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Short Title	VR Intervention to Improve Police Safety
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ABBREVIATIONS AND DEFINITIONS OF TERMS

AE	Adverse event
ASD	Autism Spectrum Disorder
CAR	Center for Autism Research
PSM	Police Safety Module
VR	Virtual Reality

ABSTRACT

Context: (Background)

Individuals with autism spectrum disorder (ASD) have core impairments in social communication skills that typically persist into adulthood and result in challenges related to independence, employment, and emotional wellbeing. Given the increased prevalence of ASD diagnoses in childhood and the noted challenges with community living skills seen in adults with ASD, it is critical to develop effective and easily accessible programs to support social skills in adolescents and adults with ASD. Advances in virtual reality (VR) technology offer new opportunities to design interventions targeting the core deficits associated with ASD and promote acquisition of skills necessary for effective navigation of challenging social situations, such as engagement with law enforcement.

Objectives: (primary and important secondary objectives)

The primary objective of this study is to demonstrate the efficacy of Floreo's PSM in adolescents and adults with ASD by assessing improvement in police interaction skills as compared to a video modeling intervention in a laboratory setting. A secondary objective is to demonstrate the virtual-based efficacy of Floreo's PSM in adolescents and adults with ASD by assessing improvement in police interaction skills as compared to a treatment-as-usual condition, in virtual video conferencing settings using CHOP-based staff as treatment implementers.

Study Design:

This is a randomized control trial in which an immersive VR module is intervention being evaluated.

Setting/Participants:

Cycle A of the study will be conducted at the Center for Autism Research at CHOP. Cycle B of the study will be conducted virtually using CHOP approved, HIPPA compliant video conferencing software. Subjects aged 12 to 60 years with ASD are eligible to participate.

Study Interventions and Measures:

The study intervention is an immersive VR police safety module. The main outcome measures are a police interaction assessment and a police knowledge assessment.

TABLE 1: SCHEDULE OF STUDY PROCEDURES

Study Phase	**Screening**	**Cycle A**			**Cycle B**			
Visit Number		**1**	**2**	**3**	**1**	**2**	**3**	**4**
								4 weeks post-intervention
Informed Consent/Assent	X	X			X			
Review Inclusion/Exclusion Criteria	X	X			X			
Screening Interview	X							
IQ Testing		X			X			
Behavioural Testing and Questionnaires		X	X	X	X	X	X	X
Baseline Assessment		X			X			
Virtual Reality Sessions		X	X	X	X	X	X	X
Police Interaction Assessment				X			X	X

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1 BACKGROUND INFORMATION AND RATIONALE

1.1 Introduction

Individuals with autism spectrum disorder (ASD) have core impairments in social communication skills that typically persist into adulthood and result in challenges related to independence, employment, and emotional wellbeing. ASD prevalence is rising, with recent estimates in studies from the Centers for Disease Control and Prevention ranging from 14.6 per 1000 children aged 8 years (Centers for Disease Control and Prevention [CDC], 2016) to 2.24% in children aged 3 to 17 years (Zablotsky *et al*., 2015). Given the increased prevalence of ASD diagnoses in childhood and the noted challenges with community living skills seen in adults with ASD, it is critical to develop effective and easily accessible programs to support social skills in adolescents and adults with ASD.

Advances in virtual reality (VR) technology offer new opportunities to design interventions targeting the core deficits associated with ASD and promote acquisition of skills necessary for effective navigation of challenging social situations, such as engagement with law enforcement. Researchers have explored the potential of virtual reality technology in targeting autism-related deficits (Parsons and Cobb, 2011), but at this time there are no evidence-based VR interventions for ASD. While most research labelled VR for the purposes of therapy has not been immersive, in recent years, the commercial introduction of head-mounted displays (HMD) and lower cost of virtual reality technology have led to greater interest in therapeutic applications of VR. As part of a mission to develop VR products for individuals with ASD, we will collaborate with a commercial tech start-up company, Floreo Technology, to study a mobile VR module for police safety skills. The project will evaluate the safety and feasibility of the mobile VR police safety module (PSM) and the effectiveness of the module in improving police interaction skills in adolescents and adults with ASD with mid-range to high-functioning intellectual abilities.

1.2 Name and Description of Investigational Product or Intervention

Floreo's virtual reality (VR) application provides immersive and engaging therapy intended to help individuals with ASD build real world skills. If proven effective, the application would be an affordable supplement to traditional therapy that is fun and engaging for the user, while allowing a supervising adult to monitor and guide the activities.

Floreo's Police Safety Module (PSM) will offer a supervised VR experience for individuals with ASD. The software will be a downloadable application that provides a three-dimensional immersive scene for headset-compatible smartphones and a supervisory overview that can run on smartphones or tablets. The individual with ASD will use a smartphone capable of running the application with a dedicated headset providing the virtual environment.

1.3 Relevant Literature and Data

Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental condition with lifelong impact. ASD is characterized by variable degrees of impairment in social communication and

restricted and repetitive patterns of behavior (American Psychiatric Association, 2013). Prevalence has been rising, with recent estimates in studies from the Centers for Disease Control and Prevention ranging from 14.6 per 1000 children aged 8 years (Centers for Disease Control and Prevention [CDC], 2016) to 2.24% in children aged 3 to 17 years (Zablotsky et al., 2015). While much attention has been paid to the pathogenesis and diagnosis of ASD, there remains a clear need for effective treatments for the core symptoms. ASD is a lifelong disorder, persisting into adulthood and resulting in significant challenges for affected individuals.

Adults with ASD experience significant social challenges that impact functional living skills and emotional well-being. Families of young adults initially diagnosed with ASD as preschoolers have noted the persistence of unmet social needs (Eaves and Ho, 2008). A more recent survey of young adults with ASD found that 24% reported social isolation, as well as high rates of anxiety, depression, and attention deficit hyperactivity disorder. In addition, 4 in 10 young adults with ASD were described as disconnected from work and continued education through their late teens and early twenties. Less than 20% of young adults with ASD lived independently (Roux et al., 2015). Researchers have also described age-related declines in social communication (Wallace et al., 2016) and adaptive functioning skills (Pugliese et al., 2015).

Individuals with social communication disabilities like ASD may be particularly susceptible to poor police interaction outcomes due to difficulty reading social cues (American Psychiatric Association, 2013), variable verbal ability (Tager-Flusberg & Kasari, 2013), heightened anxiety (Sukhodolsky et al., 2008), and reduced executive control (Blijd-Hoogewys et al., 2014). The presence of intellectual disability (ID) is associated with greater risk of injury during police interactions (Perry & Carter-Long, 2016), and approximately 30% of individuals with ASD also have ID (CDC, 2012). Rava et al. (2017) reported that elevated externalizing behaviors in U.S. teens with ASD are associated with police contact. Similarly, Tint et al. (2017) reported that instances of aggressive behavior are the most common cause of contact between police and Canadian adults with ASD.

Existing intervention approaches relevant to interactions with law enforcement for individuals with ASD have not been shown to be effective. The effort to promote optimal social and community living skills in young adults with ASD has led researchers to investigate strategies such as story-based interventions and video modeling. Social Stories™ is the most well-known story-based intervention. While a systematic review of Social Stories™ found positive benefits for various social outcomes (Karkhaneh et al., 2010), a meta-analysis found Social Stories™ to be of limited effectiveness in addressing social difficulties (Kokina and Kern, 2010).

Video modeling intervention was found to be moderately effective (Hong et al., 2016) and described as an evidence-based practice for daily living skills (Hong et al., 2015) for individuals with ASD. BE SAFE The Movie uses a video modeling approach to support more effective interactions between individuals with ASD and law enforcement officers. This program has been used in communities across the country and is featured as a safety resource by Autism Speaks. However, the efficacy and effectiveness of the BE SAFE intervention have not yet been experimentally examined and there are currently no evidence-based programs specifically designed to train police safety skills in individuals with ASD.

New VR technology is promising. Researchers have explored the potential of VR technology in targeting ASD-related deficits (Parsons and Cobb, 2011). However, most research labelled VR for the purposes of therapy has not been immersive (Lahiri et al., 2015; Didehbani et al., 2016; Josman et al., 2008). An immersive VR experience gives the user the feeling of being inside a virtual world, and offers an environment in which users can try out experiences that are hard to stage or replicate in real life. In recent years, the commercial introduction of head-mounted displays (HMD) and lower cost of VR technology have led to increased use by the public as well as greater interest in therapeutic applications of VR. These new advances in VR technology offer opportunities to design interventions targeting the core deficits associated with ASD and promote progress toward optimal functional outcomes. Given the increasing prevalence of ASD in the population, and the impact of persisting deficits in social communication and daily living skills in adults with
ASD, it is critical to develop innovative means of providing support to individuals with ASD. Consistent with this, the most recent National Standards Project from the National Autism Center, released in 2015, describes "Technology-based Intervention" as an Emerging intervention, warranting additional research (National Autism Center, 2015).

1.4 Compliance Statement

This study will be conducted in full accordance all applicable Children's Hospital of Philadelphia Research Policies and Procedures and all applicable Federal and state laws and regulations including 45 CFR 46 and HIPAA. All episodes of noncompliance will be documented.

The investigators will perform the study in accordance with this protocol, will obtain consent and assent (unless a waiver is granted), and will report unanticipated problems involving risks to subjects or others in accordance with The Children's Hospital of Philadelphia IRB Policies and Procedures and all federal requirements. Collection, recording, and reporting of data will be accurate and will ensure the privacy, health, and welfare of research subjects during and after the study.

2 STUDY OBJECTIVES

The overall objective of the proposed project is to demonstrate a satisfactory safety profile, feasibility, and efficacy of a unique mobile VR application for police safety skills in adolescents and adults with ASD. Safety and feasibility was found to be acceptable under a separate protocol (#14194), while this phase of the project will involve ongoing research and development including laboratory-based efficacy and virtually-based efficacy studies. This study will involve further development of the PSM, including greater complexity of the virtual environment and greater diversity of police interaction options.

2.1 Primary Objective (or Aim)

The primary objective of this study is to demonstrate the efficacy of Floreo's PSM in adolescents and adults with ASD by assessing improvement in police interaction skills as compared to a video modeling intervention and a treatment-as-usual condition.

2.2 Secondary Objectives (or Aim)

The secondary objective is to demonstrate the efficacy of Floreo's PSM in adolescents and adults with ASD by assessing improvement in police interaction skills as compared to a treatment-as-usual condition under virtual implementation.

3 INVESTIGATIONAL PLAN

3.1 General Schema of Study Design

3.1.1 Screening Phase

Potential subjects will be screened using a screening interview that reviews the protocol's requirements, and inclusion/exclusion criteria. Questions about level of functioning will be included to provide an estimate of IQ. In the case of a reported grade level discrepancy greater than one year, potential subjects will be asked to provide the most recent IEP evaluation in order to review IQ scores and estimate current IQ. Medical and/or research records will be reviewed to document ASD diagnosis.

Informed consent (if adult) or parental/guardian permission (if child or adult with diminished capacity) and, if applicable, assent, will be obtained prior to any study related procedures being performed, including IQ testing to confirm that subjects meet this inclusion criterion.

3.1.2 Cycle A – Laboratory-Based Efficacy Study

In the first year of the study, an efficacy study will be conducted at the Center for Autism Research. Subjects will be randomized to the VR intervention or to the video modeling control condition (with stratification, see *Study Procedure*). Subjects in each condition will undergo a baseline assessment of police interaction skills via a live role play with a study staff member and three sessions of their assigned intervention within an approximately six-week period. At the end of Visit 3, subjects' police interaction skills will be assessed via a live interaction with a police officer.

3.1.3 Cycle B – Virtually-Based Efficacy Study

In the second year (after the completion of Cycle A), a virtually-based efficacy trial will be conducted by CHOP staff via videoconference. Subjects will be randomized to the VR intervention or to the treatment-as-usual condition (with stratification, see *Study Procedure*). Subjects in each condition will undergo a baseline assessment of police interaction skills via a novel pre-/post-intervention assessment and three sessions within an approximately six-week period. At the end of Visit 3, subjects' police interaction skills will be assessed. There will be an additional follow-up visit approximately 4 weeks post-training, for all participants, to re-administer outcome measures, as an assessment of maintenance of learning.

3.2 Study Duration, Enrollment and Number of Sites

3.2.1 Duration of Study Participation

In the first year of the study (Cycle A), the study duration per subject will be up to 3 visits over approximately 6 weeks. In Cycle B, the study duration per subject will be up to 4 virtual sessions over approximately 10 weeks.

3.2.2 Total Number of Study Sites/Total Number of Subjects Projected

The study will be conducted at approximately two investigative sites in the United States. Cycle A of the study will be conducted at the Center for Autism Research at CHOP, while Cycle B will be conducted virtually using CHOP approved, HIPPA compliant video conferencing software.

Recruitment will stop when approximately 48 evaluable subjects complete each phase of the study. It is expected that approximately 400 subjects will be enrolled to produce 96 evaluable subjects.

3.3 Study Population

3.3.1 Inclusion Criteria

1) Males or females age 12 to 60 years
2) Documented ASD diagnosis
3) Verbal and overall IQ ≥ 75 (Cycle A)/Verbal and overall IQ ≥ 80 (Cycle B)
4) Informed consent (if adult) or parental/guardian permission (if child or adult with diminished capacity) and, if applicable, assent

3.3.2 Exclusion Criteria

1) Participation in Phase I (IRB# 14194)
2) Personal or family history of seizures or a seizure disorder, subject to review on a case by case basis by medical professionals at Floreo
3) Primary sensory impairment (e.g., blindness, deafness)
4) Personal history of migraines, subject to review on a case by case basis by medical professionals at Floreo
5) History of vertigo
6) Diagnosis of a known genetic syndrome (e.g., Down syndrome, Fragile X syndrome)
7) History of a medical condition which has affected/affects cognitive, sensory, or motor functioning (e.g., Fetal Alcohol Syndrome, brain injury, stroke, brain tumor)
8) Non-English speaking

9) Parents/guardians or subjects who, in the opinion of the Investigator, may be non-compliant with study schedules or procedures

Subjects that do not meet all of the enrollment criteria may not be enrolled. Any violations of these criteria must be reported in accordance with IRB Policies and Procedures.

4 STUDY PROCEDURES

4.1 Screening Interview

- Informed Consent
- Screening Questionnaire
- Medical or Research Record Review

4.2 Characterization Visits

- Informed Consent, and assent if appropriate
- IQ testing (completed at first visit)
- ASD diagnostic testing (completed at any of the 3 intervention study visits in Cycle A only)
- Self-report measures
- Parent-report questionnaires
- Stratified randomization to either the VR intervention or to the video modeling control condition
- Medical or Research Record Review

4.3 Intervention Visits

- Baseline Assessment
- VR or video modeling session
- Pre and post-intervention Police Knowledge Assessment
- Police Interaction Assessment at the end of Visit 3
- Floreo Feedback Questionnaire following the Police Interaction Assessment (Cycle B)
- Debriefing

4.4 Follow-Up Visits

4.4.1 4 weeks post-intervention (Cycle B only)

- Police Interaction Assessment
- Police Knowledge Assessment
- Debriefing

4.5 Unscheduled Visits

No unscheduled visits are anticipated.

4.6 Subject Completion/Withdrawal

Subjects may withdraw from the study at any time without prejudice to their care. They may also be discontinued from the study at the discretion of the Investigator for lack of adherence to study visit schedules or procedures. The Investigator may also withdraw subjects who violate the study plan, or to protect the subject for reasons of safety or for administrative reasons. It will be documented whether or not each subject completes the pilot study. If the Investigator becomes aware of any serious, related adverse events after the subject completes or withdraws from the study, they will be recorded in the source documents and on the CRF.

5 STUDY EVALUATIONS AND MEASUREMENTS

5.1 Screening and Monitoring Evaluations and Measurements

5.1.1 Medical or Research Record Review

For subjects who have participated in a study at the Center for Autism Research, their ASD diagnosis will be confirmed using previously collected information. The electronic medical records of subjects who receive care at CHOP may also be reviewed to confirm diagnosis. Finally, records supporting their ASD diagnosis will be requested from subjects who are not affiliated with CHOP. For subjects enrolled in Cycle B, research staff will review relevant records to confirm ASD status.

5.1.2 IQ testing

Cognitive function, including verbal and non-verbal intelligence, will be assessed using the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler & Hsiao-pin, 2011) or other equivalent IQ test. Subjects with a verbal and overall IQ greater than or equal to 75 (Cycle A), or 80 (Cycle B) will continue with the study.

5.1.3 Clinician Observed Autism Symptoms

Autism Diagnostic Observational Schedule - 2nd Edition (Lord, Rutter, DiLavore, Risi, Gotham, & Bishop, 2012). The ADOS-2 is a semi-structured standardized assessment using developmentally appropriate social interactions in a 30-45 minute evaluation session. The ADOS-2 consists of five different modules, each directed at a particular level of language ability. The ADOS-2 has been carefully psychometrically validated across a wide range of ages and severity levels in autism, and it is widely considered the single best gold standard diagnostic instrument. The ADOS will be administered onsite at CHOP during Cycle A. Feedback will be provided to participants in person or over the phone as needed, based on conversations between participating families and the study clinician. Participants who have completed an ADOS at the Center for Autism Research or a comparable organization within one year of participation in this study will not need to complete it again.

The ADOS will be audio and video recorded in accordance with CHOP Policy RI-2-03 (Recording or Filming of Patients). Audio and video recordings may be used for clinical supervision, training, educational, or research purposes.

5.1.4 Autism Screening

Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003). The SCQ is a parent report screening measure for ASD that has been validated for identifying children displaying autism symptoms. The SCQ will be completed by parents of participants.

Autism-Spectrum Quotient (AQ; (Ruzich et al., 2015)). The AQ is a widely used, 50-item self-report questionnaire designed to measure reciprocal behavior, social use of language, and other behaviors characteristic of ASD. Total AQ score and 5 subscales (communication, social skills, imagination, attention to detail, attention switching) are normally distributed, demonstrate good test-retest reliability, and have medium-to-high internal consistency (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001).

5.1.5 Other Measures and Questionnaires

Adult/Adolescent Sensory Profile (Brown, et al., 2001). The Adolescent/Adult Sensory Profile is designed as a trait measure of sensory processing patterns and effects on functional performance. An individual answers questions regarding how he or she generally responds to sensations, as opposed to how he or she responds at any given time. This enables the instrument to capture the more stable and enduring sensory processing preferences of an individual.

Child Behavior Checklist (CBCL) OR *Adult Behavior Checklist*, (T. Achenbach & Rescorla, 2001). The CBCL is a 118-item checklist completed by parents regarding a broad range of behavioral and emotional problems. Statements are rated from 0 to 2 based on how well the statement describes the youth: 0 (not true), 1 (somewhat or sometimes true) and 2 (very often true). Scores are reported for both internalizing and externalizing scales including the following subscales: Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problem, Thought Problems, Attention Problems, Rule-Breaking Behavior, and Aggressive Behavior. The *Adult Behavior Checklist* is a parent-report extension of the CBCL intended for adults aged 18-59. The *Adult Self-Report* is the self-report extension of the CBCL intended for adults aged 18-59.

Social Responsiveness Scale – Second Edition (SRS-2; Constantino, 2012). The SRS-2 distinguishes autism spectrum conditions from other psychiatric conditions by identifying presence and extent of autistic social impairment. The SRS-2 is a 65-item quantitative measure of autistic traits ranging continuously from significantly impaired to above average. Familial correlations of sub-clinical features of autism can be measured by the SRS-2, which is consistent with the potential for heritability of a broad autism phenotype in family members. Parents will complete the SRS-II or the SRS-ARV, as appropriate to the participant's age, as the measure of autistic traits in non-ASD and ASD participants. The SRS-2 will be completed by parents of subjects age 12-17.

Demographic and Medical History Form (all ages). Information about participant family, medical and diagnostic history, race/ethnicity, household income, and educational level will be collected from parents/adult participants. This information will be used to understand participant diagnostic history, control bias, and will be entered as covariates to statistical analyses when groups are not matched on critical features.

Police Knowledge Assessment. This measure has been created by study investigators to measure prior police interaction experience and feelings about interacting with police.

Police Interaction Behavior Checklist. This checklist has been created by study investigators as a learning tool to be given to all participants prior to beginning the first trial of the PSM. The Police Interaction Behavior Checklist describes how to appropriately behave while interacting with a police officer. The participant and the moderator can refer to this checklist as needed while progressing through the VR trials to aid in learning.

Floreo Feedback Questionnaire. This questionnaire has been created by study investigators to measure how the participants felt about the VR and to get feedback on how the VR can be modified to better suit people with different backgrounds.

5.2 Intervention: Virtual Reality Sessions

Each subject assigned to the PSM intervention will undergo three sessions over an approximately six week period (at least 24 hours between sessions). At the beginning of each session, research personnel will preview the VR session experience with the subject and a parent or caregiver as appropriate. The VR experience preparation will include screening of subject's health status and adjustment of the headset to fit the subject. The VR session will consist of multiple scenes in which the subject is approached and engaged by police officers in the virtual environment. Some police officer avatars in the virtual environment will be wearing facemasks to accurately reflect real-world masking behaviors in Cycle B. VR scenes will be presented via the Floreo application downloaded onto an iPhone worn by the participant in a lightweight, inexpensive VR headset. The VR interaction will be controlled and operated via linked iPad by a research staff member sitting with the subject at CAR in Cycle A, or via tele-administration in Cycle B. Subjects in the VR environment will receive live feedback from research staff members about police officer interaction expectations and safety in accordance with individual scene scripts and prompts. Each VR session should encompass four VR trials, each involving a non-identical police safety scene. The subject will take a break from the VR environment in between each trial.

5.3 Control Conditions

5.3.1 Cycle A: Video Modeling

Subjects assigned to the comparison video modeling interaction will undergo three sessions over a period of six weeks that will consist of BE SAFE The Movie Curriculum Lessons 1-4 (https://besafethemovie.com/curriculum/). The BE SAFE The Movie Curriculum consists of video-based instruction on police officer interaction expectations and safety. These include Lesson 1: Laws Help us BE SAFE; 2: Law Enforcement Officers Help Us BE SAFE; 3: Uniforms and Safety Tools; 4: Stay Calm When You Meet the Police; within each of these lessons, participants will be shown videos, and then complete additional engaging video-based activities and short movie scenarios to video model. The lessons will be presented by research staff member sitting with the subject at CAR. Video observation, activities, and modeling sessions will be structured to correspond with VR session duration and total number. Participants in the video modeling interaction arm will be screened for subject health status in preparation for their sessions.

5.3.2 Cycle B: Treatment-as-usual

Subjects assigned to the control condition will not receive any training with PSM, but will engage with the software for their assessments, and will continue their other treatments as usual. Participants in the treatment-as-usual arm will be screened for subject health status in preparation for their sessions.

5.4 Efficacy Evaluations

5.4.1 Baseline Assessment

5.4.1.1 Cycle A

Before beginning the first VR or video modeling intervention session, all participants will complete a baseline assessment of police interactions skills via a live role play of a police interaction with a study staff member. These interactions are designed to measure each participant's ability to interact with a police officer prior to completing either intervention. The study staff member will be provided with a semi-structured set of prompts to use when interacting with the participant. The interaction is designed with guidance from law enforcement officers with particular experience working with individuals with intellectual and developmental disabilities. The live interaction will be video-recorded via a videoconference platform. These recordings will be coded for a set of behaviors that would encourage successful police interactions (i.e.: making appropriate eye contact, etc.)

5.4.1.2 Cycle B

Before beginning the first VR or video modeling intervention session, all participants will complete a baseline novel remote assessment of police interactions skills. These interactions are designed to measure each participant's ability to interact with a virtual police officer prior to completing either intervention. This assessment will include coded video recordings of participants wearing the VR headset while engaging in a standardized experience. The behaviors of the participant inside the virtual environment will also be coded. The interaction is designed with guidance from law enforcement officers with particular experience working with individuals with intellectual and developmental disabilities. The live interaction will be video-recorded via a CHOP-approved, HIPPA compliant videoconference platform. These recordings will be coded for a set of behaviors that would encourage successful police interactions (i.e.: making appropriate eye contact, etc.)

5.4.2 Police Interaction Assessments

5.4.2.1 Cycle A: Live Police Interaction Assessment

After the final VR or video modeling intervention session, all participants will be assessed via a live semi-structured interaction with a police or security officer. These interactions are specifically designed to serve as an index of behaviorally defined skills associated with effective interactions with a police officer. The police officer will be provided with a semi-structured set of prompts to use when interacting with the participant, and will rate the participant's responses. The interaction is designed with guidance from law enforcement officers with particular experience working with individuals with intellectual and developmental disabilities. The live

interaction will be video-recorded. These recordings will be coded for a set of behaviors that would encourage successful police interactions (i.e. making appropriate eye contact, etc.).

Individuals with and without ASD both experience a degree of stress/anxiety when interacting with Police Officers. Police Officers also have particular characteristics, training, and expectations which make their approaches to members of the community unique. Furthermore, Police Officer approaches and interaction are very often unexpected. Yet, Police Officer approaches to civilians are common, every day occurrences, including for individuals with ASD. As a result of these factors, it is critical that experimental measurement of effective versus ineffective interaction with Police Officers in the current study are implemented using real Police or Security Officers.

While it is important that our research participants are approached by actual Police Officers, it is also critical that risks for stress/distress and other harms are minimized. To this end, the Police Officer will be instructed to take a casual, non-accusatory approach to questioning the participant, but to otherwise follow their standard procedures in the type of scenario where they need to inquire with an individual but where that individual is not a suspect. In addition, although the Police Officers will be blinded to the experimental treatment condition of the participant, all Police Officers will be made aware that the participants may have ASD, and will be given basic information and have opportunity to ask questions and learn about what it means for someone to have ASD.

Consistent with ethical standards in psychological research, all participants will be de-briefed immediately following the Live Interaction Assessment with the Police Officer. The researcher and the Police Officer will both remind the research participant that the Police Officer's approach to them was conducted as part of the study. The researcher and Police Officer will further explain to the research participant that they are not in trouble and that the Police Officer is not upset with them. The research participant will be offered the opportunity to ask questions, and to provide their thoughts and feedback on the study procedures and practices. Research participants will also be asked to rate their experience with the Live Police Interaction, as well as the study process and procedures overall, in a formal questionnaire. Information gathered from both the interview and the questionnaire will be used to inform the researchers of how the practice is affecting research participants.

5.4.2.2 Cycle B: Virtual Police Interaction Assessment

After the final VR intervention session, all participants will be assessed via a remote semi-structured interaction with a police or security officer avatar. Approximately 4weeks after the final VR intervention session, participants in Cycle B will be assessed once again via a remote interaction with a police or security officer. These interactions are specifically designed to serve as an index of behaviorally defined skills associated with effective interactions with a police officer. The police officer will be programmed with a semi-structured set of prompts to use when interacting with the participant, and will rate the participant's responses. The interaction is designed with guidance from law enforcement officers with particular experience working with individuals with intellectual and developmental disabilities. We will use video recordings of both the participant wearing the headset and behaviors while in the VR experience to code behaviors. These recordings will be coded for a set of both virtual and real-world behaviors that would

encourage successful police interactions (i.e. making appropriate eye contact, orienting to the virtual officer, etc.).

While it is important that our research participants are approached by simulated Police Officers, it is also critical that risks for stress/distress and other harms are minimized. To this end, the virtual reality Police Officer will take a casual, non-accusatory approach to questioning the participant, and will follow their standard procedures in the type of scenario where they need to inquire with an individual but where that individual is not a suspect.

Consistent with ethical standards in psychological research, all participants will be de-briefed immediately following the Remote Interaction Assessment. The research participant will be offered the opportunity to ask questions, and to provide their thoughts and feedback on the study procedures and practices. Research participants will also be asked to rate their experience with the remote Police Interaction, as well as the study process and procedures overall, in a formal questionnaire. Information gathered from both the interview and the questionnaire will be used to inform the researchers of how the practice is affecting research participants.

5.4.3 Police Knowledge Questionnaire

This questionnaire has been developed by the study team as a measure of knowledge of officer expectations for interaction and will be administered to all participants both pre-treatment and post-treatment, as well as during the follow-up visit for Cycle B.

5.4.4 Floreo Feedback Questionnaire

This questionnaire has been developed by the study team as a measure of how well the VR simulated a real police interaction and will be administered to all participants post treatment.

5.5 Video/Audio Recording

Virtual and in person clinical testing will be audio and video recorded in accordance with CHOP Policy RI-2-03 (Recording or Filming of Patients). Audio and video recordings may be used for clinical supervision, training, educational, or research purposes.

The VR sessions may be recorded for research, accuracy, and safety purposes. Video recording will not be mandatory; permission to record these sessions will be obtained in the consent form. The VR sessions will be recorded to capture any adverse effects of the VR, which may help prevent such effects in future visits. It would also be helpful to have a video record of the session to determine how the gyroscopic effects in the VR module correspond to the subjects' movements. Video modeling sessions may also be recorded for comparison purposes.

The Baseline Assessment as well as Virtual and Live Police Interactions will be recorded for research purposes. The interactions will be coded for a set of behaviors that would encourage successful police interactions (i.e. making appropriate eye-contact, orienting to the virtual officer, etc.). All recordings will be stored on a secure CHOP-approved server. If conducted via videoconference, they will be recorded through the CHOP- approved platform used.

5.6 Safety Evaluation

Immediately after completing each intervention session, research staff will ask subjects about any side effects experienced during the session. Research staff will also document the subject's overall perceived mood and emotional state**.**

6 STATISTICAL CONSIDERATIONS

6.1 Primary Endpoints

The primary efficacy endpoints will be the change in post-treatment Live and Virtual Police Interaction Assessment Scores between the Virtual Reality Intervention and treatment-as-usual groups, and the change in scores between the Baseline Assessment and Virtual Police Interaction Assessment.

6.2 Secondary Endpoints

Secondary endpoints will include the following:

- The changes in Police Interaction Knowledge Questionnaire Scores from Pre-Treatment to Post-Treatment for the Virtual Reality Intervention and BE SAFE Video-Based intervention or treatment-as-usual;
- The maintenance of learned skill improvements, indexed via the 4-week (Cycle B) Follow-Up administration of the Virtual Police Interaction Assessment.

6.3 Statistical Methods

6.3.1 Baseline Data

Baseline and demographic characteristics will be summarized by standard descriptive summaries (e.g., means and standard deviations for continuous variables such as age and percentages for categorical variables such as gender). Statistical analyses will be conducted to compare groups on each of the measures. Any baseline characteristics which exhibit statistically significant group differences despite stratified random assignment will be utilized as co-variates in both Primary and Secondary statistical analyses of intervention effects.

6.3.2 Efficacy Analysis

The primary analysis will be based on an intention to treat approach and will include all subjects randomized at Visit 1.

The primary efficacy endpoint will be the change in post-treatment Live Police Interaction Assessment Scores between the Virtual Reality Intervention and BE SAFE Video-Based intervention and the change in scores between the Baseline Assessment and Live Police Interaction Assessment. In the case of Cycle 2, the Baseline Assessment will be compared to the Virtual Police Interaction Assessment between the Virtual Reality Intervention and treatment-as-usual groups. The study hypothesis is that participants randomly assigned to the Virtual Reality Intervention will perform better on the post-treatment Live or Virtual Police Interaction Assessment than will participants randomly assigned to the BE SAFE Video-Based intervention or treatment-as-usual condition.

The secondary endpoint will include changes in Police Interaction Knowledge Questionnaire Scores from Pre-Treatment to Post-Treatment for the Virtual Reality Intervention and BE SAFE Video-Based intervention or treatment-as-usual. The study hypothesis is that participants randomly assigned to the Virtual Reality Intervention will exhibit significantly greater improvement from Pre-Treatment to Post-Treatment on Police Interaction Knowledge Questionnaire than will participants randomly assigned to the BE SAFE Video-Based intervention condition or the treatment-as-usual condition. An additional Secondary endpoint is maintenance of learned skill improvements, indexed via the 4-week Follow-Up administration of the Virtual Police Interaction Assessment in Cycle B. The study hypothesis is that participants randomly assigned to the Virtual Reality Intervention will exhibit significantly greater Live Police Interaction Assessment Scores and skill improvement/maintenance 4-week follow-up than will participants randomly assigned to the treatment-as-usual condition.

6.3.3 Safety Analysis

All subjects entered into the study at Visit 1 will be included in the safety analysis. The frequencies of AEs by type, body system, severity and relationship to study intervention type will be summarized. SAEs (if any) will be described in detail.

AE incidence will be summarized along with the corresponding exact binomial 95% two-sided confidence intervals.

6.4 Sample Size and Power

This study will compare the PSM VR intervention to treatment-as-usual (TAU) in a total of 96 adolescents and adults with ASD, in two separate studies (i.e., n=48 per study). The most relevant study to date (Didehbani, Allen, Kandalaft, Krawczyk, & Chapman, 2016) included 30 7-16 year-olds with ASD in a pre/post virtual reality intervention to improve social cognitive skills. This study suggested a medium-to-large within-group effect of VR intervention on emotion recognition (Cohen's d = .63), but did not compare two interventions. Sensitivity analysis using G*Power indicated that intervention differences using our proposed sample size (N=48 per group) will be detected with a critical t of 1.99, and that we will be able to detect differences with effect sizes of Cohen's d = .74 or larger. Data will be behaviorally coded from video interactions and correct answers marked on knowledge tests. Scores will be summed, averaged, and examined for normality at the group level. Normally distributed data will be analyzed using parametric statistics (e.g., ANOVA, regression, Pearson correlation), and data that do not meet normality assumptions will either be transformed or will be analyzed using nonparametric statistical tests (e.g., Chi-square, Spearman correlation). Analyses will be corrected for comparisons. To compare PSM to BE SAFE, an Analysis of Variance (ANOVA) with Group (PSM VR Intervention, BE SAFE The Movie Video Modeling Intervention) as a Between-Subjects factor will be conducted for Live Interaction data. A separate ANOVA (or comparable statistical test) will be conducted for Questionnaire data. Relevant potential covariates include knowledge of police interactions at intake, sensory sensitivity scores, verbal abilities, and chronological age.

7 STUDY INTERVENTION

7.1 Virtual Reality Intervention

Floreo's Police Safety Module (PSM) will offer a supervised VR experience for individuals with ASD. The software will be a downloadable application that provides a three-dimensional immersive scene for headset-compatible smartphones and a supervisory overview that can run on smartphones or tablets. The individual with ASD will use a smartphone capable of running the application with a dedicated headset providing the virtual environment.

1. ***Immersive story-based intervention.*** Floreo's PSM provides a fully realized and intricately detailed urban environment (Appendix figure 1), designed to engage the user in a virtual encounter with law enforcement officers. The immersive VR environment engages the individual with ASD as an actor in a virtual narrative, incorporating strategies from both story-based intervention and video modeling. The opportunity to enter a virtual environment is likely to be appealing for adolescents with ASD. A law enforcement officer with extensive experience working with individuals with autism spectrum disorder along with members of the Philadelphia Police Department have provided ongoing input into content and environment design for this product.

2. ***Video modeling.*** Floreo's PSM provides video modeling to an individual with ASD. The video demonstrates the approach and initial engagement efforts of various police officers in the virtual environment, from the perspective of the individual wearing the HMD (Appendix figure 2).

3. ***Supervised Learning Environment.*** Floreo's PSM allows a monitor to use a tablet or phone to supervise the individual's virtual world. The devices used by individual with ASD and the monitor are communicatively paired together over a network connection (Appendix figure 3).

7.2 Video Modeling Intervention

The video modeling intervention consists of the first four BE SAFE The Movie Curriculum Lessons (https://besafethemovie.com/curriculum/). The BE SAFE The Movie Curriculum consists of video-based instruction on police officer interaction expectations and safety. These include Lesson 1: Laws Help us BE SAFE; 2: Law Enforcement Officers Help Us BE SAFE; 3: Uniforms and Safety Tools; 4: Stay Calm When You Meet the Police; Participants will be shown videos from lessons, and then complete additional engaging video-based activities and short movie scenarios to video model.

8 SAFETY MANAGEMENT

8.1 Clinical Adverse Events

Clinical adverse events (AEs) will be monitored throughout the study. The PI and the research team will work together to minimize minor adverse events. This will be accomplished through systematic assessment for adverse events through active clinical observation and post-session

questionnaires. If adverse events occur, we will solicit direct guidance and feedback from CHOP's IRB, and immediately implement safeguards to decrease or eliminate future risks. Minor AEs that are unrelated to study participation will be reported to CHOP's IRB and the NIH program officer in a quarterly report.

Safety research on Virtual Reality (VR) indicates that photosensitive seizures, headache, and vertigo are adverse events possibly related to VR use. Our study team will consider new onset seizure disorder, any seizure triggered during participation, and either headache or vertigo severe enough to result in an emergency room evaluation or hospitalization to be SAEs and respond accordingly.

8.2 Adverse Event Reporting

Since the study procedures are not greater than minimal risk, SAEs are not expected. If any unanticipated problems related to the research involving risks to subjects or others happen during the course of this study (including SAEs) they will be reported to the IRB in accordance with CHOP IRB SOP 408: Unanticipated Problems Involving Risks to Subjects. AEs that are not serious but that are notable and could involve risks to subjects will be summarized in narrative or other format and submitted to the IRB at the time of continuing review.

Dr. Julia Parish-Morris (PI) will be responsible for handling SAEs and AEs that may occur during this study. Taking NIMH guidelines into account, we will implement rigorous protocols at each site (CHOP) to ensure that SAEs and AEs are rapidly reported to Dr. Parish-Morris. All SAEs will be reported to Dr. Parish-Morris within 24 hours. At CHOP, SAEs will be reported directly to Dr. Parish-Morris by study staff. Dr. Parish-Morris will notify CHOP's IRB and NIH program officer about SAEs within 72 hours.

9 STUDY ADMINISTRATION

9.1 Treatment Assignment Methods

9.1.1 Randomization

We will employ stratified random assignment using variables including developmental age and sex. Other participant variables that differ between our groups following this stratified randomized assignment will be accounted for statistically during our primary analyses.

9.1.2 Blinding

Study staff members and Police officers serving as confederates in the Baseline Assessment and Police Interaction Assessment and those that code the interactions will be blinded to intervention condition.

9.2 Data Collection and Management

Data collected as part of this study will be managed in strict accordance with CHOP's secure confidentiality standards. Importantly, after consenting to participate, all participants will be assigned a unique, study-specific alphanumeric identifier (subject ID). This subject ID will be used to track all study data; although study staff will necessarily have access to identifiable participant information in order to contact participants and schedule visits, in no case will the

participant's name or other identifying information appear with study data. We will keep a master list containing identifying information and subject ID number in a secure encrypted database (REDcap), separate from coded data forms, so that name-to-alphanumeric ID code correspondence cannot be deduced. Identifying information, including consent forms and information sent to us by participants or families, will be kept in a separate secure locked file only accessible to study staff.

Online Data Collection: Online data collection will be facilitated by the Clinical and Translational Core (CTC) of the CHOP/Penn IDDRC. The Core is comprised of CHOP staff only; no Penn staff are involved in data collection or management. The CTC has negotiated contracts with publishers to allow the online administration of various questionnaires, and has standardized the data collection tools. In return for these services, the de-identified data collected using CTC services will be stored in a registry, if participants agree to the future use of their data.

Data Management. REDcap is a secure, password protected, encrypted web-based survey system based on a dedicated CHOP Research Information Systems server, and will be our primary tabular data management tool. Online questionnaires will be completed using REDcap, which will also store participants' behavioral and clinical data coded by a unique alphanumeric identifier (subject ID) assigned after consenting to participate. Study staff at CHOP will be able to log in to REDcap via a separate interface that allows them to manually enter or update data. Data exported by CAR researchers for analysis will be blinded of all personally identifiable information (associated only with subject ID). A built-in audit trail records the identity of individuals that access and/or change data in the system. Data are backed up to time-stamped files daily by CHOP Research Information Systems using automated backup routines. Backup files are encrypted and transferred to a secure file server accessible only to designated personnel. In the event of data error, loss or corruption, research personnel will work with CHOP Research Information Systems to determine the most appropriate recovery strategy. As part of consent, participants will be asked if their coded data can be used in future studies, or for this study only, for which it will be retained indefinitely. Identifiable information will be retained if permission is given to re-contact the participant or family for future studies. Any identifiable information that is obtained will remain confidential per the protocol's data management plan and will be disclosed only with participant/parental permission or as required by US or State law.

Data Analysis. Primary tabular data analysis will be conducted on secure CHOP-imaged computers, and will not include personally identifiable information about participants. All data collected as part of this study will be analyzed at the group level; subjects will be identified only by ID number to protect their confidentiality. Primary data analysis will be conducted on secure CHOP-imaged computers, and will not include personally identifiable information about participants.

9.3 Confidentiality

All data and records generated during this study will be kept confidential in accordance with Institutional policies and HIPAA on subject privacy. The Investigator and other site personnel will not use such data and records for any purpose other than conducting the study.

9.4 Regulatory and Ethical Considerations

9.4.1 Data and Safety Monitoring Plan

The PI will periodically review the data collection and storage practices associated with this study and determine whether changes to enhance confidentiality and privacy are required. The PI will frequently monitor the quality control of the data with staff and research assistants. Quality assurance will be monitored by the PI. Compliance with the monitoring plan and requirements for reporting will be ensured through signed documentation acknowledging confidentiality and human subjects safeguards.

This study will indirectly investigate adverse effects related to use of VR technology. The project team will attempt to minimize these effects by familiarizing participants with the personnel and setting at each site, and closely monitoring them during the study. Tests are administered by well-trained and supervised personnel and participants are debriefed after each session. There may be discomfort associated with participation, but in our experience subjects who are well informed on the purpose of the study and who are accompanied throughout the procedures by a member of the research team tolerate this discomfort well and without complications. One approach the study team will take to protect against risks associated with VR use is to limit the duration of consecutive time participants spend in VR trials. Each participant will take a break in between each VR trial. If a participant who had not previously experienced adverse effects subsequently experiences an adverse effect, research staff will follow up with the participant or a caregiver in regard to any change in the participant's medication regimen that might potentially impact tolerance of VR. A decision will then be made regarding ongoing participation in the study.

A Data and Safety Monitoring Board will be established for this study, in accordance to the NIH policy for multisite studies. The DSMB charter has been uploaded in the eIRB application.

9.4.2 Risk Assessment

Psychological Stress and Anxiety. Due to the time associated with conducting the assessments, some subjects may experience fatigue, anxiety, or stress. The Baseline Assessment and live police interactions may also produce these feelings. Subjects will be allowed to take breaks and stop at any time.

The study visits will be organized to involve breaks for the subject, and to allow the subject to rest between procedures. Experienced clinicians will always be available to help in efforts to reduce anxiety. Research staff working on the project all have experience working with adolescents and adults, and the PI and co-Investigators each have extensive experience working with individuals with ASD, and will therefore do everything possible to accommodate subjects.

Risk of Seizures and Migraines. There is a very low risk of seizures as a result of Virtual Reality technology, which is significantly increased for individuals with a history of seizures. There is also a low risk of migraines, which is significantly increased for individuals with a history of migraines. To reduce both of these risks we will screen all subjects for both a personal and family history of seizures and a personal history of migraines, and exclude any subject who

screens positive for either personal or family history of seizure activity of any type or personal history of any degree or migraines.

There is also some evidence that sleep deprivation and recent alcohol use may increase risk for seizure activity during use of Virtual Reality or other technologies. Therefore, we will encourage participants to reschedule in the event of night-before sleep deprivation or recent alcohol use, to avoid testing on days with either of these risks present. Finally, there is some evidence that extended playing time is associated with increased seizure risk. Therefore, we include required breaks between trials in the Virtual Reality intervention, with approximately 20 minutes of VR and 20 to 25 minutes of break time during the 45 minute VR intervention condition.

Risk of Nausea and Eye Strain. Use of Virtual Reality technology can be associated with nausea or eye strain. To reduce this risk, we include required breaks between the VR trials, as described above. The experimenters will also ask the subjects how they are feeling in between each trial. Finally, the researcher will be aware of the potential for nausea and eye strain and will observe the subject for signs of potential nausea and/or eye strain, including covering the eyes, putting one's head down into their hands, holding one's head or stomach, etc. In cases where these potential indicators are observed, the experimenter will specifically ask how the subject is feeling and whether or not they are experiencing symptoms of nausea, eye strain, headache, or stomach pain or discomfort. If subjects report experiencing nausea or eye strain then the sessions will be stopped, in order to reduce risk of more serious adverse events such as migraines or seizures.

Risk of Musculoskeletal Injury. Use of virtual reality technology has potential to result in musculoskeletal injury. Specifically, as a result of differences in the virtual reality scene world and the real world, subjects may move in ways that do not match the real world with the risk of bumping into real world objects or falling. To reduce this risk, the Virtual Reality Police Intervention platform does not allow for "walking" within any of the virtual reality scenes. Instead, even if the subject moves forward, backward, or to the side, the VR environment does not change. As a result, movement of subjects is both discouraged and significantly reduced as a result of the virtual environment. However, movements do occur, and subjects are able to "rotate" / "spin around" and look upwards and downwards within the virtual environment. To further reduce the risk of musculoskeletal injury, subjects will use Virtual Reality in a central position of a room which is more than sufficient for the types of smaller-scale movements which are generally observed during this particular Virtual Reality Police Interaction training module. Furthermore, the experimenter will always be in the room with subject, and will monitor the subject's movement within the room and intervene if at any time there is potential for the subject to move to a location where an injury could occur, such as a wall or piece of furniture.

Sensorimotor Adaptations which Temporarily Affect Real World. Use of virtual reality technology has potential to result in sensorimotor adaptations (e.g., eye-hand coordination) which may result in a brief period of disorientation and risk for musculoskeletal injury. Specifically, as a result of differences in the virtual reality scene world and the real world, subjects may have briefly altered sense of their sensorimotor functioning in the real world. To reduce the risk of injury as a result of any potential sensorimotor adaptations, we will implement

a brief post-intervention rest period during which the subject is encouraged to both sit and rest and then stand up and walk around in a safe open room space with the experimenter present until any potential sensorimotor adaptations have reversed to normal.

Transmitted Diseases from Poor Hygiene. Head-mounted immersive virtual reality requires re-use of the same headset, earphones, and iPhone across subjects. As a result, there is risk of diseases being transmitted from one subject to another as a result of poor hygiene. To reduce the risk of disease transmission, the experimenters will wipe down all components of the physical setup using alcohol disinfectant wipes after each subject, as well as immediately prior to each new subject.

Breach of Confidentiality. To minimize this risk, all research records will be kept confidential and all research information will be associated with codes and not personal identifiers. The investigators will not be able to identify subjects' identities while working with the database created for this study.

Risk of Audio and video recording: There is the possibility that participants' audio-video recordings might be seen by someone outside of the study team. However, recordings will be kept on password-protected computers and DVDs/tapes will be kept in locked cabinets only accessible by the study team.

9.4.3 Potential Benefits of Trial Participation

No direct benefits are expected from this study. The potential benefits of this project to society are considerable. There is limited evidence for effective interventions for social communication deficits in adolescents and adults with ASD. Demonstration of effectiveness of a mobile VR police safety module in adolescents and adults with ASD will provide support for a new pathway for social communication intervention in ASD. This study will provide insights that can guide further development of new tools to train a variety of social skills in adolescents and adults with ASD. Furthermore, the proposed effort will establish an infrastructure for future investigations to probe the role of VR technology in ASD intervention and treatment.

Feedback will be provided to participants in person or over the phone as needed, based on conversations between participating families and the study clinician.

9.4.4 Risk-Benefit Assessment

While we cannot guarantee that subjects will receive any direct benefit from participation in this study it is hoped that the knowledge gained will benefit the subjects as well as the larger community of people with ASD. The risks of the study procedures are all considered minimal risk.

9.5 Recruitment Strategy

Each site will utilize the resources available to them for recruitment, and CHOP staff will support the other sites in their recruitment efforts. Such resources may include previous participant/student lists, websites, and social media. Colleagues of investigators or site directors who interact with individuals with ASD may refer their patients or students to study staff, with

appropriate permission. All recruitment materials will be submitted to the CHOP IRB for approval prior to being used.

9.6 Informed Consent/Assent and HIPAA Authorization

Potential subjects will be asked for their consent at several points of the study. Interested subjects will first contact study staff via phone or email for information about the study. Subjects will verbally provide HIPAA authorization over the phone before completing the screening procedures. Written informed consent for the study procedures will be obtained online prior to the first study visit. The online consent forms will obtain valid electronic signatures, and consent responses will be tracked by parent or adult participant email. Participants will also be able to print or save a copy of their consent form(s) through REDCap.

Screening Phase. The HIPAA authorization form will describe the study details and HIPAA procedures that are in place to ensure privacy and confidentiality. It will also explain that all information collected will be kept strictly confidential and the nature of the risks and benefits of participating in the screening. Subjects will then undergo the short screening interview over the phone to make sure that the subject is eligible to participate. Study staff will make it clear at the conclusion of the screening interview whether and why a subject is eligible to proceed. The specific inclusion or exclusion criteria in question will be described, and subjects will have an opportunity to ask questions.

Cycle A and Cycle B will be two unique subject populations. Each group will have their own consent process and consent forms.

In person visit (Cycle A). After the screening phase, subjects who are eligible and who are interested in proceeding will be scheduled for an in-person visit at CAR. Consent to participate will be obtained online. Eligible subjects or their parents will be emailed a link to access the consent form in REDCap. The consent process will also be completed online, tracked by parent or adult participant e-mail address. The consent form will have contact information for the investigator and study staff if subjects or parents have questions about the consent form or about the study. The risks, benefits, financial considerations, and HIPAA procedures that are in place to ensure privacy and confidentiality will be highlighted on the consent page. Participants will be reminded that participation in the study is voluntary and can be terminated by the parent/legal guardian(s) (for participants under age 18 or adults with diminished capacity) or participant at any time with no obligations to continue and no penalties whatsoever. Refusal to participate will in no way influence the individual's relationship with CHOP. Participants will have as much time as needed to make a decision regarding participation. Participants will be asked to indicate consent by checking a box at the bottom of the consent screen.

Remote visit (Cycle B). After the screening phase, subjects who are eligible and who are interested in proceeding will be scheduled for a remote visit. Consent to participate will be obtained online. Eligible subjects or their parents will be emailed a link to access the consent form in REDCap. The consent process will also be completed online, tracked by parent or adult participant e-mail address. The consent form will have contact information for the investigator and study staff if subjects or parents have questions about the consent form or about the study. The risks, benefits, financial considerations, and HIPAA procedures that are in place to ensure

privacy and confidentiality will be highlighted on the consent page. Participants will be reminded that participation in the study is voluntary and can be terminated by the parent/legal guardian(s) (for participants under age 18 or adults with diminished capacity) or participant at any time with no obligations to continue and no penalties whatsoever. Refusal to participate will in no way influence the individual's relationship with CHOP. Participants will have as much time as needed to make a decision regarding participation. Participants will be asked to indicate consent by checking a box at the bottom of the consent screen. All participants aged 12-17.99 and adults with diminished capacity will assent in the same manner (a note will encourage parents/legal guardians to read the directions at an appropriate level to participants). After consenting/assenting online, they will be offered the opportunity to print out a copy of the consent form with their name on it for their records. Participants can withdraw consent at any time.

9.6.1 Assessment of the Capacity to Consent

Adults who have a legally authorized representative (LAR) and/or may or may not have a diminished capacity to consent will be enrolled in the study.

The capacity of prospective adult subjects with the potential for having a diminished ability to provide consent will be determined by the family, as all main study consent procedures will occur online. If subject does not have the capacity to understand one or more of the required elements of consent, then the prospective subject will not be able to consent. The subject's legally authorized representative must then provide informed consent on the subject's behalf. Investigators will comply with CHOP Policy for Consent (RI-5-01) for identifying the individual who serves as the patient's representative. Adults who lack the capacity to consent will be required to provide assent. Study staff will be available to prospective participants to address questions, if needed.

9.6.2 Waiver of Assent

A waiver of assent is requested for the screening phase of the study, as parents will likely be contacted when children are unavailable. The research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context. The subjects' rights and welfare will not be adversely affected by the assent waiver because assent will be obtained before any of the main study (i.e. non-screening) research procedures occur.

9.7 Payment to Subjects/Families

Participants at CHOP will be compensated $20 for each hour of participation (rounded up) and will be paid for each full hour of participation even if they fail to complete the hour. Cycle A is expected to take 3 hours for questionnaires and clinical testing, 3 hours for VR or video-based intervention sessions, for a total of 6 hours ($120). Cycle B is expected to take 3 hours for questionnaires and clinical testing, 3 hours for VR or video-based intervention sessions, and 1 hour for the 4-week follow-up, for a total of 7 hours ($140).

10 PUBLICATION

At appropriate scientific junctures, results from these studies will be presented at scientific forums (e.g., national meetings). Similarly, as results are achieved that deserve to be shared with the greater scientific community, they will be submitted for publication in appropriate peer review journals. They may also be presented in book chapters.

11 REFERENCES

Please see attached grant for references.

APPENDIX

Figure 1 – Urban environment designed for Floreo's mobile VR police safety module (PSM)

Figure 2 – Police officer in virtual environment designed for Floreo's mobile VR PSM

Figure 3 – Mobile VR application with smartphone and head mounted display paired with tablet