool Box administrations per month and the trainer will review one random recording per month to assess for potential drift.

For role-plays, the PI has extensive experience supervising and training the actors performing in the job interview and social skill role-play assessments [17–21]. The staff will read through the role-play performance script, meet with the PI to discuss any questions, and then practice the role-play three times with the PI. The PI will provide feedback, and then the actor will practice the role-play with other research staff. The PI will observe these performances, provide feedback, and then authorize the actor to work with participants. Then the PI will observe the first 3 role-play performances with participants and provide further feedback. Then the PI will review at least 1 role-play session per month to assess for potential drift. If the actors drift from the role-play script, then the PI will offer feedback to improve their performance. If the actors deviate from the script on three occasions, then they will be retrained to improve their performance.

### 2.13.3. VR-JIT delivery fidelity

First, the employment specialists and employment coordinators will attend a one-hour orientation led by the PI on how to use VR-JIT. Next, the staff will use the tool themselves and complete three virtual interviews while becoming more familiar with navigating the e-learning component. Then, the staff will receive instruction in role-play, teaching peers who are also in training on how to use VR-JIT. The peers will switch roles so each can practice teaching VR-JIT. The role-plays will be supervised by the PI. To facilitate teaching VR-JIT with a high level of fidelity, the PI has designed a fidelity checklist to be used when teaching VR-JIT. Staff will be required to complete the checklist while they are teaching so they are covering each aspect of VR-JIT. In addition, the research team will review the fidelity checklists and the staff will audio record two orientations per month; the research team will review these recordings and independently rate them using the fidelity checklist. If a staffer delivering VR-JIT fails to obtain 100% fidelity on the checklist during three consecutive orientation sessions, that person will receive refresher training on the delivery process. The refresher training will require the staff person to review the script for delivery and practice leading the orientation with a peer; that practice will be audio recorded and reviewed until fidelity of 100% is attained. Once the staff person attains fidelity through the refresher process, that person can be scheduled to conduct orientation visits again.

In addition, the research team will assess intervention adherence by monitoring: 1) total number of completed virtual interviews (IPS + VR-JIT group) and mock interviews (IPS-only group); 2) attendance at the required VR-JIT sessions; 3) reasons for missed visits; and 4) attendance at regular IPS meetings (both groups). The research team will review and discuss intervention adherence (and challenges to adherence) during weekly team meetings.

## 3. Discussion

Although technology-based interventions are becoming more widely accessible to the general public, the research evaluating the impact of technology on the community-based effectiveness and implementation of mental health and employment services is only now beginning to emerge [80]. This study will be among the first to evaluate the behavioral, cost-effectiveness, and the implementation potential of a technology-based intervention to enhance IPS services for individuals with severe mental illness. Our use of the hybrid type I effectiveness-implementation design is quite novel as we will be able to not only

focus on evaluating whether VR-JIT improves job interview skills and employment outcomes but also administer an in-depth process evaluation will improve our initial understanding of whether VR-JIT: 1) can be feasibly adopted within IPS; 2) is acceptable to providers and clients; 3) is scalable across IPS teams; 4) is generalizable to other vocational rehabilitation settings; 5) is cost-effective; and 6) might be sustainable.

### 3.1. Potential enhancements to IPS

Assuming that VR-JIT effectively improves skills and access to employment within IPS, the findings from this study have the potential for a widespread impact at both individual- and system-levels with IPS supported employment. Specifically, the use of VR-JIT to facilitate interview training traditionally led by employment specialists could release approximately 3–5 h per week per employment specialist, which translates into 9–15 h per IPS team. Thus, these 9–15 h could be re-allocated to other important IPS activities such as completing job development (e.g., resume building, developing relationship with community employers), linking clients to community resources (e.g., connecting clients to the State's Division of Rehabilitation Services), or administration (e.g., case notes, respond to emails, schedule appointments).

### 3.2. Pre-funding modifications to the trial

Reviewers suggested that VR-JIT could influence a person's motivation to engage in job interviews as a potential secondary outcome and mechanism for employment. Thus, we added an adaptation of the intrinsic motivation inventory [81] to T1–T3 to capture this potential outcome. In addition, reviewers suggested that VR-JIT could influence real-life distal outcomes via employment. Thus, at T1 and T3 we plan to assess substance use behavior using the Alcohol Use Disorder Identification Test and the Drug Abuse Screening Test [82,83], and we will also assess overall quality of life using the World Health Organization Quality of Life interview [84]. In addition, we added a psychosocial survey to T1 and T3 to assess perceived discrimination at work, changes in living arrangements (e.g., homelessness), use of health care services (e.g., hospitalizations), and changes in medication adherence.

### 3.3. Post-funding modifications to the trial

After the study was funded, we convened a community advisory board (CAB) and a scientific advisory board (SAB) to review the proposed study and provide recommended modifications based on the CAB and SAB's acceptability and the potential feasibility of the proposed design. The CAB includes the PI and Co-I (MF), Thresholds' vice president of employment, the director of IPS, the director of research, a client receiving IPS services at Thresholds, an employment specialist working with an IPS team independent of Thresholds, and the state coordinator of psychiatric rehabilitation services for the State of Illinois (EO). Meanwhile, the SAB consisted of the same individuals from the Thresholds leadership team, the PI and Co-Investigators (MJS, MF, NJ, JS), and the scientific consultants (MB, SM, KM).

#### 3.3.1. Modifications requested by the CAB and SAB

After a full review, the CAB made the following four recommendations. First, we initially proposed to deliver VR-JIT via a computer lab at a Thresholds location on the north side of Chicago. However, the CAB recommended that we relocate the computer lab to the south side of Chicago, which would position the lab in a more centrally accessible area and enable the study to recruit a more diverse sample of research participants. Second, the CAB noted that the structure of IPS services at Thresholds recently eliminated the "employment coordinator" position. Thus, the CAB identified that the team leaders, who primarily supervise employment specialists and engage in higher

level coordination of IPS delivery, could fill the proposed role of the employment coordinator. Logistically, the team leaders have offices and meet routinely at the same location as the computer lab. Thus, the delivery process remains the same (i.e., employment specialists train participants to use VR-JIT, and then team leaders monitor the participant's use of the computer lab). Third, the CAB suggested that the time required for the study assessments at visit 2 could be burdensome for participants and advised that the visit be separated into visits 2a and 2b. Fourth, the CAB identified that once enrolled in IPS, clients may take up to four months to fully engage in IPS services, which means our inclusion criteria of having participants enroll in IPS within the previous two weeks would not be feasible for recruitment. Thus, the CAB suggested that we expand the time frame to focus on recruiting clients who enrolled in IPS within the previous four months.

The SAB convened to review the study design and measures in the original proposal and provided 7 recommendations to optimize the design. First, the SAB reviewed and agreed with the modifications to the study design suggested by the CAB. Second, the SAB noted that the proposed design had VR-JIT completely replacing any job interview training performed by the employment specialists. However, the SAB noted that clients might work independently with VR-JIT but would likely need additional support from their employment specialist. Thus, the SAB suggested that clients using VR-JIT could reinforce their learning by engaging in follow-up discussions with the employment specialists about their experience with VR-JIT. Third, the SAB suggested that each participant's clinical history be evaluated using the Structured Interview for the DSM-V instead of the MINI to remain consistent with the clinical standard in the field, as the MINI is based on the DSM-IV. Fourth, the SAB suggested that because a large majority of clients at Thresholds have schizophrenia, the study should evaluate the participant's neurocognitive performance using the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) battery of assessments rather than the NIH Tool Box. Fifth, the SAB recommended that the study use the MATRICS' Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT), which has been more widely studied (and, therefore, more generalizable) than the BLERT and cognitive empathy task. Sixth, because many study participants will experience varying levels of psychosis and mood disturbances, the SAB suggested replacing the BSI with the Beck Depression Inventory and the Brief Psychiatric Rating Scale. Seventh, the SAB recommended adding monthly follow-up phone calls with study participants to evaluate their ongoing employment status, as monthly data will be more reliable than a single follow-up at six months. Finally, the SAB recommended we replace the use of the SIEU, one of our key process evaluation measures, with a collection of measures that are better aligned with the implementation assessment, which is the focus of the proposed Type I hybrid design, and with assessing sustainability. Here is the updated list of our measures: 1) our focus groups will use questions based on Proctor et al.'s implementation outcomes taxonomy [26]; 2) we will use the Implementation Leadership Scale to assess pre-study levels of potential for implementing evidence-based practice [85]; 3) we will use a post-delivery survey of outcomes called the Annual Survey of Evidence-Based Programs (ASEBP) from EPISCenter (2005); and 4) we will use the Program Sustainability Assessment Tool to assess sustainability [86].

### 3.4. Conclusion

This is the first trial to evaluate VR-JIT in a community-based setting under conditions more closely approximating real-world delivery. Our trial represents a critical step in the translational research pipeline, as the friendly confines of the laboratory are left behind and the intervention is embedded to the greatest extent possible in the typical workflow of an existing delivery system. At this stage, the question of "Can it work?" is being addressed after our having established in efficacy trials that it does work when delivered in a particular manner.

Moving to an effectiveness trial shifts the study from one valuing internal validity to one emphasizing external validity and the goal of understanding how the service delivery context in which VR-JIT is used affects and relates to its effectiveness in helping the participants achieve employment. Consistent with the aims of a type I hybrid effectiveness-implementation trial as described by Curran et al. [27], this study is powered to test the effectiveness of VR-JIT compared to IPS as usual in a community-based service delivery system for adults with SMI seeking employment and simultaneously allows a rigorous evaluation of critical implementation factors. This study design is intended to gather data for rapid translation and scale-up if the intervention is deemed effective at the conclusion of the trial. Further, such an implementation evaluation could elucidate factors relating to the effectiveness of VR-JIT as well as those that could affect future adoption and sustainability. Should VR-JIT be effective and shown to be viable for wide-scale implementation in community mental health systems, the effects would be wide-ranging given the physical and mental health benefits associated with gainful employment [87].

### Disclosures

The authors report that there are no competing interests or conflicts of interest.

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