Université du Québec en Outaouais

Investigation de la faisabilité, l'acceptabilité et l'efficacité initiale d'un programme de remédiation cognitive en réalité virtuelle pour les personnes atteintes de troubles psychotiques.

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Par
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Investigation de la faisabilité, l'acceptabilité et l'efficacité initiale d'un programme de remédiation cognitive en réalité virtuelle pour les personnes ayant un trouble psychotique.

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Résumé

Contexte. La majorité des individus vivant avec un trouble psychotique présente des difficultés dans leur fonctionnement au quotidien et au niveau cognitif. La remédiation cognitive est une intervention de rééducation efficace pour cette population puisqu'elle permet d'améliorer les processus cognitifs ainsi que leur fonctionnement dans la communauté. L'intégration de la réalité virtuelle dans ce type d'intervention permet la pratique d'exercices cognitifs dans des environnement réalistes qui peuvent faciliter le transfert des acquis dans les activités quotidiennes. Avec l'aide de patients-experts et de professionnels, l'équipe du laboratoire de Remédiation Cognitive et de Neuroimagerie a développé un programme de remédiation cognitive en réalité virtuelle, *ThinkTactic VR*, qui cible la cognition et inclut des tâches de mémoire, d'attention, de résolution de problème et de cognition sociale. **Objectif.** Cette étude, qui s'insère dans un plus grand essai clinique en cours, vise à évaluer la faisabilité, l'acceptabilité et l'efficacité préliminaire du programme *ThinkTactic VR* chez les patients présentant des troubles psychotiques. **Méthodologie**. Pour cet essai doctoral, 17 participants vivant avec un trouble psychotique ont été assignés aléatoirement à deux différentes conditions. Huit participants ont été assignés à la condition d'intervention et ont participé à un maximum de 12 séances de *ThinkTactic VR*. Les neuf autres participants ont été assignés à la condition de contrôle actif et ont participé à un maximum de 12 séances de jeux commerciaux en réalité virtuelle. Les participants ont été évalués sur différents domaines de la neurocognition, de la cognition sociale et du fonctionnement quotidien, avant et après l'intervention. Des statistiques descriptives et des modèles à effets mixtes avec des interceptes aléatoires ont été utilisés pour examiner les changements au niveau des fonctions cognitives et du fonctionnement dans la communauté. **Résultats.** Les données préliminaires issues de cet essai doctoral indiquent que *ThinkTactic VR* est faisable auprès des individus vivant avec un trouble psychotique avec un faible taux d'attrition et peu de symptômes de cyber malaise. Les résultats provisoires soulèvent également une grande acceptabilité de ce programme auprès de cette population avec un haut niveau de satisfaction envers l'intervention. De plus, à partir de l'échantillon partiel analysé, l'entrainement avec *ThinkTactic VR* est associé à l'augmentation significative des résultats du fonctionnement quotidien comparativement au groupe contrôle. Aucun effet significatif sur les domaines cognitifs n'a émergé des analyses réalisées sur les données disponibles à ce jour. Toutefois, un effet modéré, tendant vers la significativité, est obtenu pour l'amélioration de la théorie de l'esprit. Par ailleurs, des effets faibles à modérés ont été observés pour la régulation des émotions, les fonctions exécutives, la mémoire de travail et la cognition globale. **Conclusions.** Cette étude présente des résultats préliminaires en lien avec le programme *ThinkTactic VR* indiquant qu'il est faisable, acceptable et qu'il améliore le fonctionnement au quotidien des patients. Les conclusions concernant l'efficacité du programme sur les fonctions cognitives seront clarifiées une fois la collecte de donnée de l'essai clinique complétée.

***Mots-clés* :** *trouble psychotique, neuro cognition, cognition sociale, remédiation cognitive, réalité virtuelle.*

Summary

Context. Most individuals with a psychotic disorder experience cognitive difficulties and challenges in daily functioning. Cognitive remediation is an effective rehabilitation intervention for this population that improve both cognition and functioning. Integrating virtual reality to cognitive remediation allows individuals to practice cognitive exercises in realistic scenario that mimic daily life which could improve the transfer of skills to daily activities. With expert patients and health care professionals, the Cognitive Remediation and Neuroimaging Laboratory team co-developed a virtual reality cognitive remediation program, *ThinkTactic VR,* which targets both neuro cognition and social cognition. **Objective.** This study is part of a larger ongoing clinical trial and aims to evaluate the feasibility, acceptability, and initial efficacy of the *ThinkTactic VR* program in patients with psychotic disorders. **Methodology.** For this doctoral trial, 17 participants with psychotic disorders were randomly assigned to two different conditions. Eight participants were assigned to the intervention condition, where they participated in 12 *ThinkTactic VR* sessions. The other nine participants were assigned to the active control condition, where they participated in 12 sessions of commercial virtual reality games. Participants were assessed pre- and post-treatment across different domains of neurocognition, social cognition, and daily functioning. Descriptive statistics and mixed-effects models with random intercepts were used to analyze the scores of various cognitive function measurement tools. **Results.** Preliminary data presented in this clinical thesis indicate that *ThinkTactic VR* is feasible for individuals with psychotic disorders, with a low attrition rate and minimal symptoms of cybersickness. The preliminary results also highlight high acceptability of this program among this population, with high satisfaction levels reported for the intervention. Furthermore, based on the partial sample analyzed, training with *ThinkTactic VR* is associated with significant improvements in daily functioning outcomes compared to the control group. There are no significant effects on cognitive domains from the analyses conducted on the data available to date. However, a moderate effect approaching significance was observed for improvements in theory of mind. Additionally, small to moderate effects were noted for emotion regulation, executive functions, working memory, and global cognition. **Conclusions.** This study presents preliminary results on the *ThinkTactic VR* program, indicating that it is feasible, acceptable, and improve functioning in this population. Conclusions regarding the efficacy of the program on cognitive functions will be clarified once data collection for the broader study is completed.

***Key words*:** *psychotic disorder, neuro cognition, social cognition, cognitive remediation, virtual reality*

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AIHQ	Ambiguous Intentions Hostility Questionnaire
CANTAB	Cambridge Neuropsychological Test Automated Battery
CONSORT	Consolidated Standards of Reporting Trials
CPZ	Chlorpromazine
CRT	Cognitive Remediation Therapy
DMS	Différence de moyenne standardisée
ERQ	Emotion Regulation Questionnaire
GAF	The Global Assessment of Functioning Scale
IQ	Intellectual Quotient
MINI	The Mini-International Neuropsychiatric Interview
PANSS	Positive and Negative Syndrome Scale
PENN	PENN Emotion Recognition Test
REB	Research Ethics Board
RFS	Role Functioning Scale
SSQ	The Sickness Simulator Questionnaire
SSTICS	The Subjective Scale to Investigate Cognition in Schizophrenia – Brief
TAAS	Treatment Adherence Acceptability Scale
UPSA-B	The UCSD Performance-based Skills Assessment Brief
VR	Virtual Reality
WAI-S	Working Alliance Inventory - Short
WASI	The Weschler Abbreviated Scale Intelligence

Avant-propos

Dans le cadre de cet essai, l'étudiante a activement pris part à chacune des étapes du projet de recherche. Elle a premièrement développé le protocole pour le développement de l'étude en collaboration avec une étudiante à la maitrise et la superviseure. Elle a ainsi contribué à chacune des étapes de la soumission et l'acceptation de l'essai clinique, passant par le choix des instruments de mesure, le calendrier de l'administration des instruments, le choix du groupe contrôle et toutes les procédures éthiques nécessaires pour débuter un projet d'une telle envergure. Elle a aussi dirigé le développement du manuel du thérapeute utilisée pour accompagner les participants dans les visites de remédiation cognitive. Elle a ensuite recruté la grande majorité des participants incluent dans l'essai en mettant en place des stratégies de recrutement, en appelant les participants intéressés et en dépistant l'éligibilité de chacun d'entre eux. Elle s'est impliquée dans la collecte des données des participants recrutés en effectuant les séances pré-intervention et post-intervention, pour un total d'une cinquantaine de séances de plus de trois heures chacune. Elle s'est assurée de convenablement former une collègue pour effectuer les mêmes visites de manière standardisée. Un engagement constant et dévoué depuis le début des études doctorales a été fourni par l'étudiante. Elle a effectué toutes les recherches nécessaires pour effectuer la revue de la littérature en lien avec son sujet, à développer sa méthodologie et créer le script R de manière autonome pour l'ensemble des analyses effectuées dans son essai.

CHAPITRE I - INTRODUCTION

1.1. Troubles psychotiques

Les troubles psychotiques sont des troubles de santé mentale ayant un impact important sur le fonctionnement cérébral des personnes touchées et modifiant les perceptions, les croyances, les pensées et les comportements (Gouvernement du Québec, 2022). De 0,5% à 2% de la population internationale est affectée par un trouble psychotique (Gourier-Frery et al., 2014). Les troubles appartenant au spectre de la schizophrénie et les autres troubles psychotiques (SSATP) se distinguent par leur degré de sévérité déterminée par le niveau, le nombre et la durée des signes psychotiques et des symptômes présents (American Psychiatric, 2016; Heckers et al., 2013). Le spectre de la schizophrénie et les autres troubles psychotiques comprennent la schizophrénie, le trouble schizoaffectif, le trouble schizophréniforme, le trouble délirant, le bref trouble psychotique et les troubles psychotiques induits par une substance (American Psychiatric, 2016).

Les troubles du spectre de la schizophrénie et les autres troubles psychotiques sont caractérisés par la présence de différents symptômes se classant en deux catégories : les symptômes positifs et négatifs (American Psychiatric, 2016). Les symptômes positifs regroupent les idées délirantes, les hallucinations, les discours désorganisés et les comportements désorganisés (American Psychiatric, 2016). Les idées délirantes renvoient à la présence de fortes croyances ne correspondant pas à la réalité et apparaissant irrationnelles pour l'entourage (National Institute of Mental Health, 2024). Les hallucinations sont quant à elles des perceptions de type auditives, visuelles, olfactives ou somatiques vécues par l'individu qui ne reflète pas une présence objective dans l'environnement (National Institute of Mental Health, 2024). Les hallucinations auditives sont les plus souvent expérimentées par les individus ayant un trouble psychotique (Verma et al., 2021). Le discours désorganisé renvoie à une difficulté d'organisation des pensées et du discours qui résulte en une incohérence des propos de l'individu (Tandon et al.,

2013). Finalement, les comportements désorganisés correspondent à des comportements agités et répétitifs (American Psychiatric, 2016). La présence d'idées délirantes, d'hallucinations ou d'un discours désorganisé est requis pour reconnaître la présence d'un trouble psychotique (American Psychiatric, 2016).

Parmi les symptômes négatifs caractéristiques des individus vivant avec un trouble psychotique figurent la diminution de l'expression émotionnelle, l'avolition, l'anhédonie, l'alogie et l'asocialité (American Psychiatric, 2016). L'alogie réfère à la diminution de l'expression verbale et l'avolition renvoie à l'incapacité d'initier et de conserver une implication dans une activité avec un but (American Psychiatric, 2016). Enfin, l'anhédonie correspond à une incapacité de retirer du plaisir de quelconques activités et l'asocialité est la difficulté à s'investir dans des relations interpersonnelles (American Psychiatric, 2016).

1.2. Neuro cognition

Un dysfonctionnement cognitif est également présent chez la majorité des personnes vivant avec un trouble psychotique (Bortolato et al., 2015; Karyakina & Shmukler, 2021). Certaines études suggèrent que plus de 90% de cette population présentent des atteintes cognitives (Goonathilake et al., 2022; Keefe et al., 2005). Une importante variation du fonctionnement cognitif chez ces individus est toutefois relevée (McCutcheon et al., 2023). Certaines études mettent en évidence que les difficultés se présentent de manière spécifique à certains domaines neurocognitifs (Gebreegziabhere et al., 2022), alors que d'autres études suggèrent que ces difficultés se présentent davantage de manière généralisée (Fioravanti et al., 2012). La présence de difficultés cognitives impacte significativement le quotidien de ces individus, notamment en entrainant une incapacité de conserver un emploi et de vivre de manière indépendante (Havery et al., 2019).

Les fonctions neurocognitives renvoient au traitement de diverses informations avec des processus tels que la mémoire, l'attention, les fonctions exécutives, la résolution de problème et la compréhension verbale (Fett et al., 2011). Plusieurs méta-analyses ont comparé les performances des individus ayant un trouble psychotique avec des individus neurotypiques à des tâches mesurant les domaines de la neuro cognition (Bortolato et al., 2015; Gebreegziabhere et al., 2022). L'ensemble de ces études ont montré des altérations significatives dans la mémoire, les fonctions exécutives, l'attention et la vitesse de traitement de l'information chez les individus ayant un trouble psychotique.

Plus précisément, les difficultés attentionnelles chez ces individus se présentent par une difficulté à maintenir un niveau d'attention constant sur une longue période et à extraire une information spécifique d'un contexte vu une forte distractibilité par des stimuli non pertinents (Tan, 2009). Ces difficultés attentionnelles ont directement un impact sur les habiletés mnésiques déjà altérées (Fioravanti et al., 2012; Gray et al., 2014). En effet, les études suggèrent que les individus vivant avec un trouble psychotique rencontrent des difficultés de mémoire épisodique et à long terme (Kelly et al., 2019; Kwok et al., 2020). Ces difficultés peuvent être expliquées par une inhabileté à mettre en place des stratégies sémantiques menant ainsi à des mécanismes d'encodage altérés (Gebreegziabhere et al., 2022; Kelly et al., 2019). La mémoire de travail se retrouve également impactée par les difficultés d'encodage et des difficultés à porter l'attention sur les stimuli importants (Beckse et al., 2022). Ces atteintes des processus cognitifs vont ainsi affecter les habiletés de planification, d'inhibition, de flexibilité mentale et de résolution de problèmes chez cette population (Gebreegziabhere et al., 2022; Thai et al., 2019; Tschentscher et al., 2023). Les études soulèvent également une lenteur dans le traitement des informations reçues et dans la génération de réponses, ce qui affecte inévitablement l'accomplissement des tâches de la vie quotidienne chez cette population (Gebreegziabhere et al., 2022; Kar & Jain, 2016).

1.3. Cognition sociale

La cognition sociale correspond au processus mental sous-jacent aux interactions sociales permettant de faire une interprétation appropriée des propos des individus et de générer des réponses adaptées au contexte (Green et al., 2008). Plusieurs études sur la cognition sociale montrent qu'il s'agit d'un domaine grandement affecté chez les personnes vivant avec un trouble psychotique (Mehta et al., 2013; Torosyan et al., 2017). Pour interagir adéquatement avec autrui, plusieurs habiletés sont nécessaires, mais déficitaires chez ce type de population (Savla et al., 2013). Par exemple, ces individus présentent une difficulté dans le traitement des émotions, englobant la reconnaissance, la compréhension et la régulation des émotions (Green & Horan, 2010; Savla et al., 2013). En effet, plusieurs études montrent que les personnes ayant un trouble psychotique rencontrent des difficultés importantes lors de l'identification des émotions de base (joie, colère, tristesse, dégout, surprise, peur) à travers les expressions faciales (Fortuny et al., 2023). Un second domaine de la cognition sociale inclut le style d'attribution qui reflète la manière dont un individu explique une situation, positive ou négative, par soit des facteurs internes, externes ou situationnels (Savla et al., 2012). De manière générale, les études montrent des difficultés dans le style d'attribution chez les personnes vivant avec un trouble psychotique alors que les individus tendent à expliquer les situations négatives par le blâme des autres plutôt que par des facteurs situationnels extérieurs (Savla et al., 2012; Pinkham, 2014). Finalement, la théorie de l'esprit est également une habileté cognitive fréquemment affectée chez les individus vivant avec un trouble psychotique (Savla et al., 2012). La théorie de l'esprit réfère à la capacité d'inférer les états mentaux, les intentions et les émotions d'autrui (Bora et al., 2009; Green & Horan, 2010; Savla et al., 2013). Cette difficulté à inférer les états mentaux d'autrui est l'une des composantes ayant le plus d'impact négatif sur le fonctionnement social et l'habileté à accomplir les activités de la vie quotidienne de manière adéquate (Fett et al., 2011; Thibaudeau et al., 2021).

Intervenir auprès des divers domaines de la cognition sociale chez les individus vivant avec un trouble psychotique est un moyen efficace pour permettre une amélioration du fonctionnement social de ces individus dans leur vie quotidienne (Kurtz & Richardson, 2012).

1.4. Les antipsychotiques comme traitement des symptômes positifs

La principale cible de traitement auprès des personnes vivant avec des troubles psychotiques a longtemps priorisé la réduction des symptômes positifs (Harvey & Bellack, 2009). Le dérèglement des neurotransmetteurs dopaminergiques dans les différentes voies du cerveau permet d'expliquer, en partie, la présence de symptômes positifs chez cette population (Stępnicki et al., 2018). Cette explication biologique des symptômes positifs justifie l'utilisation d'antipsychotiques comme un des principaux traitements pour les personnes vivant avec un trouble psychotique (Lally & MacCabe, 2015). Les antipsychotiques de première génération montrent une bonne efficacité pour la réduction de symptômes positifs, mais créent plusieurs effets secondaires indésirables et ne permettent pas d'améliorer les fonctions cognitives (Bilder et al., 1992; Miyamoto et al., 2005; Reilly et al., 2006). La complexité de l'étiologie des déficits cognitifs rend difficile le développement de traitement pharmacologique efficace, expliquant ainsi le peu de progrès effectué à ce niveau (Martínez et al., 2021).

1.5. Le fonctionnement quotidien

De nouvelles orientations en termes de cibles thérapeutiques ont évolué vers l'objectif d'améliorer le fonctionnement quotidien des individus (Harvey & Bellack, 2009). Le fonctionnement quotidien correspond aux habiletés détenues par l'individu dans son fonctionnement social, le fonctionnement au travail, à l'école ou dans ses activités quotidiennes et dans son autonomie (Kharawala et al., 2022). Le fonctionnement global est directement lié à la qualité de vie des individus, ce qui impacte le niveau de bonheur et la satisfaction qu'ils détiennent face à leur vécu (Nevarez-Flores et al., 2018). Les difficultés dans les domaines de la

neuro cognition et de la cognition sociale interviennent de manière importante dans le bon fonctionnement quotidien des personnes souffrant d'un trouble psychotique (Kharawala et al., 2022).

Une étude montre que des domaines spécifiques de la neuro cognition tels que la mémoire et l'apprentissage verbal impactent les activités quotidiennes et que la mémoire de travail affecte le fonctionnement et les habiletés sociales (Halverson et al., 2019). Par exemple, lorsqu'un individu doit sélectionner les aliments à acheter à l'épicerie pour préparer un repas, planifier un trajet de transport public ou mémoriser un discours, il doit solliciter plusieurs de ses fonctions cognitives pour accomplir ces tâches de la vie quotidienne (Lepage et al., 2014). Les domaines de la cognition sociale sont également primordiaux pour avoir un bon fonctionnement dans la vie quotidienne (Couture et al., 2006; Fett et al., 2011; Halverson et al., 2019). Une mauvaise reconnaissance des émotions peut conduire les individus à effectuer de mauvaises attributions des évènements et à inférer de manière erronée les états mentaux de leurs pairs (Couture et al., 2006). La présence de difficultés en cognition sociale mènera les individus à vivre plus fréquemment des frustrations et des incompréhensions dans les interactions sociales (Couture et al., 2006). Les difficultés vécues peuvent ainsi conduire à une diminution de la satisfaction de sa vie, des initiatives d'interactions avec autrui, des développements de relations sociales et une accumulation de problèmes au travail (Couture et al., 2006).

Limites des traitements actuels

Quelques études ont montré une augmentation de la performance de la neuro cognition chez les personnes vivant avec la schizophrénie à la suite de la prise d'antipsychotiques de deuxième génération, mais l'amélioration est relativement faible (Keefe et al., 2007). De plus, deux importantes études comparant les antipsychotiques de première et deuxième génération n'ont pas

réussi à montrer qu'il n'y avait une amélioration significative des symptômes négatifs et cognitifs à la suite d'aucun de ces deux traitements (Haddad et al., 2023; Lally & MacCabe, 2015; Lieberman et al., 2005). Les altérations dans les domaines cognitifs continuent ainsi à avoir des impacts importants sur la vie des individus touchés (Lieberman et al., 2005).

1.6. La remédiation cognitive

La remédiation cognitive est une intervention efficace pour améliorer le fonctionnement cognitif (Cella et al., 2020; Vita et al., 2021). La remédiation cognitive est définie par Le Groupe de Travail d'Experts en Remédiation Cognitive comme étant une intervention psychosociale et comportementale ciblant les fonctions cognitives, telles que l'attention, la mémoire, les fonctions exécutives, la cognition sociale et la métacognition (Bowie et al., 2020). Cet entrainement comportemental consiste en des activités administrées sous forme d'exercices ou de pratique à faire à répétition pour renforcer les fonctions cognitives (Bowie et al., 2020). Ce type d'intervention se présente sous différentes formes; papier-crayon, à l'ordinateur, de manière individuelle ou en groupe (Lewandowski, 2016). Différentes stratégies d'apprentissages sont utilisées pour optimiser l'entrainement, telles que l'apprentissage sans erreur, le renforcement positif et le modeling (Barlati et al., 2013). La remédiation cognitive a comme but de rendre les acquis plus fonctionnels et elle est considérée comme réussie et efficace lorsque les acquis sont transférés dans les activités de la vie quotidienne de la personne (Bowie et al., 2020).

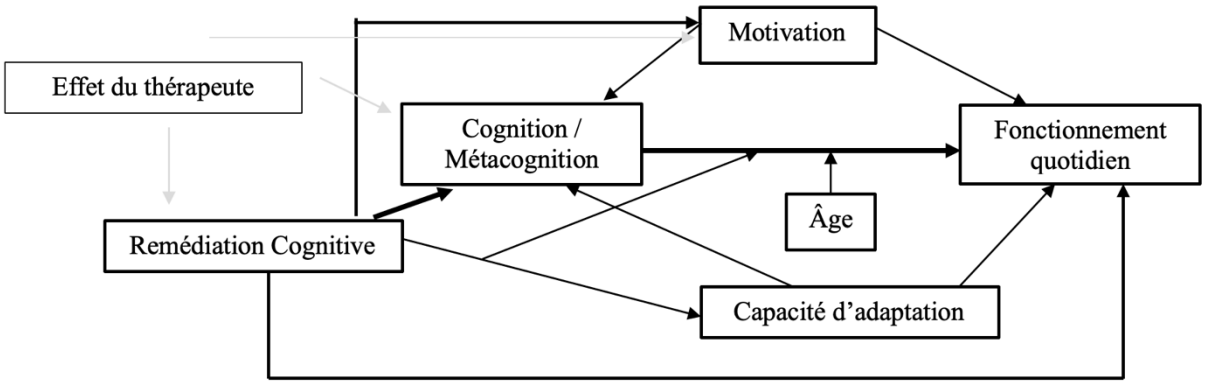
Un consensus d'expert en remédiation cognitive s'est prononcé sur quatre composantes principales qui devraient se retrouver dans les programmes de remédiation cognitive afin d'optimiser ses effets (Bowie et al., 2020). Il doit tout d'abord avoir la présence d'exercices cognitifs répétés à plusieurs reprises, tout en augmentant graduellement le niveau de difficulté de ces exercices (Bowie et al., 2020). Aucun consensus n'est toutefois émis en termes de nombre de séances d'exposition de remédiation cognitive. L'intervention doit également offrir l'opportunité

pour les participants de développer des stratégies afin de travailler leur capacité de métacognition (Bowie et al., 2020). Le programme doit également permettre un transfert des acquis dans la vie de tous les jours, soit en offrant des exemples de situation de la vie quotidienne, en intégrant des jeux de rôle et/ou en ciblant des objectifs de traitement dans le fonctionnement quotidien (Bowie et al., 2020). Finalement, un thérapeute entrainé pour ce type d'intervention devrait également être présent pour accompagner le participant (Bowie et al., 2020). Celui-ci devrait soutenir le participant dans l'élaboration de stratégie, apporter des rétroactions positives, s'assurer que l'exécution se fait correctement et être un soutien pour l'individu (Bowie et al., 2020). Une méta-analyse montre que l'intégration de ces quatre composantes dans la remédiation cognitive permet aux participants de bénéficier de meilleurs gains cognitifs (Vita et al., 2021).

Les études montrent que la remédiation cognitive a un effet direct sur les fonctions cognitives et sur le fonctionnement quotidien. Toutefois, comme le montre le modèle de Wykes et Spaulding (2011) (voir Figure 1), plusieurs variables peuvent influencer, modérer ou médier l'effet de cette intervention sur la cognition et le fonctionnement quotidien. Par exemple, la motivation et les capacités d'adaptation peuvent influencer l'effet de l'intervention sur les fonctions cognitives et sur le fonctionnement quotidien (Wykes et al., 2024). La présence d'un thérapeute pourrait également impacter l'amélioration des fonctions cognitives par le biais des stratégies enseignées et potentiellement avoir des effets sur la motivation grâce à un meilleur engagement et une bonne alliance avec celui-ci (Wykes et al 2024), ce qui reste toutefois à étudier.

Figure 1.

Effets de variables modératrices, médiatrices et effet potentiel du thérapeute sur le changement comportemental.



Note. Figure adaptée de « Thinking about the future cognitive remediation therapy--what works and could we do better? » par Wykes et Spaulding (2011), rapporté dans Thinking About the Future of Cognitive Remediation Therapy Revisited: What Is Left to Solve Before Patients Have Access? Par Wykes, T., Bowie, C.R., & Cella, M. (2024). *Schizophrenia Bulletin,* 50(5), 993-1005. https://doi.org/10.1093/schbul/sbae075. Copyright 2024 by Oxford University Press on behalf of the Maryland Psychiatric Research Center.

La remédiation cognitive auprès des individus ayant un trouble psychotique

Cette intervention psychosociale et comportementale s'est montrée efficace auprès des personnes vivant avec un trouble psychotique, en montrant des améliorations des fonctions cognitives, du fonctionnement social (Cella et al., 2020) et adaptif (Barlati et al., 2013; Katsumi et al., 2019). En effet, ce type d'intervention s'est montré bénéfique pour la mémoire de travail, la vitesse de traitement de l'information, l'apprentissage et les fonctions exécutives (Cella et al., 2020; Katsumi et al., 2019). La remédiation cognitive s'est également montrée efficace au niveau du fonctionnement social, soit en améliorant la satisfaction des relations interpersonnelles et le fonctionnement social (Barlati et al., 2013). La remédiation cognitive est d'autant plus efficace

lorsqu'elle combine l'entrainement de la neuro cognition et de la cognition sociale et lorsqu'il y a des stratégies enseignées pour appliquer les divers apprentissages du programme dans la vie quotidienne (Barlati et al., 2013). Le tableau 1 résume les résultats des principales méta-analyses étudiant l'efficacité de la remédiation cognitive chez les individus ayant un trouble psychotique.

Tableau 1

Principaux résultats des méta-analyses concernant l'efficacité de la remédiation cognitive chez les individus ayant un trouble psychotique.

Auteurs	Nombre d'études (nombre de participants)	Type de population	Résultats principaux
Twamley et al., 2003	17 (695 participants)	Schizophrénie	Un effet significatif modéré (d = 0,32) est observé sur la performance neuropsychologique des individus.
McGurk et al., 2007	26 (1 151 participants)	Schizophrénie	La remédiation cognitive crée des améliorations significatives avec un effet modéré pour la performance cognitive (d = 0,41) et un effet un peu plus faible pour le fonctionnement psychosocial (d = 0,36).
Wykes et al., 2011	40 (2 104 participants)	Schizophrénie	La remédiation cognitive a un effet modéré (d = 0,45) sur la cognition globale des individus ayant un trouble psychotique.
Cella et al., 2020	20 (1509 participants)	Premier épisode psychotique et trouble psychotique à long terme	Un effet modéré significatif est observé (DMS > 0,47) pour la vitesse de traitement de l'information, la mémoire et la mémoire de travail. Un effet de la remédiation cognitive est aussi observé pour le fonctionnement global et social.
Lejeune et al., 2021	73 (4594 participants)	Schizophrénie ou trouble schizo-affectif	La remédiation cognitive a un effet faible à modéré (g > 0,20) qui est observé sur l'apprentissage verbal, la mémoire de travail, l'attention, la résolution de problème et la vitesse de traitement de l'information.
Vita et al., 2021	130 (8851 participants)	Schizophrénie et troubles psychotiques	Un effet significatif faible à modéré est observé pour la plupart des domaines cognitifs (d > 0,20) à la suite d'interventions de remédiation cognitive. Des améliorations sont observées dans la mémoire verbale et visuelle, les fonctions cognitives et la cognition globale.
Vita et al., 2024	130 (5334 participants)	Schizophrénie	La remédiation cognitive a un effet significativement positif qui persiste sur la cognition globale (d = 0,23) et sur le fonctionnement global (d = 0,26).

Note. d = d de cohen; DMS = Différence de moyenne standardisée; g = Hedge's g.

Selon une méta-analyse, les programmes de remédiation cognitive sont faisables et acceptables auprès des personnes ayant un trouble psychotique (Vita et al., 2023). Les individus complètent davantage les programmes de remédiation cognitive lorsque ceux-ci incluent des techniques pour appliquer les apprentissages dans la vie de tous les jours et lorsque le rationnel du traitement est expliqué (Vita et al., 2023). L'ensemble de ces facteurs permet de réduire le taux d'abandon chez les individus exécutant ce type de traitement (Vita et al., 2023). Cette même méta-analyse rapporte qu'en moyenne 16% des individus vivant avec un trouble psychotique abandonneront le programme de remédiation cognitive avant la fin (Vita et al., 2023).

Les programmes de remédiation cognitive actuels présentent toutefois certaines limites. Ces programmes ne permettent souvent pas d'obtenir des améliorations constantes dans le fonctionnement de la vie quotidienne (Bowie & Harvey, 2006; Cella et al., 2020). En effet, une méta-analyse a montré que les effets de la remédiation cognitive basée sur des exercices à effectuer à l'ordinateur avaient peu d'effet sur le fonctionnement quotidien de la personne (Gomar et al., 2015; Prikken et al., 2019). Le transfert des acquis effectués lors de la remédiation cognitive dans des activités de la vie de tous les jours est limité à la suite de ce type d'intervention (Bowie, 2019; Peyroux & Franck, 2014). De plus, il est possible de voir un impact direct de la perte de motivation interne, caractérisant les troubles psychotiques, sur l'adhérence et le déroulement des interventions cognitives traditionnelles (Bryce et al., 2018). Le manque de motivation intrinsèque des participants face aux interventions mène régulièrement à l'abandon de l'intervention, ce qui diminue l'efficacité de celle-ci (Glenthøj et al., 2020; Vita et al., 2022). Le développement de programme de remédiation cognitive incluant davantage les besoins et les points de vue des utilisateurs et des professionnels de la santé s'avèrent ainsi une nécessité afin de fournir des soins adaptés à la population cible.

1.7. La réalité virtuelle

La réalité virtuelle est une technologie permettant d'accommoder les différentes limites rencontrées dans les méthodes d'administration traditionnelles de la remédiation cognitive (Makransky & Petersen, 2021). La réalité virtuelle offre la possibilité d'avoir de nouvelles modalités de traitements pour plusieurs types de troubles psychiatriques (Freeman et al., 2017; Park et al., 2019). Cette technologie sécuritaire et non invasive permet aux individus d'interagir et de percevoir des images tridimensionnelles créées par un ordinateur (Rus-Calafell et al., 2018). L'immersion dans les environnements virtuels permet d'induire des réactions similaires de ce qui est retrouvé dans leur vie de tous les jours (Schöne et al., 2023). Elle permet ainsi d'exposer les individus à des environnements qui semblent réels et où des stratégies thérapeutiques peuvent être précisément implantées selon les difficultés expérimentées (Freeman et al., 2017). Le niveau de difficulté des situations peut être augmenté et être fait à répétition afin de permettre un apprentissage adéquat (Freeman et al., 2017).

La réalité virtuelle permet ainsi aux individus d'être accompagnés et entrainés dans des situations qu'il n'est pas possible de générer dans le « vrai monde » pour faire de la remédiation cognitive (Freeman et al., 2017). La présence d'un thérapeute avec les individus, lors des étapes dans la réalité virtuelle, assure un soutien nécessaire pour accomplir adéquatement les tâches demandées (Cieślik et al., 2020). L'individu peut se pratiquer à développer des habiletés et les maitriser avant de les appliquer dans leur vie de tous les jours (Chan et al., 2023). Les caractéristiques de la réalité virtuelle permettent ainsi de croire que les acquis faits lors des entrainements dans cette technologie seront plus facilement transposables dans la vie de tous les jours (Cieślik et al., 2020; Tieri et al., 2018). La réalité virtuelle est ainsi une intervention permettant une meilleure satisfaction et un meilleur engagement de la part des participants comparativement à des méthodes plus traditionnelles (Makransky & Lilleholt, 2018).

Programme de remédiation cognitive en réalité virtuelle en santé mentale

Quelques programmes de remédiation cognitive en réalité virtuelle ont été développés pour améliorer les fonctions neuro cognitives, la cognition sociale ainsi que le fonctionnement quotidien des individus vivant avec diverses problématiques de santé mentale (Schroeder et al., 2022). Ces programmes sont développés pour les individus vivant avec un trouble anxieux, un stress post-traumatique, un trouble du spectre de l'autisme, la schizophrénie et un trouble neurocognitif majeur (Park et al., 2019). Très peu d'études ont vérifié l'efficacité des programmes de remédiation cognitive en réalité virtuelle chez les individus ayant un trouble psychotique (Schroeder et al., 2022). Parmi ces études, la plupart montrent que les individus suivant un programme en réalité virtuelle obtiendront une amélioration de l'attention, de la mémoire et de la planification comparativement au groupe ne recevant pas ce traitement (Amado et al., 2016; Chan et al., 2010; La Paglia et al., 2013; Wang et al., 2022). Le tableau 2 indique les principaux résultats des programmes en remédiation cognitive en réalité virtuelle visant à améliorer les fonctions neurocognitives.

Tableau 2

Caractéristiques des programmes de remédiation cognitive en réalité virtuelle ciblant les domaines neurocognitifs chez les individus ayant un trouble psychotique.

Auteurs	Échantillon	Diagnostique	Contenu réalité virtuelle	Résultats	Limites
Chan et al., 2010	Groupe expérimental : 12; Groupe contrôle : 15	Schizophrénie	Les individus participent à des tâches qui sollicitent l'intelligence fluide. Dans la tâche "balle et oiseau", le participant doit toucher la balle qui vient vers lui avec une partie de son corps. Dans la tâche "requin", le participant navigue dans l'océan et doit suivre une étoile jaune en évitant des distractions.	L'évaluation post-intervention révèle une amélioration significative de la cognition globale, de la mémoire et de la répétition.	Les tâches effectuées par les participants ne sont pas représentatives des activités de la vie quotidienne.

La Paglia et al., 2013	Groupe expérimental : 6; Groupe contrôle : 6	Schizophrénie et trouble schizoaffectif	Les participants naviguent dans quatre environnements différents (parc, vallée, plage, supermarché) où les domaines cognitifs suivants sont travaillés : attention (soutenue, sélective et divisée) et fonctions exécutives.	L'évaluation post-intervention révèle une amélioration de l'attention soutenue, de la vitesse de traitement de l'information et de la planification du groupe expérimental. Une amélioration de l'attention divisée est soulevée dans les deux groupes.	L'étude n'a pas effectué une randomisation des participants et la taille de l'échantillon est petite.
Amado et al., 2016	Groupe expérimental : 7	Schizophrénie et trouble schizoaffectif	Les participants naviguent dans une ville où ils doivent retrouver leur chemin, mémoriser leur itinéraire, planifier des actions et suivre les instructions qui leur sont données. Une discussion de 20 minutes suit la réalité virtuelle pour discuter du transfert de ces acquis dans la vie quotidienne.	L'évaluation post-intervention révèle une amélioration de l'attention, de la mémoire, de l'autonomie et du fonctionnement quotidien. Aucune amélioration au niveau de la planification n'est soulevée.	L'étude ne possède pas de groupe contrôle et la taille de l'échantillon est très petite.
Wang et al., 2022	Groupe expérimental : 31; Groupe contrôle : 33	Schizophrénie	Les participants jouent à "Fruit Pionner" où ils doivent couper le plus de fruits possibles en évitant des boules de fer. Ils sollicitent ainsi la vitesse de traitement de l'information, l'attention sélective, la mémoire de travail et la sensibilité à l'interférence.	L'évaluation post-intervention révèle une amélioration de la mémoire de travail et des fonctions exécutives dans le groupe expérimental. Aucune amélioration de la cognition sociale n'est remarquée dans le groupe expérimental.	Les tâches effectuées par les participants ne sont pas représentatives des activités de la vie quotidienne.
Komemi et al., 2024	Groupe expérimental : 31	Schizophrénie et trouble schizoaffectif	Les participants effectuent des tâches de la vie de tous les jours comme la gestion dans un arrêt d'autobus, travailler dans un supermarché où plusieurs domaines de la neurocognition sont ciblés. Le programme utilisé se nomme CR-EVR (cognitive remediation – ecological virtual reality)	L'évaluation post-intervention révèle une amélioration de la Vitesse de traitement de l'information, la flexibilité mentale, les habiletés visuomotrices, les symptômes psychotiques et le fonctionnement adaptatif.	Absence de groupe contrôle

Quelques programmes ciblant davantage les habiletés sociales montrent également que la communication sociale, la théorie de l'esprit et le langage pragmatique s'améliorent et que les acquis sont généralisables à la vie de tous les jours (Tableau 3) (Park et al., 2011; Rus-Calafell et al., 2018).

Tableau 3

Caractéristiques des programmes de remédiation cognitive en réalité virtuelle ciblant la cognition sociale chez les individus ayant un trouble psychotique.

Auteurs	Échantillon	Contenu en réalité virtuelle	Effets	Limites
(Park et al., 2011)	Groupe expérimental : 33; Groupe contrôle : 31	Les participants font des jeux de rôles avec un avatar ciblant des habiletés de conversation, d'écoute de l'autre, d'affirmation de soi et d'expression émotionnelle.	Une amélioration plus marquée du groupe expérimental est observée dans les habiletés de conversation et l'affirmation de soi. Le groupe contrôle montre davantage d'améliorations dans les habiletés non-verbales.	-
(Rus-Calafell et al., 2014)	Groupe expérimental : 12	Les individus participent à des activités ciblant sept habiletés sociales dans un environnement de supermarché ou dans un bar.	Des améliorations sont observées à la suite de l'intervention au niveau des interactions sociales avec un effet faible (d = 0,23) et du fonctionnement social (communication interpersonnelle, loisirs, activités prosociales et retrait social) avec un effet modéré (d > 0,35)	Absence de groupe contrôle et petit échantillon.
(Adery et al., 2018)	Groupe expérimental : 16	Les participants ont des tâches où ils doivent soutenir un contact visuel, commencer une discussion, demander de l'aide, dans des environnements d'épicerie, de cafétéria et d'arrêt d'autobus. Programme : Multimodal Adaptive Social Intervention in Virtual Reality (MASI-VR).1	Il y a une amélioration des symptômes négatifs (η2 = 0,23) et des symptômes cliniques globaux (η2 = 0,22).	Absence de groupe contrôle et petit échantillon.
(Shen et al., 2022)	Groupe expérimental : 28; Groupes contrôles : 30 et 29	Les participants observent et participent à des interactions sociales en réalité virtuelle avec le programme VR-based social cognition and interaction training (VR-SCIT). La perception des émotions, la théorie de l'esprit, le biais d'attribution et l'adaptation à des problèmes interpersonnels sont travaillés.	Les participants ayant reçu une intervention montrent une amélioration de la perception émotionnelle, du biais d'attribution, du fonctionnement social et de la métacognition (d > 0,48)	-
(Nijman et al., 2023)	Groupe expérimental : 41; Groupe contrôle : 40	Les participants font trois types de modules dans Dynamic Interactive Social Cognition Training in Virtual Reality (DiSCoVR): (1) reconnaissance de l'affect social, (2) perception sociale et théorie de l'esprit, (3) application de la cognition sociale dans les interactions.	Aucun effet d'interaction est sorti significatif pour les différentes variables, indiquant une absence d'effet.	Étude à simple aveugle

Note. d = d de Cohen; η2 = Eta-carré (taille d'effet).

Les quelques études montrent ainsi une bonne efficacité des programmes de remédiation cognitive en réalité virtuelle, mais quelques limites méthodologiques sont présentes. En effet, les échantillons sont parfois de petite taille et une absence de groupe contrôle caractérise certaines études (Adery et al., 2018; Amado et al., 2016; Rus-Calafell et al., 2014). Certaines de ces études sont également caractérisées par une absence de randomisation des participants et l'utilisation de tâches non représentatives des activités de la vie quotidienne (La Paglia et al., 2013; Wang et al., 2022).

1.8. Le programme de remédiation cognitive en réalité virtuelle ThinkTactic VR

Un nouveau programme de remédiation cognitive en réalité virtuelle pour les personnes vivant avec un trouble psychotique a été développé dans le laboratoire de Remédiation Cognitive et Neuroimagerie pour pallier aux limites des programmes préalablement développés (Yee et al., 2024). Comme recommandé par l'International Working Group, le programme en réalité virtuelle a été développé en collaboration avec les personnes qui utiliseront ce programme (Birckhead et al., 2019). Ainsi, des personnes vivant avec un trouble psychotique ont participé à l'amélioration du programme afin de le rendre le plus efficace possible et de le rendre adapté à leurs besoins (Birckhead et al., 2019). Des professionnels de la santé ont également participé à l'élaboration de ce programme vu leurs connaissances sur la présence des symptômes causant des difficultés à cette population et leurs impacts sur le fonctionnement quotidien (Medalia et al., 2009). Ces deux groupes ont ainsi participé à une série de sessions de groupe dans lesquelles ils discutaient des besoins et des difficultés rencontrées au niveau des fonctions cognitives et dans la vie quotidienne (Yee et al., 2024). Les deux groupes ont soulevé la nécessité d'avoir un programme améliorant la motivation, les domaines de neuro cognition et de cognition sociale et que le programme devrait favoriser l'habileté à résoudre des problèmes de la vie quotidienne (Yee et al., 2024). Les deux groupes avaient également l'occasion de donner des rétroactions sur le

programme en réalité virtuelle pour mieux cibler les besoins de la population cible (Yee et al., 2024).

Le programme de réalité virtuelle développé dans le laboratoire, nommé *ThinkTactic VR*, consiste en trois différents environnements où des tâches ciblant la neuro cognition et la cognition sociale sont demandées dans des situations que l'individu pourrait rencontrer dans la vie de tous les jours (Yee et al., 2024). Le premier environnement consiste à l'exploration d'un moyen de transport public (autobus) où l'individu doit choisir le bon trajet en fonction de son objectif, mettre en pratique des habiletés de planification, d'attention et de mémoire (Yee et al., 2024). Dans ce module, les individus doivent également interagir avec des personnes ayant des propos impolis ou confrontant, où la régulation émotionnelle et le biais attributionnel sont sollicités (Yee et al., 2024).

Le second module consiste en l'accomplissement de différentes tâches se déroulant dans un appartement (Yee et al., 2024). L'individu doit faire face à une situation de dégât d'eau, budgéter une commande de nourriture pour emporter, interagir avec de nouvelles personnes, etc. Les différentes tâches dans ce module viennent solliciter des domaines de la neuro cognition et de la cognition sociale, telles que la résolution de problème, la flexibilité cognitive, la théorie de l'esprit, la régulation des émotions et l'adaptation au stress (Yee et al., 2024).

Finalement, dans le troisième module, l'individu doit prétendre être un serveur et prendre les commandes des différents clients (Yee et al., 2024). Dans cet environnement, la mémorisation est l'habileté principalement travaillée, où l'individu doit se souvenir des différents éléments des commandes des clients (Yee et al., 2024). Les personnes doivent également faire preuve de professionnalisme et faire face à des événements stressants, ce qui sollicite la cognition sociale (Yee et al., 2024).

Un manuel de thérapeute a été développé pour complémenter chacune des sessions de réalité virtuelle (Yee et al., 2024). Ce manuel indique au thérapeute des concepts de psychoéducation et des stratégies de remédiation cognitive supplémentaires à discuter avec le participant (Yee et al., 2024). Ce manuel contient des stratégies touchant différents domaines de la neuro cognition et de la cognition sociale et comment ces domaines se reflètent dans le fonctionnement quotidien. L'intégration d'une discussion à la fin des sessions de remédiation cognitive pendant lesquelles le thérapeute incite le participant à faire des liens entre les stratégies utilisées dans les exercices en réalité virtuelle et sa vie quotidienne permet une augmentation des améliorations des fonctions cognitives (Lejeune et al., 2021). Afin de contrôler pour l'effet des discussions avec les participants dans la condition intervention, un manuel a aussi été développé pour la condition contrôle dans lequel différents thèmes en lien avec le maintien d'habitudes de vie saine sont abordés.

Une étude pilote a été effectuée afin de vérifier la faisabilité et l'efficacité initiale du module du restaurant auprès d'individus vivant avec la schizophrénie (Bogie et al., 2023). Les résultats de cette étude démontrent qu'il s'agit d'un traitement faisable vu le faible taux de participants ayant vécu des malaises (Bogie et al., 2023). La majorité des participants ont également apprécié l'expérience et y participeraient une autre fois (Bogie et al., 2023). Les résultats montrent également que l'intervention est efficace vu la présence d'amélioration au niveau de la mémoire ($d = 0,58$) (Bogie et al., 2023). Toutefois, aucune étude n'a encore été effectuée pour vérifier la faisabilité, l'acceptabilité et l'efficacité de l'intégrité du programme *ThinkTactic VR.*

1.9. Objectifs et hypothèses

Cette étude teste la faisabilité, l'acceptabilité et l'efficacité préliminaire de ce programme de remédiation cognitive pour les patients atteints de troubles psychotiques qui vise à améliorer leurs fonctions neurocognitives et leur cognition sociale.

Objectif 1 : Plus spécifiquement, le premier objectif de cette étude est d'évaluer la faisabilité du programme de remédiation cognitive en réalité virtuelle en vérifiant l'adhérence, l'attrition, la complétion des devoirs et le degré de malaise vécu chez les personnes souffrant de troubles psychotiques.

Objectif 2 : Le second objectif est d'évaluer l'acceptabilité du programme en vérifiant l'alliance thérapeutique, la satisfaction et le degré d'acceptabilité des individus par rapport au programme.

Objectif 3 : Le troisième objectif est d'examiner l'efficacité préliminaire du programme de remédiation cognitive en réalité virtuelle en évaluant les améliorations du fonctionnement neurocognitif, de la cognition sociale et du fonctionnement quotidien à l'aide d'instruments de mesure appropriés pour chacune de ces fonctions.

La première hypothèse suppose que le programme de remédiation cognitive en réalité virtuelle peut être adopté dans le cadre d'entraînement cognitif des personnes atteintes de troubles psychotiques. Il est supposé que la majorité des participants complèteront la plupart des sessions en réalité virtuelle et la majorité de leurs devoirs. De plus, il est supposé que la réalité virtuelle n'ait pas d'impact indésirable significatif sur les participants, ce qui se reflètera par un faible score composite au questionnaire de cybermalaise.

La deuxième hypothèse suppose que le programme soit acceptable pour les individus, ce qui se reflètera par un score au TAAS supérieur ou égal à 50 et un score supérieur à 10 au questionnaire de satisfaction. Il est également supposé que les résultats aux différentes échelles

du questionnaire d’alliance thérapeutique (WAI-S) soient supérieurs à 22, ce qui reflète une alliance adéquate.

La troisième hypothèse suppose que les participants dans la condition d'intervention auront des améliorations significativement plus importantes dans les scores composites d’instrument mesurant les différents domaines de la neuro cognition (critère primaire d'efficacité), une semaine après avoir suivi le programme de remédiation cognitive en réalité virtuelle, que les individus dans la condition de contrôle actif. On suppose également que les individus dans la condition intervention montrent des améliorations significativement plus importantes des scores Z composites aux instruments de mesure de cognition sociale et de fonctionnement quotidien (critère d'efficacité secondaire), une semaine après avoir suivi le programme en réalité virtuelle, que les individus dans la condition de contrôle actif.

CHAPITRE II - ARTICLE

Preliminary feasibility, acceptability and efficacy of *ThinkTactic VR*: a cognitive remediation program in virtual reality for people with psychotic disorders.

Collecte de données pour l'étude globale prévue pour 2026.

Summary

Context. Most individuals with a psychotic disorder experience cognitive difficulties and challenges in daily functioning. Cognitive remediation is an effective rehabilitation intervention for this population that improve both cognition and functioning. Integrating virtual reality to cognitive remediation allows individuals to practice cognitive exercises in realistic scenario that mimic daily life which could improve the transfer of skills to daily activities. With expert patients and health care professionals, the Cognitive Remediation and Neuroimaging Laboratory team co-developed a virtual reality cognitive remediation program, *ThinkTactic VR,* which targets both neuro cognition and social cognition. **Objective.** This study is part of a larger ongoing clinical trial that aims to evaluate the feasibility, acceptability, and preliminary efficacy of the *ThinkTactic VR* program in patients with psychotic disorders. **Methodology.** For this doctoral trial, 17 participants with psychotic disorders were randomly assigned to two different conditions. Eight participants were assigned to the intervention condition, where they participated in 12 *ThinkTactic VR* sessions. The other nine participants were assigned to the active control condition, where they participated in 12 sessions of commercial virtual reality games. Participants were assessed pre- and post-treatment across domains of neurocognition, social cognition, and daily functioning. Descriptive statistics and mixed-effects models with random intercepts were used to analyze cognitive test scores collected before and after intervention, to assess potential improvements in cognition and daily functioning among participants. **Results.** Preliminary data presented in this clinical thesis indicate that *ThinkTactic VR* is feasible for individuals with psychotic disorders, with a low attrition rate and null to minimal cybersickness. The preliminary results also highlight high acceptability of this program among this population, with high satisfaction levels reported for the intervention. Furthermore, based on the partial sample analyzed, training with *ThinkTactic VR* is associated with significant improvements in daily functioning outcomes compared to the control group. There are no significant effects on cognitive domains from the analyses conducted on the data available to date. Moderate effect approaching significance was observed for improvements in theory of mind. Additionally, non-significant small to moderate effects were noted for emotion regulation, executive functions, working memory, and global cognition. **Conclusions.** This study presents preliminary results on the *ThinkTactic VR* program, indicating that it is feasible, acceptable, and improve functioning in this population. Conclusions regarding the efficacy of the program on cognitive functions will be clarified once data collection for the broader study is completed.

2.1. Introduction

Cognitive deficits are a core aspect of psychotic disorders as they affect most individuals with this condition and create substantial challenges in daily life (Mucci et al., 2017; Tschentscher et al., 2023). Neurocognitive functions (e.g. memory, executive functions, attention, and information processing speed) are significantly impaired in individuals living with psychotic disorder compared to neurotypical individuals (Bortolato et al., 2015; Gebreegziabhere et al., 2022). Social cognition, the mental processes underlying social interactions, is also affected in individuals living with this condition (Mucci et al., 2017). Theses impairments significantly impair community functioning and functional capacity, which specifically alters daily activities, working capacity and independent living of people with psychotic disorder (Kharawala et al., 2022).

Cognitive remediation is an intervention aiming to improve cognition and functioning by doing repeated exercises assisted by a trained therapist, implementing strategies and transferring learning in real life (Bowie et al., 2020). This type of intervention is well accepted and produce small to moderate improvements in cognitive, social and functioning in people living with a psychotic disorder, as demonstrated by several meta-analysis (Cella et al., 2020; Katsumi et al., 2019; McGurk et al., 2007; Vita et al., 2023; Wykes et al., 2011).

However, current cognitive remediation programs have some limitations. The direct impact of loss of internal motivation, which often characterizes psychotic disorders, can affect the course of treatments and lead to attrition (Vita et al., 2022). Additionally, some studies found small impact of traditional cognitive remediation interventions on daily functioning with limited transfer of skills to everyday activities (Bowie, 2019; Prikken et al., 2019). To overcome the limitations of traditional administration of this intervention, a new technology, virtual reality, has shown to be a

promising tool for delivering cognitive remediation (Makransky & Petersen, 2021; Schroeder et al., 2022).

Virtual Reality (VR) is a safe and non-invasive technology that allows individuals to interact and perceive three-dimensional images created by a computer (Mancuso et al., 2020). It allows individuals to be exposed to real-world environments and situations that cannot be practice in conventional intervention (Freeman et al., 2017). In virtual reality, therapeutic strategies can be precisely implemented according to the difficulties experienced (Freeman et al., 2017). Individuals can practice developing skills and mastering them before applying them in their daily lives (Chan et al., 2023). The transfer of achievements made during training to everyday life could be increase by the characteristics of virtual reality (Cieślik et al., 2020).

Only a few studies investigated the efficacy of virtual reality cognitive remediation program. Most showed improvements in attention, memory, and executive functions compared to the group not receiving the treatment (Amado et al, 2016; Chan et al., 2010; La Paglia et al., 2016; Wang et al., 2022). Other virtual reality programs targeting social skills showed improvement in social communication and theory of mind (Park et al., 2011; Rus-Calafell et al., 2018; Shen et al., 2022). These acquired skills were also generalizable to daily life (Park et al., 2011; Rus-Calafell et al., 2018). A limited number of studies integrated user feedback to develop their cognitive program (Birckhead et al., 2019). This lack of engagement can lead to poorer implementation of the intervention (Mumma et al., 2016). The limited engagement and input form users give place to improvement in the development of an adapted program.

To address the lack of intervention including input from users and healthcare professionals, our team has developed a new virtual reality cognitive remediation program for people living with a psychotic disorder (Yee et al., 2024). As recommended by the Virtual Reality Clinical Outcomes Research Experts committee, the virtual reality program was developed in

collaboration with people living with a psychotic disorder and healthcare professionals (Birckhead et al., 2019). A final program, *ThinkTactic VR*, was developed by incorporating the suggestions of both groups (Yee et al., 2024). Three different environments are included in the program and each one is composed of exercises with different levels of difficulties, where neurocognition and social cognition are engaged to perform tasks in situations that mimic real-life scenarios (Yee et al., 2024).

We conducted a pilot study to assess the feasibility and initial efficacy of the restaurant module in individuals living with schizophrenia (Bogie et al., 2023). The results of this study showed that it is a feasible intervention, and that it could be effective, as evidenced by the improved use of memory strategies after the training (d = 0.59) (Bogie et al., 2023). The positive results in the pilot study highlight the potential of this program.

Based on these results, the current study investigates the feasibility and acceptability of the whole *ThinkTactic VR* program by monitoring adherence, homework completion, the degree of discomfort experienced in virtual reality, the satisfaction and degree of acceptability in relation to the program. We also examined the preliminary efficacy of the program by evaluating improvements in neurocognitive functioning, social cognition and community functioning using appropriate measurement instruments for each of these functions in comparison to an active control condition in VR. We hypothesized that most participants would complete most of the virtual reality sessions and homework. We also did not expect virtual reality to have any adverse impact on participants. We hypothesized that participants would find the program acceptable by obtaining high scores on the acceptability and therapeutic alliance questionnaire. Finally, we hypothesized that compared to the control group, participant in the cognitive remediation intervention would show greater improvements in: (1) neurocognitive score (primary outcome), (2) social cognition score and (3) community functioning score (secondary outcomes).

2.2. Methodology

This research was approved by the Research Ethics Board at the Royal Ottawa Mental Health Centre (REB #2023001), at University of Quebec in Outaouais (REB #2024-2879) and at The Ottawa Hospital (REB #20240007-01H). This study was registered on ClinicalTrials.gov (identifier: NCT05973110).

Participants

The total sample will include 52 participants, but the current version of the manuscript consists of 17 individuals diagnosed with a psychotic disorder by a physician. Participants were recruited on the recommendation of clinicians from the Schizophrenia Recovery Unit at the Royal Ottawa Mental Health Centre, at The Ottawa Hospital and at the regional psychosis clinic. The inclusion criteria were: (1) diagnosed with a psychotic disorder confirmed by the MINI (Sheehan et al., 1998), (2) aged between 18 and 55 years old, (3) the ability to speak and read English, (4) a stable medication for at least one month before the participation in the study and (5) a total score on the Positive and Negative Syndrome Scale between 30 and 95 (Kay et al., 1987). The exclusion criteria were : (1) a neurological or medical disorders that could cause cognitive impairment (2) an intellectual disability defined as a score of 70 or below on the Wechsler Abbreviated Scale of Intelligence (Wechsler, 2011), (3) a vision conditions that cannot be corrected with lenses or glasses that fit virtual reality glasses, (4) serious medical issues related to the eyes, ears, and balance (5) history of seizures, epilepsy, substance use disorders in the last three months, (6) a previous traumatic brain injury that resulted in loss of consciousness.

Study design

The study had a randomized-controlled, double-blind group design. Participants were randomized on a 1:1 ratio on either *ThinkTactic VR* or active control condition. Both conditions were delivered in VR. All participants received their treatment as usual during the clinical trial.

Study procedure

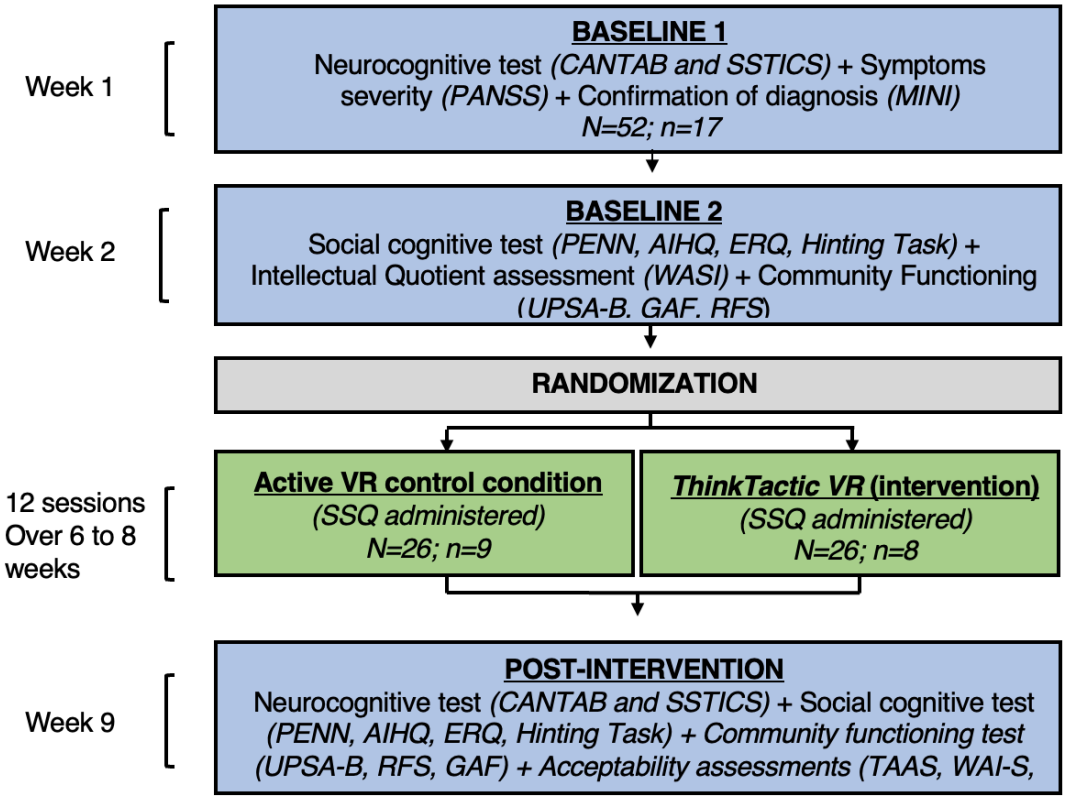
Every participant interested in the study underwent an eligibility screening call with one study staff member. If eligible, they were invited to a first visit to the Royal's Institute of Mental Health Research. Participants were then informed about all the study details and give their written informed consent to participate in the study. During the first two baseline visits, participants were assessed with neurocognitive, social cognitive and community functioning test to establish their baseline level. Clinical assessments were also administered to assure the participants respond to eligibility criteria. All participants were invited to participate in a total of 12 sessions of virtual reality, aimed at a frequency of two sessions per week. Duration of the treatment was six to eight weeks (average = 6.79 weeks). In the intervention condition, participants completed a cognitive remediation program in virtual reality (*ThinkTactic VR*) and participants in the active control condition engaged in commercial virtual reality games (*Nature Trek*; Greener Games). All participants were accompanied in VR by a therapist and participated in discussion at the end of their immersion. Bridging conversation was used in *ThinkTactic VR* to help apply cognitive skills in everyday life and psychoeducation conversation was used in the control condition to discuss implementation of healthy lifestyle habits (see details in Supplementary Methods I). Bridging conversation in ThinkTactik VR also helped participants develop their metacognitive skills, as the various questions prompted them to reflect on their current cognitive functioning, the

strategies they use, which ones works better than others, and how they might improve them to be more effective.

After each exposition in VR, participants completed a questionnaire to measure cybersickness. After the 12 VR sessions, participants were invited to return for a follow-up visit, where they were re-administered the same neurocognitive, social cognitive and community functioning measures as the first two baseline visits. Questionnaires were also administered at this final visit to measure satisfaction with the virtual reality program and the therapeutic alliance. Details of the study procedure are shown in Figure 1.

Figure 2

Schematic summary of the study procedure



Note. AIHQ = Ambiguous Intentions Hostility Questionnaire; CANTAB = Cambridge Neuropsychological Test Automated Battery; ERQ = Emotion Regulation Questionnaire; MINI = The Mini-International Neuropsychiatric Interview; PANSS = Positive and Negative Syndrome Scale; PENN = PENN Emotion

Recognition Test; SSQ = The Sickness Simulator Questionnaire; SSTICS = The Subjective Scale to Investigate Cognition in Schizophrenia – Brief; UPSA-B = The UCSD Performance-based Skills Assessment Brief; GAF = The Global Assessment of Functioning Scale; RFS = Role Functioning Scale; TAAS = The Treatment Adherence Acceptability Scale; VR = Virtual Reality; WAI-S = The Working Alliance Inventory – Short; WASI = The Weschler Abbreviated Scale Intelligence.

Description of the intervention

The intervention comprised 12 VR sessions of about 60 minutes with a trained therapist combined with home assignments. In each session, participant was first introduced with the module they would complete and then proceed to 45 minutes of cognitive training. The participants did three different modules administered by Oculus headset and with two hand-held controllers. VR training was followed by a 15-minute conversation on how neurocognition and social cognition are reflected in everyday functioning. Participants were asked to reflect on the strategies they used when completing the task, and how they could use them as well in their daily activities. Participants were then given a homework assignment to put the strategies they had learned into practice in their daily lives. Full description of *ThinkTactic VR* development is in Yee et al. 2024, and the therapist manual is in Supplementary Methods I.

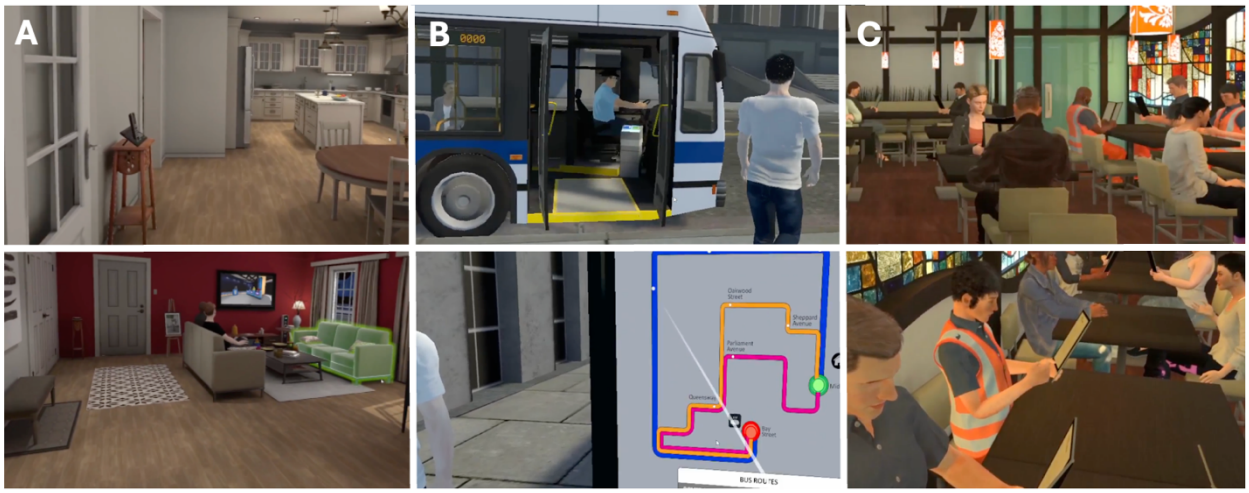
VR Module Descriptions

First module is taking place in a restaurant where the user takes the role of a server. The user is responsible to take food orders of customers and to repeat it to the kitchen by memory. In later levels, the difficulty increases with the presence of music and conversations that can be distracting for participants. There is also an addition of items to the orders, requiring participants to memorize more items. The second module experienced by participants is set in an apartment where users encountered different situations, such as choosing a healthy meal from the fridge, solving a plumbing problem, holding a conversation with a stranger, etc. In the last environment,

participants are placed in a bus, where they are asked to perform a series of tasks found in everyday life. For example, they must choose the most efficient route to a destination and remember the bus stop. The complexity increases in later levels as more surrounding sounds are added. They also have to manage a situation where there is a detour and resolve a situation where a cashier give them the wrong amount of money. Examples of the virtual reality modules of *ThinkTactic VR* are illustrated in Figure 2. Further information on each module and the content of each session can be found in the Supplementary Methods II.

Figure 3

Images from ThinkTactick VR



Note. The apartment module is featured on the left (A), the bus module is featured in the middle (B) and the restaurant module is featured on the right (C).

Description of the control condition

Participants in the control condition took part in commercial virtual reality games (Nature Trek by Greener games). An active control group in virtual reality was chose to control for the virtual reality exposure. Participants explored different environments in nature. These games did not engage participant in cognitive tasks. No cognitive remediation, neurocognitive strategy or social

cognition was taught to these participants. Instead, the trained therapist discussed healthy lifestyle habits and how to maintain them in day-to-day life (Supplementary Methods I). To control for the effects of therapist discussion and social interaction, both the control and *ThinkTactik VR* groups were designed to include a comparable level of engagement and interaction. Examples of the virtual reality nature environments are illustrated in Figure 3.

Figure 4

Images from the virtual reality environments used for the active control group.

Note. The images represent examples of nature environment explored by participant (Nature Trek). A grassland environment is featured on the left (A), a winter forest is featured in the middle (B) and beach environment is featured on the right (C).

Outcomes

Measurements were assessed on-site by assessors who received approximately 15 hours of training for the study (doctorate students in clinical neuropsychology). Psychometric information about each assessment can be found in Supplementary Methods III.

Clinical measures

The psychotic module of The Mini-International Neuropsychiatric Interview (MINI), a structured interview (Sheehan et al. 1998) was administered to confirm presence of psychotic disorder. To assess the severity of positive, negative and generalized psychopathology symptoms, the semi-structured interview of the Positive and Negative Syndrome Scale (PANSS) was

administered (Kay et al., 1987). PANSS is a semi-structured interview used to assess the severity of 30 symptoms (positive, negative and generalized psychopathology) in people living with a psychotic disorder (Kay et al., 1987). *The Weschler Abbreviated Scale Intelligence (WASI)* is an intelligence quotient (IQ) test designed to measure intelligence and cognition in adults (Wechsler, 2011). To estimate IQ, only the form of Scale 2 was administered, namely the Vocabulary and Matrix Reasoning subscales.

Feasibility assessment

The Sickness Simulator Questionnaire (SSQ) examines the degree of discomfort in participants after using virtual reality (Kennedy et al., 1993). The SSQ consists of three domains: symptoms related to nausea, symptoms related to oculomotricity and symptoms related to disorientation (Kennedy et al., 1993).

Acceptability assessments

The *Working Alliance Inventory – Short (*WAI-S) was used to evaluate the working alliance between the participant and the therapist on three aspects: agreement on the tasks to be performed, agreement on the goals of the treatment, and the development of an emotional bond (Munder et al., 2010). *The Treatment Adherence Acceptability Scale* (TAAS) was used to measure treatment acceptability and adherence (Milosevic et al., 2015). *A program satisfaction questionnaire* measuring satisfaction of participant with the virtual reality cognitive remediation program was used. The questionnaire includes open-ended questions to find out which aspects were appreciated, and which could be improved from the point of view of participants.

Neurocognitive measures

Neurocognition was assessed with the *Cambridge* Neuropsychological Test Automated Battery *(CANTAB),* a computer-based battery that include cognitive tasks to evaluate different

cognitive functions as attention, working memory, executive functions, verbal and visual episodic memory, information processing speed, mental control, and social aspects like emotion recognition (Robbins et al., 1994). The Subjective Scale to Investigate Cognition in Schizophrenia – Brief (SSTICS-B), a self-report measure, was also used to assess participants' subjective perception of their cognitive abilities (Cella et al., 2020).

Social cognition assessments

The Hinting Task was used to measure theory of mind (Corcoran et al., 1995). Participants listened to ten stories presented verbally and were asked to deduce what are the characters intention when they provide a hint to the other character of the story (Corcoran et al., 1995). To assess the ability to recognize emotion, the PENN Emotion Recognition Test was used where participants were asked to identify the emotion on a picture of a face representing joy, sadness, anger, fear or a neutral expression (Kohler et al., 2003). The Emotion Regulation Questionnaire was administered to measure emotion regulation strategies used by the respondent in two ways: tendency to regulate emotions through cognitive reappraisal or expressive suppression (Gross & John, 2003). To measure attribution bias, the Ambiguous Intentions Hostility Questionnaire was used where participants read hypothetical negative social situations and explain why the situation occurred by answering various questions (Combs et al., 2007). They rate the intention of the other person's action; how angry they feel and how much they would attribute blame to the other person (Combs et al., 2007).

Community Functioning assessments

The UCSD Performance-based Skills Assessment Brief (UPSA-B), a role-play test, was used to evaluate the functional capacity (Mausbach et al. 2006). Tasks as counting changes, reschedule an appointment, call assistance to have a phone number were done by participants

where they manipulated real life material (Mausbach et al. 2006). *The Global Assessment of Functioning Scale (GAF),* which is administered as a structured interview, was used to rate how much the person's illness is affecting their day-to-day life (Schwartz, 2007). *The Role Functioning Scale* (RFS) is another interviewer-rated assessment where functioning was evaluated across four domains: working productivity, degree of independence, immediate social network and participation in recreational/community activities (Goodman et al., 1993).

Analysis

To summarize descriptive information of the sample in the two randomized groups, means and standard deviations were used. To determine whether there are any demographic or clinical variables that differ significantly between the two conditions at baseline, t-test (for continuous data) and chi square test (for categorical data) were performed.

Analysis for feasibility and acceptability: Descriptive statistics (means, frequencies and standard deviations) were used to examine the feasibility and acceptability of the intervention. Specifically, data on attrition rates, program adherence, homework completion, missing participant and level of discomfort during sessions (SSQ) were used to examine feasibility. For the acceptability, data collected from a program satisfaction and acceptability questionnaires were used (Satisfaction with CRT, WAI-S and TAAS). Comparison analysis (t-test) was made between the two conditions to detect any difference between the groups for each feasibility and acceptability data.

Analysis for efficacy: To examine the preliminary efficacy of the virtual reality program on neurocognitive function, two CANTAB total composite Z-scores were calculated per participant (primary efficacy endpoint), one score at baseline and one score post-intervention. Composite Z-score were obtained by standardizing results for each CANTAB subtests to obtain Z-score and

averaging some of them together to have a derive score for each cognitive domain. A global composite score was computed as a mean of Z-score across all cognitive domains (Details are presented in Supplementary Methods IV).

Linear mixed model with random intercepts were used to examine the total CANTAB scores. Analyses were also carried out for each neuro-cognitive domain measured (working memory, executive functions, cognitive flexibility, verbal memory, visual memory, memory, information processing speed and attention). Randomized intercepts were used to account for interindividual variability in baseline cognition score for each participant. Linear mixed model included results to compare data between group (*ThinkTactic VR* vs control), time (baseline data and post-training data) and group x time interaction.

Preliminary efficacy of the intervention on social cognition domains was calculated by doing linear mixed model analysis with the two scores that were created for each assessments using data from the PENN, Hinting Task, ERQ and AIHQ (secondary efficacy criterion), one score at baseline and one score post-intervention. We conducted a series of separate mixed-effects models with randomized intercepts to examine the impact of the intervention on social cognition. The same linear mixed model with randomized intercepts analysis were done using data from the community functioning measure (GAF, RFS and UPSA-B) to determine the impact of the intervention on global functioning.

2.3. Results

Results are presented for a total of 17 participants with psychotic disorders who were recruited between September 2023 and November 2024. All the participants were randomized in one of the two groups. A CONSORT diagram of recruitment, allocation and drop-out is shown in Figure 1.

Figure 5

CONSORT Diagram for the Randomized Clinical Trial.

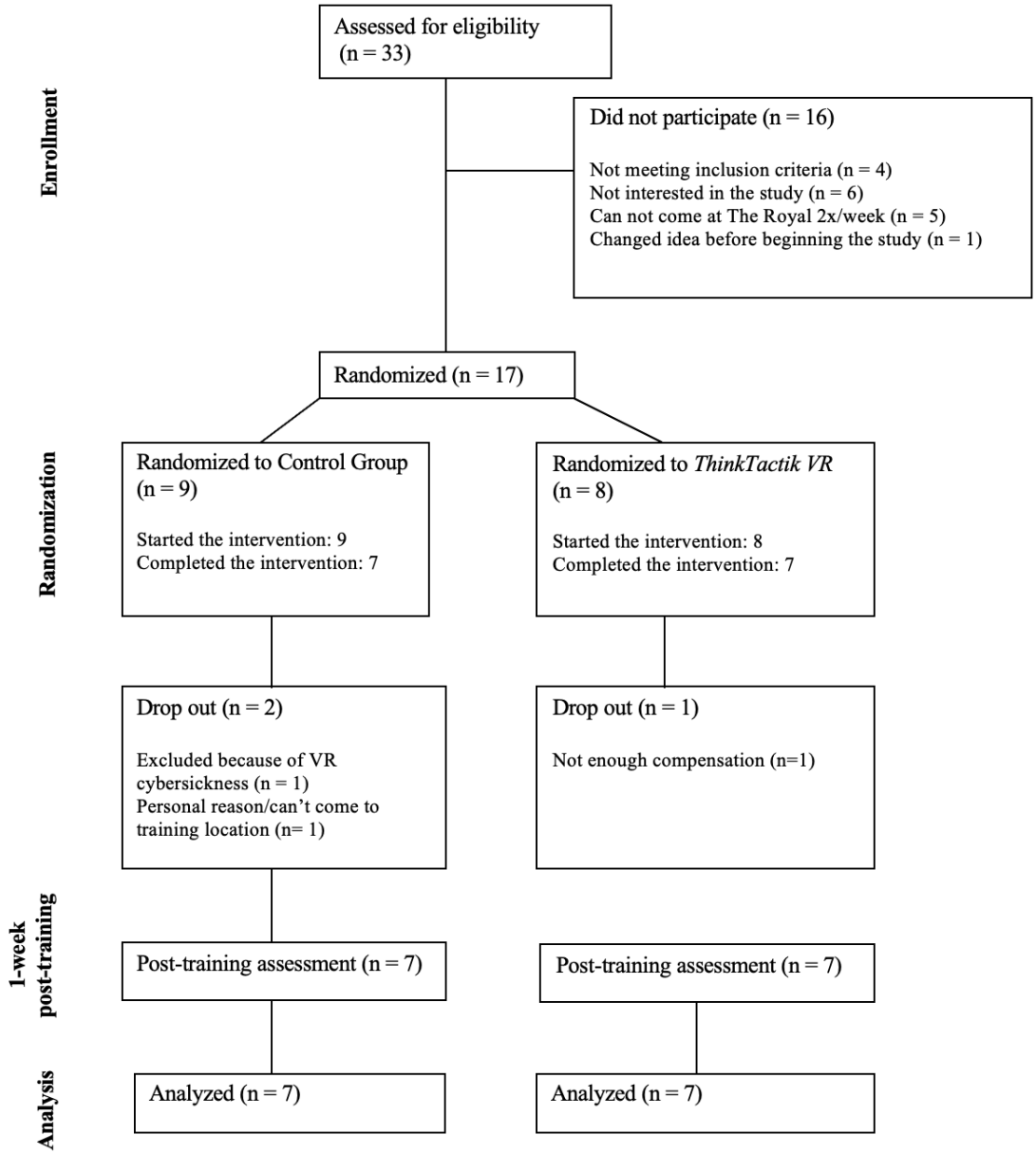


Table 4 summarize the demographic and clinical information of the participants. There was no significant difference between the groups in any demographic and clinical characteristics.

Table 4

Demographic and Clinical Characteristics of the Sample.

	Control Group (N=7)	ThinkTactic VR (N=7)	t/χ2	P-value
Age				
Mean (SD)	33.14 ± 8.32	36.86 ± 9.53	-0.777	0.452
[Min, Max]	[25.00, 45.00]	[24.00, 53.00]		
Sex				
Male	5 (71.00 %)	6 (86.00 %)	0	1
Female	2 (29.00 %)	1 (14.00 %)		
Ethnic Group				
Asian	2 (29.00 %)	1 (14.00 %)	0.258	0.879
Black	1 (14.00 %)	2 (29.00 %)		
White/Caucasian	4 (57.00 %)	4 (57.00 %)		
Employment Status				
Employed	1 (14.00 %)	3 (43.00 %)	4.143	0.126
Student	3 (43.00 %)	0 (0.00 %)		
Unemployed	3 (43.00 %)	4 (57.00 %)		
Diagnosis				
Schizoaffective disorder	4 (57.00 %)	1 (14.00 %)	1.244	0.265
Schizophrenia	3 (43.00 %)	6 (86.00 %)		
Year of post education				
Mean (SD)	1.43 ± 1.81	1.00 ± 1.41	0.493	0.631
[Min, Max]	[0.00, 5.00]	[0.00, 3.00]		
PANSS - Total				
Mean (SD)	62.71 ± 15.27	62.71 ± 13.71	0	1
[Min, Max]	[36.00, 80.00]	[48.00, 86.00]		
PANSS - Positive Symptoms				
Mean (SD)	16.29 ± 5.71	14.29 ± 5.09	0.692	0.502
[Min, Max]	[7.00, 23.00]	[9.00, 23.00]		

	Control Group (N=7)	ThinkTactic VR (N=7)	t/χ2	P-value
PANSS - Negative Symptoms				
Mean (SD)	14.71 ± 4.75	18.86 ± 5.96	-1.439	0.177
[Min, Max]	[10.00, 23.00]	[13.00, 29.00]		
PANSS - General Symptoms				
Mean (SD)	31.71 ± 6.60	29.57 ± 6.08	0.632	0.539
[Min, Max]	[19.00, 39.00]	[23.00, 39.00]		
IQ estimate				
Mean (SD)	100.86 ± 14.21	95.29 ± 11.00	0.821	0.429
[Min, Max]	[79.00, 116.00]	[76.00, 111.00]		
CPZ equivalence				
Mean (SD)	485.71 ± 353.51	303.57 ± 174.06	1.223	0.253
[Min, Max]	[200.00, 1025.00]	[75.00, 500.00]		

Note. t = t-test; χ^2 = chi-squared test; PANSS = Positive and Negative Syndrome Scale (Score on a scale of 7 to 49 for Positive symptoms and Negative Symptoms; Score on a scale of 16 to 112 for General Symptoms; Score on a scale of 30 to 210 for Total Score); IQ = Intellectual Quotient estimated with WASI; CPZ = Chlorpromazine.

Feasibility outcome

As presented in Figure 4, a total of 33 participants were contacted to participate in this study in the initial recruitment phase (September 2023 to October 2024). 52% of contacted person accepted to participate in this clinical trial. A total of seventeen of these participants were randomized to one of the two conditions and 16 were not included for various reasons (Figure 4). Of the 17 participants randomized, 14 were assessed post-training (17.64% overall attrition rate). More precisely, eight participants were randomized to *ThinkTactic VR* and only one participant dropped out of the condition for insufficient compensation. Participants in *ThinkTactic VR* completed a mean of 11, *SD* = 2,65 sessions. A total of nine participants were randomized in the control condition where one participant dropped out of the control condition for personal reason,

and one was excluded for having cybersickness in VR. Participants in this condition completed a mean of 12, SD = 0 sessions in virtual reality.

Participants were also asked to complete homework at the end of each of the 12 sessions. On average, participants in the *ThinkTactic VR* condition completed 45% of their assign homework, *SD* = 17.3 and participants in the control condition completed 70.8% of their assigned homework, *SD* = 8.74. A significative difference between the group for the homework completion was revealed t (11.36) = 2.60, p = 0.02 showing a greater completion in control condition.

In each VR session, participants were asked to complete the SSQ to report the presence of any cybersickness symptoms. The results of each SSQ scales are presented in Table 5. Overall, participants reported low levels of cybersickness in the two groups and results do not significantly differ between the two groups with $p > 0.5$.

Table 5

Average cybersickness symptoms according to the control and intervention groups.

	Control Group (N=7)	ThinkTactic VR (N=7)	*t*	df	*p*	Cohen's d
Nausea Symptoms						
M (SD)	23.58 ± 28.37	19.64 ± 23.01)	0.285	11.509	0.780	0.153
[Min, Max]	[0.73, 82.92]	[0.73, 57.24]				
Disorientation Symptoms						
M (SD)	32.60 ± 46.60	35.41 ± 48.09	-0.111	11.988	0.913	-0.059
[Min, Max]	[1.07, 131.70]	[0.00, 122.07]				
Oculomoteur Symptoms						
M (SD)	26.96 ± 27.43	21.55 ± 24.92	0.386	11.892	0.706	0.207
[Min, Max]	[0.00, 77.55]	[0.00, 55.98]				
Total Score						
M (SD)	31.30 ± 36.64	27.84 ± 33.94	0.183	11.930	0.858	0.098
[Min, Max]	[0.58, 106.16]	[0.29, 82.28]				
Nausea (- Anxiety)						
M (SD)	13.46 ± 19.32	11.13 ± 15.70	0.247	11.519	0.809	0.132
[Min, Max]	[0.00, 53.57]	[0.73, 41.10]				
Oculomoteur (- Anxiety)						
M (SD)	18.92 ± 18.31	14.79 ± 18.65	0.418	11.996	0.683	0.224
[Min, Max]	[0.00, 54.23]	[0.00, 41.98]				
Total (- Anxiety)						
M (SD)	23.37 ± 28.36	21.17 ± 28.05	0.146	11.999	0.887	0.078
[Min, Max]	[0.58, 83.14]	[0.29, 69.62]				

Note. *t* = t-test; df = degrees of freedom; SSQ = Sickness Simulator Questionnaire. The result of the SSQ was calculated using two methods: the traditional scoring method (Kennedy et al., 1993) and using the more recent method of Bouchard et al., 2021 that takes in count for the anxiety. Possible score for the Nausea ranges from 0 to 200, for the Disorientation range from 0 to 292.32, for the Oculomoteur range from 0 to 159.2 and for the Total Score range from 0 to 235.6.

In response to the blinding question, participants in the *ThinkTactic VR* program condition confidently said they were in the active condition ($M = 4.29$, $SD = 0.76$) with a possible score of

five. Most of the participants in the control condition reported feeling neutral about being in the active condition (M = 3.62, SD = 1.41). No significant difference was detected between the two groups t (10.98) = -1.15, p = 0.27, which support the successful blinding.

Acceptability outcome

Participants in the control group would adhere and found acceptable the program they did as an intervention with a mean score of 59.00 (SD = 10.60) out of a total possible score of 70 at the TAAS questionnaire. Similar results are found for the *ThinkTactic VR* group with a mean score of 54.70 (SD = 5.85), with no significant difference between the groups t (7.80) = 0.88, p = 0.41.

Participants in both groups had a high level of working alliance with their therapist. More specifically, with a possible total score of 28 at each scale of the WAIS questionnaire, participants in the control group had a high bond with the therapist (M = 24.00, SD = 5.17), as the participants in the *ThinkTactic VR* group (M = 25.2, SD = 3.82), with no significant difference between the two groups t (9.86) = 1.75, p = 0.11. Participants in both groups also found that they and the therapist were working in the same direction to achieve their goal (control group: M = 24.00, SD = 5.18; *ThinkTactic VR* group: M = 21.30, SD = 3.99) with no significant difference between the group t (9.36) = 1.05, p = 0.32. Additionally, both groups found that they had an agreement with the therapist regarding the treatment goal (control group: M = 25.2, SD = 3.82; *ThinkTactic VR* group: M = 21.70, SD = 3.20), with no significant difference between the group (t (9.86) = 1.75, p = 0.11).

Finally, both groups were satisfied by the VR experience and found it enjoyable. Both groups would recommend the VR experience to a friend and found it realistic. On a possibility of a total score of 15, participants in the control group had a high satisfaction regarding the VR

experience (*M* = 12.60, *SD* = 2.23), as the participants in the *ThinkTactic VR* group (*M* = 12.7, *SD* = 1.38). The total score did not significantly differ between the two groups *t* (10.02) = -0.14, *p* = 0.88. Participants mentioned they enjoyed *ThinkTactic VR* because of the use of new technology and the conversation that followed the VR sessions, during which strategies were taught for applying learning in the real world. Participants were also invited to share which module they liked least in the program. The apartment module was the one highlighted by more than half the participants because they didn't challenge them enough. The figure in Supplementary Results II illustrates the results of both groups on the total score of all the acceptability questionnaires.

Preliminary efficacy

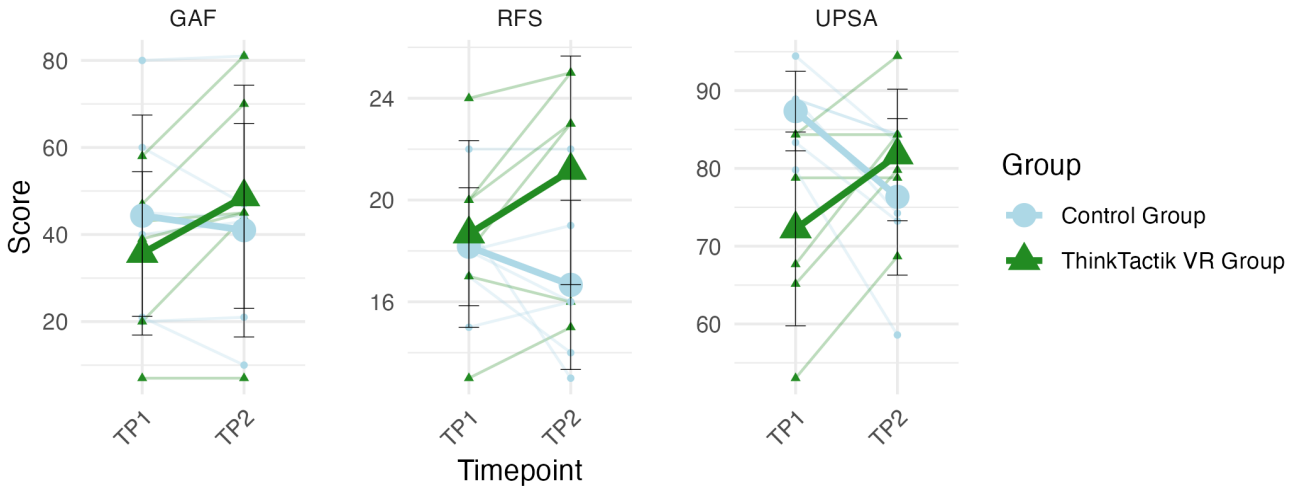
Community functioning outcome

Mean and standard deviations for pre-training and post-training outcomes are presented in Supplementary Results III - Table 4. All details of estimates of time and group interaction are shown in Supplementary Results III – Table 5. Linear mixed model demonstrated greater improvements in the *ThinkTactic VR* group than the control group for some community functioning outcomes at post-training. Significant improvements with large effect size were found for global functioning in GAF (*b* = 16.33, 95% Cl [5.29 – 27.38], *p* = 0.01, η^2 = 0.49), role functioning in RFS (*b* = 4.07, 95% Cl [1.09 – 7.05], *p* = 0.01, η^2 = 0.45), degree of independence in RFS (*b* = 1.48, 95% Cl [0.42 – 2.53], *p* = 0.01, η^2 = 0.46), extended social network in RFS (*b* = 2.02, 95% Cl [0.01 – 4.04], *p* = 0.05, η^2 = 0.31) and functional capacity in UPSA-B (*b* = 19.97, 95% Cl [11.62 – 28.33], *p* < 0,01, η^2 = 0.45).

Mean differences of global functioning measures from pre-training to post-training are shown in Figure 6 for both groups. An improvement is observable for the *ThinkTactic VR* Group compared to the control group for every community functioning outcome.

Figure 6

Mean Difference for Global Functioning Assessments for both Groups



Note. GAF = Global Assessment of Functioning; RFS = Role Functioning Scale; UPSA = UCSD Performance-Based Skills Assessment; TP1 = Timepoint 1 (Pre-training); TP2 = Timepoint 2 (Post-Training). Scoring for scales: GAF = 0 to 100; RFS = 4 to 28; UPSA = 0 to 100. Graphs includes 7 participants in control group (blue line) and 7 participants in *ThinkTactic VR* group (green line). Errors bars represent standard errors.

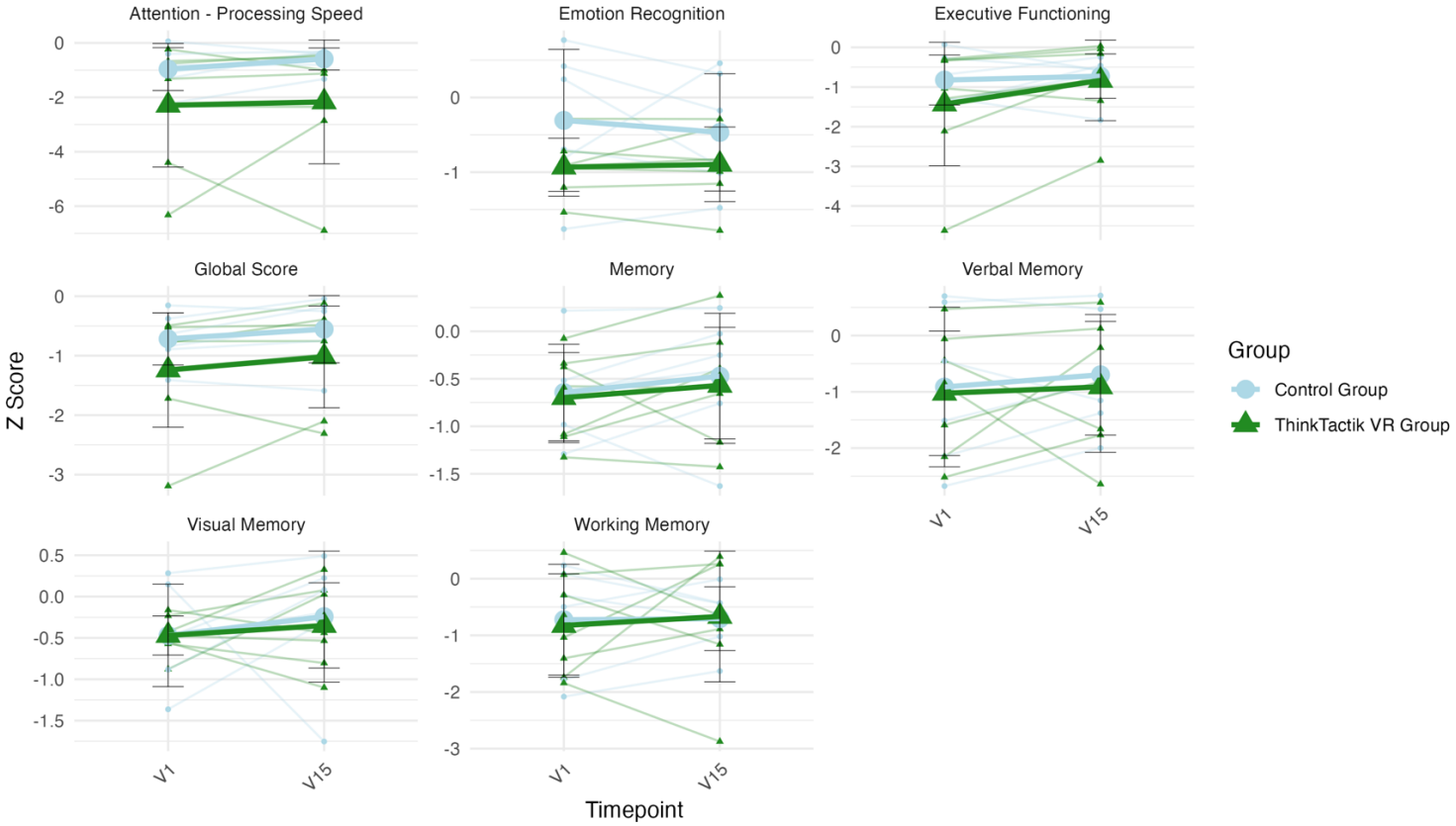
Neurocognitive and social cognitive outcomes

Mean and standard deviations for all the pre-training and post-training outcomes are presented in Supplementary Results IV - Table 6 and Table 7. Estimates of time and group interaction for each domain are shown in Supplementary Results V – Table 8 and Table 9. None of the cognitive domains have a significant time by condition interaction with the current sample. A tendency for significance is noted for theory of mind on Hinting Task with (b =3.29, 95% Cl [-0.78 – 7.35], p = 0.10, η^2 = 0.22). Non-significant small to moderate (η^2 > 0,01) effect size were also noted favoring *ThinkTactic VR* for executive functioning, working memory, global cognition and emotion regulation strategy (expressive suppression).

Mean differences from pre-training to post-training are shown in Figure 7 and Figure 8 for both groups. The improvements are observable for the *ThinkTactic VR* compared to the control group in cognitive domains detailed above.

Figure 7

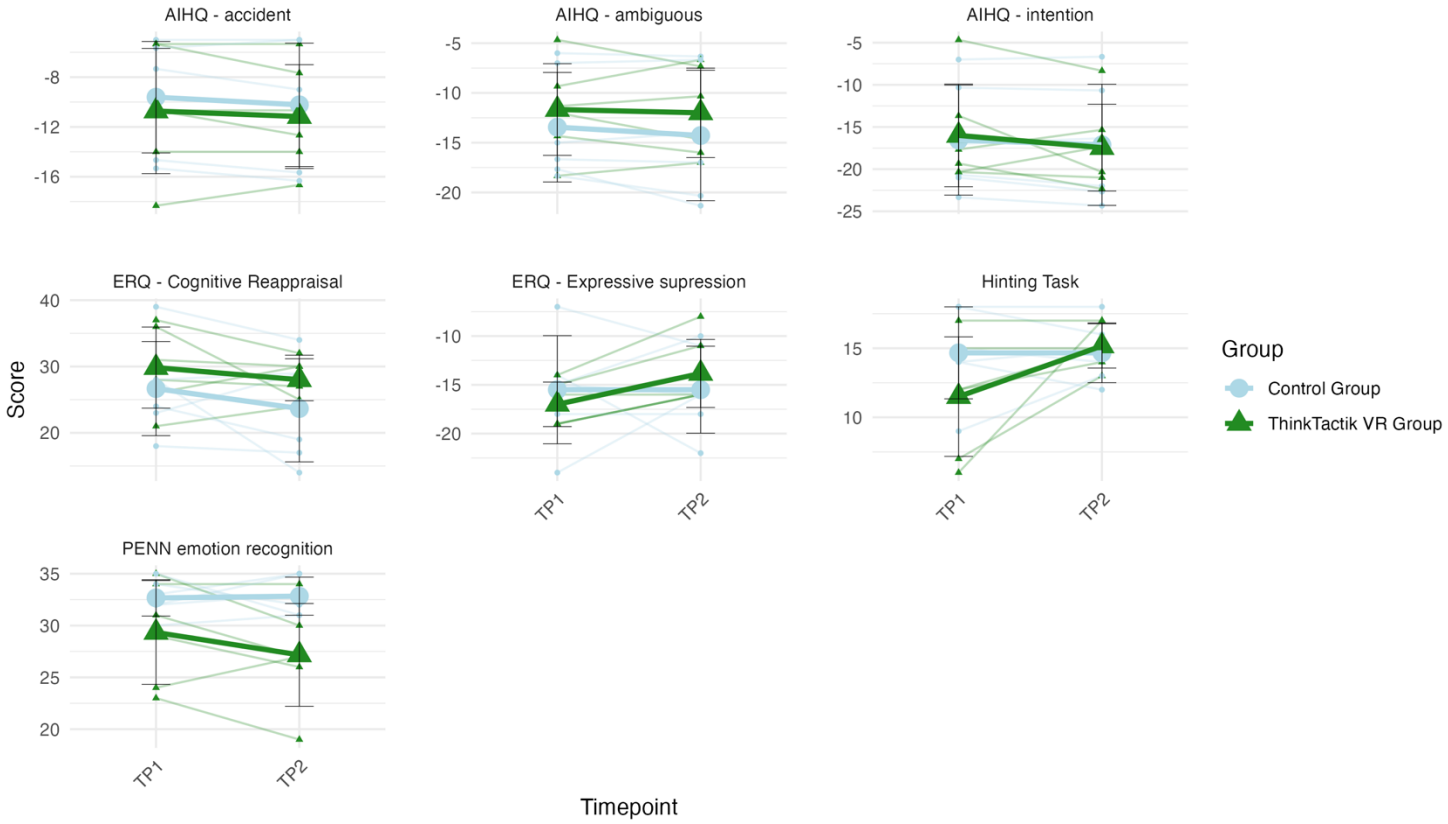
Mean Difference for CANTAB Scores for each Group



Note. V1 = Visit 1 (pre-training); V15 = Visit 15 (post-training). Graphs includes 7 participants in control group (blue line) and 7 participants in ThinkTactic VR group (green line). Errors bars represent standard errors.

Figure 8

Mean Difference for Social Cognition Domains for both Group.



Note. AIHQ = Ambiguous Intentional Hostility Questionnaire; ERQ = Emotion Regulation Questionnaire; TP1 = Timepoint 1 (Pre-training); TP2 = Timepoint 2 (Post-Training). Graphs includes 7 participants in control group (blue line) and 7 participants in ThinkTactic VR group (green line). Errors bars represent standard errors.

Interaction between timepoint and condition was examined to determine the change in subjective perception of cognitive level in participant. The change in subjective cognition from pre-training to post-training was greater for the intervention group compared to active group, but not statistically significant $b = 2.67$, 95% Cl [-6.97 – 12.30], $p = 0.55$, $\eta^2 = 0.04$).

2.4. Discussion

We compared *ThinkTactic VR* group to an active control group to investigate the feasibility, acceptability and preliminary efficacy of this new virtual reality cognitive remediation program for individuals with a psychotic disorder. *ThinkTactic VR* is the first CRT co-designed program targeting at the same time neurocognitive domains, social cognitive domains and global functioning in real life scenarios. Overall, our results show that *ThinkTactic VR* tends to be feasible and acceptable. The results also show that compared to the active control group, participant in the *ThinkTactic VR* condition had larger improvements of global functioning. Similarly, participants in the *ThinkTactic VR* group tended to have greater improvements in social cognitive domains, and in few neurocognitive domains. Completion of the study with a full sample will enable us to confirm whether the trends observed are significant or not, given that the current analysis lacks power to interpret statistical significance alone.

Feasibility

Of all the participants reached to take part in the study, more than half decided to take part in this clinical trial. Most of the people contacted that did not participate in the study was because of the time commitment or because they didn't match the eligible criteria. The participation in this study has a 17.64% attrition rate (22.22% in the control group and 12.5% in the *ThinkTactic VR* group), which is comparable to other studies using traditional cognitive remediation therapy with people with psychotic disorder (Vita et al., 2023). Vita et al. (2023) reported a 16.52% overall dropout rate for studies using cognitive remediation with this clinical population, showing *ThinkTactic VR* perform better than standard CRT. Previous studies using virtual reality cognitive remediation also reported higher participation rates ranging from 69% to 89% (Park et al., 2019;

Komemi et al., 2024; Adery et al., 2018; Rus-Calafell et al., 2014; Vass et al., 2022). *ThinkTactic VR* falls within this range with a participation rate of 83%, indicating great feasibility.

A significant difference was found in the amount of homework completed by participants. Participants in the intervention group completed significantly less homework than participants in the control group. The homework assigned in *ThinkTactic VR* were more focused on cognitive strategies, while in the control group it was more focused on behavioral exercises. Behavioral exercises are easier to understand and practice than cognitive ones, which may explain why it was easier for participants in the control condition to keeping up with the types of homework assigned (Dobson & Dobson, 2009).

Overall, participants experienced low level of cybersickness in both groups. Only one participant, in the control condition, failed the virtual reality trial, as he had too many symptoms to benefit from intervention with this type of technology. The short exposition to VR interspersed of five minutes breaks may have contribute to a better experience of participant in VR and may explain the low rate of cybersickness (Lawson et al., 2021). These results are consistent with other studies where the cybersickness rate was also low in people with psychotic disorders who had been exposed to a virtual reality intervention (Bisso et al., 2020). These results suggest that this technology can be suitable for intervention with this type of population.

Acceptability

Acceptability and adherence of the virtual reality program was confirmed with a high satisfaction and adherence rate on the Satisfaction with CRT questionnaire and TAAS. Most of the participants enjoyed participating in the program, would recommend it to a friend and had pleasure doing it. Our results are concordant with the proof-of-concept of Bogie et al. (2023) where participants also had a high satisfaction regarding the restaurant module in *ThinkTactic*

VR. The results are also comparable with other cognitive remediation program in virtual reality where participant often appreciated the experience (Adery et al., 2018; Nijman et al., 2020; Shen et al., 2022). The playful aspect of the intervention (different levels, presence of avatars, video games, etc.) can foster the participants appreciation of the intervention and encourage them to participate adequately in all sessions due to greater motivation (Lumsden et al., 2016).

Overall, participants also demonstrated a strong working alliance with the therapist assisting them in the program, as indicated by a high score in the WAI-S. Previous studies showed that a good therapeutic alliance is a significant predictor of participant engagement and attendance in intervention (Browne et al., 2021). The high-level alliance between participants and therapist in this study could explain the high acceptability and feasibility of the *ThinkTactic VR* program. These findings suggest that *ThinkTactic VR* could enable clinicians to use a new technology to complement the treatment they provide to psychotic patients. Integrating this intervention into clinical practice could improve patient adherence and motivation to be involved in the care of their cognitive health.

Preliminary efficacy

The results regarding the efficacy of *ThinkTactic VR* on global functioning revealed a significant time by group difference interaction, with improvement in the UPSA-B, GAF and RFS scores, accompanied by large effect size. The results are consistent with recent meta-analysis of cognitive remediation efficacy in people living with schizophrenia (Vita et al., 2021; Lejeune et al., 2021). However, the effect size observed in this clinical trial are larger than those typically reported in non-immersive interventions, which highlight strong efficacy of virtual reality intervention (Vita et al., 2021; Lejeune et al., 2021). Some authors emphasized that incorporating the four core elements of cognitive remediation (ex. repeated exercises, strategies

implementation, presence of a therapist, bridging conversation), which are integrated in *ThinkTactic VR*, can lead to greater improvement in functioning (Vita et al., 2021; Lejeune et al., 2021). The present findings are important as they suggest that *ThinkTactic VR* can be a new way to improve the overall functioning and daily living skills of people with psychotic disorders. This is particularly significant given the severe impairments in global functioning in this population (Higuchi et al., 2017). This intervention could promote greater autonomy and independence, thereby reducing their need of assistance.

While no other results reached significance at this stage, moderate to large effect size in the improvement of social cognitive domains were observed for participants in the *ThinkTactic VR* group. More specifically, there was a trend toward significance for theory of mind, a social cognitive domain that has been improved with cognitive remediation with this type of population in other studies (Kurtz et al., 2016; d'Arma et al., 2021, Vass et al., 2020). Integration of social situation in *ThinkTactic VR,* which require participants to interpret social interaction, can solicit theory of mind and have improve it. These findings support the results of recent meta-analysis suggesting medium to large effect of social cognition training on multiple social cognitive domains (Grant et al., 2017; Nijman et al., 2020). The tendency of improvement for social cognitive domains may contribute to better functioning in social context, improved relationship, and potentially reduced social isolation and stigma (Tan et al. 2016).

While moderate effects on executive function and small effects on working memory were observed in the *ThinkTactic VR* group, results did not reach statistical significance. These findings contrast with finding from the majority of clinical trial, which have shown that cognitive remediation can improve multiple neurocognitive domains like memory, attention, executive function, working memory, speed of processing and global cognition (Komemi et al., 2024; LaPaglia et al., 2016; Vita et al., 2021). Although previous studies showed greater improvements

of neurocognitive domains after CRT, some studies also showed small effect size of the intervention on few cognitive domains like executive function and working memory, which is in line with our fundings (Chan et al., 2023). In some studies, no improvement in neurocognition or daily life functioning has been observed after computerized CRT (Gomar et al., 2015). During the administration of *ThinkTactic VR,* therapist encouraged participant to reflect on how to apply learned cognitive strategies to real-life situations. However, certain cognitive assessments, such as CANTAB (Robbins et al., 1994), prioritize response time in scoring, which do not align with the intervention emphasis on taking time to think about the best strategy. This contradiction may limit the ability of the neurocognitive assessment to capture the cognitive gains achieved through the program. Future studies should consider using a cognitive measure in virtual reality to assess cognitive functions in everyday situations (Miskowiak et al., 2022).

Strength and Limitations

This clinical trial is the first to investigate the efficacy of a virtual reality-based cognitive remediation program designed to simultaneously target neurocognitive domains, social cognition and functional capacity in people living with psychotic disorder. This study addresses key methodological limitations of previous study by using a double-blind randomization design. It also overcomes the common absence of a control group by incorporating an active control group engaged in virtual reality games, allowing for a more rigorous comparison with the intervention group. In future research, *ThinkTactic VR* should be compared to a traditional, non-VR cognitive remediation program to assess the added impact of virtual reality as a therapeutic modality.

Several limitations should be highlighted. The small sample size is an important limitation of the study and may account for the insufficient statistical power to detect significant effects. However, the number of participants included was adequate to assess the feasibility, acceptability

and preliminary efficacy of the intervention. The full study, which will include a larger sample, is expected to have sufficient power to detect any changes once the analyses are conducted again. Future research should aim to recruit a larger sample to come to more accurate and solid conclusions about the efficacy of this intervention. Additionally, our findings suggest that some exercises included in the Restaurant module of ThinkTactic VR might not have been challenging enough for some participants, as reported in our qualitative questionnaires. The lack of difficulty in some VR sessions may have limited the cognitive benefits attainable through the program (Browne et al., 2020). Future research regarding this program should consider modifying the apartment module to increase the cognitive demands of the tasks at higher difficulty levels.

2.5. Conclusion

ThinkTactic VR appears to be a feasible and acceptable intervention for individuals with a psychotic disorder. Preliminary results also suggest potential benefits for functioning. However, with more than half of the sample to collect, no definitive conclusions can be drawn regarding the non-significant results in neurocognition and social cognition. Nonetheless, these preliminary findings support the use of virtual reality cognitive remediation program as a more ecological valid approach to improving global functioning in people living with a psychotic disorder.

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CHAPITRE III - DISCUSSION GÉNÉRALE

Le présent essai doctoral avait comme objectif d'investiguer la faisabilité, l'acceptabilité et l'efficacité initiale d'un nouveau programme de remédiation cognitive en réalité virtuelle, *ThinkTactic VR,* chez des personnes vivant avec un trouble psychotique. Les recherches antérieures montrent que les différents domaines cognitifs chez les individus vivant avec un trouble psychotique sont grandement affectés comparativement à la population générale (Fett et al., 2020). Ces difficultés cognitives impactent directement le fonctionnement quotidien de ces individus, soulignant ainsi l'importance de développer des moyens pour améliorer les domaines cognitifs (Fett et al., 2020). Les interventions réalisées par le biais de la réalité virtuelle semblent être une avenue prometteuse afin d'améliorer le fonctionnement psychosocial de cette population, mais peu d'étude a été faite à ce sujet (Schroeder et al., 2022). Cette recherche propose ainsi une nouvelle manière d'intervenir sur la cognition auprès d'une population psychotique. À notre connaissance, la recherche actuelle est l'une des premières à évaluer l'efficacité d'un programme de remédiation cognitive en réalité virtuelle, pour les personnes souffrant de troubles psychotiques, ciblant à la fois les domaines neurocognitifs et socio-cognitifs dans des scénarios de la vie réelle.

Dans l'ensemble, le taux d'attrition et le faible taux de symptômes de cybermalaise appuient la faisabilité du programme *ThinkTactic VR* auprès d'une population vivant avec des troubles psychotiques. Le haut taux de satisfaction et la haute alliance thérapeutique fournissent également des preuves sur l'acceptabilité de ce programme. Le suivi post intervention a démontré des tailles d'effet faible à modéré pour l'amélioration des domaines neurocognitifs comme la mémoire de travail et les fonctions exécutives. Des effets modérés à importants sont observés dans l'amélioration de la régulation des émotions et la théorie de l'esprit chez les individus ayant suivi *ThinkTactic VR*. De plus, les participants dans le groupe *ThinkTactic VR* ont eu des

améliorations significativement plus importantes que les individus dans le groupe contrôle dans les différentes mesures de fonctionnement quotidien et d'habileté à vivre indépendamment.

3.1. Faisabilité du programme

Le premier objectif de recherche était d'examiner la faisabilité du programme *ThinkTactic VR* auprès d'une population vivant avec un trouble psychotique. En concordance avec l'hypothèse, les résultats en lien avec le taux d'attrition et le niveau de cybermalaise vécu montrent que *ThinkTactic VR* est faisable pour ce type de population.

La participation à l'étude a un taux d'attrition global de 17,64% (22,22% dans le groupe contrôle et 12,5% dans le groupe *ThinkTactic VR*), ce qui est comparable à d'autres études utilisant la thérapie de remédiation cognitive avec des personnes souffrant de troubles psychotiques. Dans une méta-analyse, les auteurs ont rapporté un taux d'abandon global de 16,52% dans les études de remédiation cognitive auprès de ce type de population (Vita et al., 2023). Ils ont également rapporté que les études incluant à la fois des patients hospitalisés et des patients externes avaient un taux d'abandon significativement plus élevé comparativement aux études incluant seulement des patients hospitalisés (Vita et al. 2023). En effet, les études incluant seulement les patients hospitalisés ont un cadre plus favorable à la participation vu la proximité de l'emplacement de l'intervention (Villeneuve et al. 2010). Considérant que les essais cliniques incluant seulement des patients hospitalisés ont une participation plus élevée, le fait d'avoir un taux d'abandon équivalent à ce type d'étude, tout en incluant des patients externes, indique que *ThinkTactic VR* est faisable pour les participants.

La plupart des études cliniques de remédiation cognitive en réalité virtuelle auprès de cette population indiquent aussi un haut taux de participation variant entre 69% et 89% (Park et al., 2019; Komemi et al., 2024; Adery et al., 2018; Rus-Calafell et al., 2014; Vass et al., 2022).

ThinkTactic VR se situe dans cet intervalle avec un taux de participation de 83%, indiquant encore une fois une bonne faisabilité. Il est possible que la flexibilité des membres de l'équipe quant à la planification des visites des participants et que le remboursement des frais de stationnement et d'autobus aient influencé la participation des individus. Par ailleurs, la fréquence des interventions offertes aux participants, soit de deux fois par semaines sur une période de six semaines, peut être un facteur favorable à la participation des individus à notre essai clinique. Une étude rapporte que plus le nombre de séances augmente et est demandant pour les participants, plus le taux d'abandon est élevé (Szymczynska et al. 2017). Le nombre de séances moyen en remédiation cognitive est de 15,82 pour ce type de population, ce qui place notre intervention très près de ce qui est normalement proposé (Vita et al., 2023). Ainsi, les modalités d'administration de l'intervention sont adéquates et optimales pour favoriser une bonne faisabilité de *ThinkTactik VR.*

Sur l'ensemble des participants appelés pour participer à l'étude actuelle, 52% ont accepté de prendre part à cet essai clinique. La majorité des personnes contactées n'ayant pas participé à l'étude l'ont fait en raison du temps important à devoir consacrer à l'étude ou parce qu'elles ne correspondaient pas aux critères d'éligibilité. La participation des individus vivant avec un trouble psychotique à des études cliniques est plus complexe en raison de l'influence de multiples facteurs (Zullino et al., 2003). Comparativement aux autres populations cliniques participant aux études, ces individus indiquent moins vouloir « aider à l'avancement de la science » et sont moins convaincus qu'ils peuvent bénéficier de l'intervention proposée (Zullino et al., 2003). Les auteurs rapportent que le refus de participation aux études à double-aveugle et à ceux qui impliquent plusieurs séances d'entrevue est fréquent chez ce type de population (Zullino et al., 2003). Le taux de participation de 52% peut ainsi être expliqué par cette tendance générale chez cette population à être moins impliqué dans les recherches.

Il est possible que les multiples critères d'exclusion mis en place afin de contrôler les variables ayant un impact sur l'efficacité de la remédiation cognitive aient contribué à la difficulté de recrutement et à l'inclusion de peu de participants. Par exemple, la présence d'un trouble de consommation de substance chez un participant l'exclut automatiquement de l'étude vu les impacts importants de la consommation sur les fonctions cognitives (Juarez-Portilla et al., 2018). Toutefois, une grande proportion d'individus vivant avec un trouble psychotique, soit 41,7% de ceux-ci, vivent avec un trouble de l'usage d'une substance (Hunt et al., 2018). Cette exclusion, toutefois nécessaire, limite un nombre important de participants pouvant être inclus dans l'étude.

Le taux de complétion des devoirs assignés aux participants dans *ThinkTactic VR* (45%) est significativement plus bas que le taux de complétion dans le groupe contrôle (66,7%), ce qui soulève une certaine difficulté à compléter adéquatement l'ensemble des devoirs assignés par le thérapeute. Une étude antérieure a rapporté un taux de complétion de devoirs de la part des participants de 89,36% (Medalia et al., 2021). Il est possible que ce haut de taux de complétion dans cette étude soit influencé par l'accompagnement serré et les rappels fréquents de la part des cliniciens pour l'exécution des devoirs (Medalia et al., 2021). Les difficultés mnésiques chez la plupart des individus vivant avec un trouble psychotique, combiné avec l'absence de rappel et de feuille de suivi pour noter les devoirs à effectuer, peuvent expliquer les oublis des devoirs et le taux de complétion plus bas (Guo et al., 2019). Les devoirs assignés dans la condition *ThinkTactik VR* contiennent davantage des exercices cognitifs comparativement à la condition contrôle qui possèdent davantage des exercices comportementaux. La complexité plus élevée des devoirs dans *ThinkTactic VR* pourrait expliquer que ces participants aient accompli une plus faible proportion de devoirs que ceux dans la condition contrôle (Dobson & Dobson, 2009).

Dans l'ensemble, les participants ont ressenti un faible niveau de cybermalaise dans les deux groupes. Un seul participant a échoué à l'essai de réalité virtuelle, car il présentait trop de symptômes pour bénéficier de l'intervention avec ce type de technologie. De manière générale, les courtes périodes d'exposition à la réalité virtuelle entrecoupées de pauses de quelques minutes peuvent avoir contribué à une meilleure expérience chez les participants dans le contexte de la réalité virtuelle et peuvent expliquer le faible taux de cybermalaise (Lawson et al., 2021). Ces résultats sont en accord avec d'autres études où la présence de symptômes de cybermalaise était également faible, ce qui indique que cette technologie semble être adaptée pour ce type d'intervention auprès de ces individus (Bisso et al., 2020).

3.2. Acceptabilité du programme

Le deuxième objectif de recherche était d'examiner l'acceptabilité de *ThinkTactic VR* auprès de la population vivant avec un trouble psychotique. Les résultats aux questionnaires d'acceptabilité, d'adhérence et de satisfaction révèlent que l'ensemble des participants considèrent l'intervention comme étant largement acceptable, ce qui corrobore avec l'hypothèse émise. Les participants pourraient adhérer à ce type d'intervention puisqu'ils n'ont pas trouvé le programme intrusif, exténuant et que la plupart ne préféraient pas essayer un autre programme pour les aider.

L'acceptabilité du programme de réalité virtuelle a été confirmée par un taux de satisfaction élevé au questionnaire *Satisfaction with CRT*. La majorité des participants ont apprécié leur participation au programme en donnant de très bons commentaires et en rapportant avoir eu de haut niveau de plaisir à effectuer le programme. Ces résultats concordent avec l'étude de validation de concept de Bogie et al. (2023) où l'ensemble des participants ont également rapporté apprécier la remédiation cognitive en réalité virtuelle. Les résultats vont également dans

le même sens de l'ensemble des études sur les programmes de remédiation cognitive en réalité virtuelle où les participants rapportent toujours une grande satisfaction (Adery et al., 2018; Nijman et al., 2020; Shen et al., 2022). La satisfaction élevée face à *ThinkTactic VR* peut être expliqué par le fait que ce programme est présenté sous la forme d'un jeu (p. ex. présence de différents niveaux à accomplir, de tâches à réussir pour progresser dans les niveaux, l'assignation d'un avatar pour accomplir les tâches, similarité avec un jeu vidéo, etc) (Lumsden et al., 2016). L'administration des tâches cognitives sous forme de jeu auprès des individus vivant avec différents troubles psychotiques, tel que la schizophrénie, permet un meilleur engagement des participants dans les programmes cognitifs, puisqu'ils permettent d'augmenter le plaisir vécu, la motivation et la présence aux séances (Lumsden et al., 2016). Cette formule de remédiation cognitive permet ainsi aux participants d'avoir un haut niveau de satisfaction envers *ThinkTactic VR.*

La majorité des participants avaient également une alliance de travail élevée avec le thérapeute, avec un score élevé au questionnaire WAI-S. La forte alliance thérapeutique entre le participant et le thérapeute a pu contribuer à l'adhésion au programme, comme l'indiquent Browne et al (2021), qui affirment qu'une bonne alliance permet aux participants d'avoir un meilleur engagement dans le traitement. Dans le même sens, Huddy et al (2012) rapportent qu'une bonne alliance thérapeutique permet d'augmenter la satisfaction au programme cognitif reçu des individus ayant un trouble psychotique. Les participants ont déclaré se sentir soutenus par le thérapeute et que les actions entrepris les aidaient à atteindre les objectifs qu'ils s'étaient fixés. L'accord entre les participants et le thérapeute sur les tâches à accomplir pour parvenir à leur objectif a pu encourager les participants à se mobiliser dans la prise en charge de leur santé mentale, ce qui appuie le fort engagement observé dans *ThinkTactic VR* (Allen et al., 2017).

3.3. Efficacité initiale

Cet essai doctoral est une étude pilote qui a pour but de déterminer les effets préliminaires de *ThinkTactic VR* sur les fonctions cognitives auprès de la population vivant avec un trouble psychotique. Cette étude visait à vérifier les tendances générales observables sur différentes variables. L'interprétation se fait ainsi principalement sur des tailles d'effets et lorsque l'échantillon sera complété, les interprétations se feront davantage sur les résultats significatifs. Des conclusions définitives pourront être dressées sur les résultats non-significatifs seulement une fois l'étude globale complétée.

Fonctionnement quotidien

Alors que les objectifs thérapeutiques pour les individus vivant avec un trouble psychotique se tournent de plus en plus vers une amélioration du fonctionnement quotidien afin d'assurer une meilleure qualité de vie, les résultats de la prochaine section ont d'importantes retombées cliniques (Dziwota et al., 2018). En effet, les résultats concernant l'amélioration des scores aux instruments mesurant le fonctionnement global corroborent encore une fois l'hypothèse émise. Après 12 séances d'intervention en réalité virtuelle, les individus dans *ThinkTactic VR* ont des résultats significativement plus élevés dans les instruments mesurant le fonctionnement global que ceux dans le groupe contrôle. Les tailles d'effets modérés à élevées indiquent que *ThinkTactic VR* semble avoir un impact important sur le fonctionnement quotidien des individus. Les études précédentes montrent que certains programmes permettent une amélioration au niveau du fonctionnement quotidien, social ou lié à l'emploi (Amado et al., 2016; Rus-Calfell et al., ; Park et al., ; Smith et al., 2015; Sohn et al., 2016). Les résultats de la présente étude ajoutent des évidences sur l'efficacité de la remédiation cognitive en réalité virtuelle sur le fonctionnement quotidien, l'indépendance, la productivité et le fonctionnement psychosocial. Les

tailles d'effet observées dans cet essai clinique en réalité virtuelle sont largement supérieures à ce qui est observé dans les études de remédiation cognitive non-immersive, ce qui souligne l'efficacité importante du programme pour le fonctionnement quotidien (Vita et al., 2021; Lejeune et al., 2021). L'intégration d'un thérapeute assistant le participant dans la réalité virtuelle et lui enseignant des stratégies cognitives à appliquer dans la vie de tous les jours peut aussi contribuer à une meilleure amélioration du fonctionnement quotidien (Vita et al., 2021; Kambeitz-Ilankovic et al., 2019). Les résultats de cette étude appuient les données précédentes montrant que la combinaison de la remédiation cognitive, d'exercices sociaux et de psychoéducation permet une amélioration du fonctionnement (Lu et al. 2022).

L'utilisation de la technologie de la réalité virtuelle permet d'exposer les participants à différents environnements de la vie quotidienne de manière immersive et multisensorielle (Cooper et al., 2021). Ils sont invités à pratiquer des habiletés dans des contextes rencontrés dans la vie de tous les jours, ce qui favorise un transfert des acquis dans leur vie personnelle (Sekhon et al., 2017). Les différents contextes écologiques permettent aussi de provoquer des réponses authentiques qui sont plus susceptibles d'être transférées dans la vie de tous les jours lorsqu'ils apprennent, à l'aide de thérapeute et d'avatar intégré au programme, les manières de réagir (Son and Park, 2022).

Selon le modèle théorique de Wykes et al. (2024), le fonctionnement quotidien peut être amélioré par le biais de divers facteurs dans la remédiation cognitive. Bien que les améliorations observées dans les différents domaines neurocognitifs aient des tailles d'effets faibles, elles ne sont pas sans effet (Wykes et al., 2024). L'accumulation de faibles améliorations dans quelques domaines cognitifs peut avoir des effets cliniques suffisamment importants pouvant contribuer au développement de compétences nécessaires dans la communauté (Wykes et al., 2024). En effet, ces faibles améliorations peuvent faciliter la réalisation de différentes tâches de la vie quotidienne

chez les participants, ce qui favorise leur autonomie et leur aisance dans le déroulement de leur quotidien (Wykes et al., 2024).

Le modèle théorique de Wykes et Spaulding (2011) indique également que des facteurs non spécifiques, tels que l'alliance avec le thérapeute, peuvent avoir des effets cliniquement significatifs sur le fonctionnement quotidien. Dans cet essai clinique, l'alliance thérapeutique a été mesurée et les résultats montrent une relation thérapeutique élevée. Bien que l'impact de cette alliance sur l'amélioration des domaines cognitifs ne soit pas directement mesuré, celle-ci a le potentiel d'augmenter l'engagement, la motivation et l'utilisation des stratégies apprises (Wykes et al., 2024). L'ensemble de ces facteurs peuvent ainsi soutenir les gains fonctionnels acquis par les participants.

Domaines neurocognitifs

Le troisième objectif de la présente étude était d'explorer l'effet de *ThinkTactic VR* sur différents domaines neuro cognitifs. L'hypothèse émise supposait que les scores aux différents sous-domaines neurocognitifs des individus dans la condition intervention augmenteraient de manière plus importante, comparativement au groupe contrôle, après avoir suivi 12 séances du programme. Des effets faibles à modérés ont été observés dans le changement des scores à la mémoire de travail, des fonctions exécutives et de la cognition globale, et ce, en faveur de *ThinkTactic VR*. Malgré qu'une amélioration est noté avec des tailles d'effets faibles, l'ensemble des effets d'interaction du groupe et de la condition assignée ne sont pas statistiquement significatifs. La taille d'effet demeure toutefois une mesure importante afin de voir l'amplitude des changements observés (Sullivan et al., 2012).

La plupart des études cliniques vérifiant l'efficacité de la remédiation cognitive trouvent des tailles d'effets faibles à modérés pour l'ensemble des domaines cognitifs, montrant ainsi des

évidences en termes d'efficacité sur la cognition chez les individus vivant avec un trouble psychotique (Vita et al., 2021). La cognition globale, la mémoire verbale et les fonctions exécutives sont des domaines couramment améliorés à l'aide de la remédiation cognitive traditionnelle (Vita et al., 2021). Bien qu'efficaces, la plupart de ces interventions ont des résultats limités concernant le transfert des habiletés dans le fonctionnement quotidien (Bowie, 2019). L'incorporation de la réalité virtuelle dans les études récentes est justifiée par un besoin de scénarios réalistes et écologiques pour aider cette population (Freeman et al., 2018). Les études intégrant la réalité virtuelle pour administrer la remédiation cognitive montrent une variabilité dans les résultats obtenus alors que des améliorations dans différents domaines cognitifs sont obtenues (Schroeder et al., 2022). Les résultats d'efficacité initiale de *ThinkTactic VR* sont en concordance avec certaines de ses études, alors que des améliorations sont soulevées pour la mémoire de travail et les fonctions exécutives (Komemi et al., 2024; Wang et al., 2022). Nos résultats semblent toutefois différer d'autres études montrant des améliorations des individus sur les domaines de l'attention (Amado et al., 2016; La Paglia et al., 2013), la mémoire verbale (Amado et al., 2016; Chan et al., 2010) et la vitesse de traitement de l'information (La Paglia et al., 2013; Komemi et al., 2023). Les résultats doivent toutefois être interprétés avec prudence, puisque les études montrant des tailles d'effets importantes et significatives sont des études ne possédant pas de groupe contrôle pour comparer les améliorations. La présente étude montre ainsi la pertinence de comparer les améliorations acquises grâce à l'intervention, à un groupe contrôle, pour contrer les effets de l'interaction avec le thérapeute et de l'exposition à la réalité virtuelle.

Les stratégies cognitives proposées par l'avatar et le thérapeute dans *ThinkTactic VR* visent à orienter leurs applications concrètes dans les tâches de la vie quotidienne. Les stratégies enseignées demandent aux participants de prendre un temps de réflexion afin de bien les

appliquer, pour favoriser une amélioration de leur fonctionnement dans les situations de la vie quotidienne. Les faibles améliorations observées dans les épreuves mesurant la neurocognition peuvent être expliquées par l'utilisation de la batterie de tests CANTAB qui prend en considération la vitesse de l'exécution des tâches des participants pour noter leur performance. Considérant que les stratégies enseignées impliquent de prendre un temps de réflexion pour optimiser la précision de leur performance, le CANTAB, est possiblement un instrument incompatible avec ce qui leur aient appris. Il est ainsi possible que cette mesure n'ait pas évalué leur plein potentiel neurocognitif.

Domaines de la cognition sociale

La troisième hypothèse supposait également que les scores aux différents sous-domaines de la cognition sociale des individus dans la condition intervention augmenteraient de manière plus importante, comparativement au groupe contrôle, après avoir suivi 12 séances du programme. Des effets larges ont été observés dans le changement de résultats aux instruments mesurant la théorie de l'esprit et la régulation des émotions. D'autre part, des effets modérés ont été observés dans le changement des résultats aux instruments mesurant l'attribution du blâme face à des scénarios ambigus et accidentels. Encore une fois, malgré des tailles d'effets importantes, l'ensemble des effets d'interaction du groupe et de la condition assignée ne sont pas statistiquement significatifs. Une tendance vers la significativité est toutefois observée pour l'amélioration de la théorie de l'esprit ($p = 0,10$).

La plupart des programmes de remédiations cognitives semblent voir un effet sur la théorie de l'esprit comme l'indique Kurtz et al. (2016), d'Arma et al (2021) et Vass et al (2020). Les tailles d'effets rapportés dans ces études sont semblables à ceux obtenus dans cet essai clinique. Les résultats de cette recherche appuient les conclusions des études précédentes montrant que les

interventions cognitives et sociales pour la population vivant avec des troubles psychotiques sont efficaces pour améliorer la théorie de l'esprit. Les patients peuvent habituellement améliorer ce domaine de la cognition sociale grâce à l'apprentissage de différentes stratégies leur permettant de diriger leur attention sur l'information pertinente à l'interprétation de la situation (Bazin et al 2010). L'exposition à des situations où les participants doivent interpréter la signification de différentes interactions sociales et développer différentes perspectives permet de solliciter la théorie de l'esprit (Bazin et al 2010). L'intégration de ces stratégies dans *ThinkTactic VR* dans plusieurs modules, combiné à une discussion, avec un thérapeute, axé sur l'implantation de ses stratégies dans la vie quotidienne, a été efficace pour l'amélioration de la théorie de l'esprit chez les participants.

Peu d'étude l'a investigué, mais les résultats de certaines études corroborent avec ceux de cet essai alors que les stratégies de régulation d'émotion s'améliorent à la suite d'entrainement en remédiation cognitive ou d'entrainement social (Lam et al., 2020; Park et al., 2021). La combinaison d'un entrainement neurocognitif et d'habileté sociale permet d'augmenter l'utilisation de stratégies adaptatives afin de mieux réguler ses émotions (Lindenmayer et al., 2013). Les exercices cognitifs ciblant la prise de perspective mènent régulièrement à l'utilisation appropriée de stratégies pour réguler les émotions adéquatement (Hildebrandt et al., 2019).

L'absence d'amélioration en lien avec la reconnaissance des émotions dans le groupe ayant suivi *ThinkTactic VR* corroborent avec certaine étude de remédiation cognitive en réalité virtuelle (Nijman et al., 2022). En effet, aucun effet d'interaction significatif n'a été relevé alors qu'ils comparaient l'effet d'un programme en réalité virtuelle visant à améliorer la cognition sociale chez les individus avec un trouble psychotique. Les avatars dans *ThinkTactic VR* sont des « personnages » ayant été créé de manière informatique où les expressions faciales ne contiennent pas autant de détails que ceux rencontrés chez des humains. L'absence

d'amélioration de la reconnaissance des émotions pourrait s'expliquer par la simplification des visages en réalité virtuelle qui se limitent aux traits principaux, et qui omettent certains des détails. Cette limitation peut ainsi empêcher l'intervention d'être efficace pour ce domaine spécifique de la cognition sociale (Dyck et al., 2010).

3.4. Les principales retombées de l'essai doctoral

Le nouveau programme de remédiation cognitive en réalité virtuelle présentée dans cet essai possède des implications cliniques allant au-delà des résultats présentés ci-dessus. Cet essai peut mettre de l'avant l'impact significatif que la réalité virtuelle peut avoir sur la manière de prendre en charge l'éventail de symptômes vécus par les personnes vivant avec un trouble psychotique.

La documentation actuelle fait état de la gravité des difficultés cognitives vécues par les individus ayant un trouble psychotique et les impacts que ceux-ci ont sur le fonctionnement quotidien de ces personnes (Gebreegziabhere et al., 2022; Harvey et al., 2019). Les antipsychotiques restent le traitement de première ligne pour traiter cette condition de santé mentale, qui visent principalement la réduction des symptômes positifs (Sakurai et al., 2021). Bien que les atteintes cognitives soient parmi les premiers symptômes vécus par les individus, le traitement de ceux-ci est largement négligé dans la prise en charge de la condition (McCleery et al., 2019). Peu de possibilités adaptée et efficace s'offrent pour ce type de population pour traiter les symptômes cognitifs. La présente étude permet ainsi d'apporter de nouveaux résultats empiriques sur l'utilisation de la réalité virtuelle dans un contexte visant à améliorer les fonctions cognitives et le fonctionnement social des individus vivant avec un trouble psychotique. Les résultats obtenus dans cet essai permettent ainsi de combler un manque de données dans ce domaine et offre des preuves préliminaires concernant l'efficacité de la remédiation cognitive en

réalité virtuelle. Les données prometteuses concernant la faisabilité et l'acceptabilité de *ThinkTactic VR* soutiennent la pertinence de continuer l'étude pilote et d'élargir l'échantillon de participants.

Ce projet représente une contribution originale, en développant et en investiguant, pour la première fois, ce nouveau programme de remédiation cognitive en réalité virtuelle (*ThinkTactic VR*). En effet, aucun programme dans ce domaine d'étude n'a été développé en intégrant à la fois les perspectives des utilisateurs vivant avec un trouble psychotique et des professionnels de la santé (Yee et al., 2024). Cette étude pilote se distingue ainsi par sa pertinence, puisque nous obtenons de nouveaux résultats pour une intervention jamais testée qui vise à offrir un traitement pour une condition où peu d'options sont offertes.

Approche pour professionnels

Les preuves initiales sur la faisabilité, l'acceptabilité et l'efficacité potentielle d'un programme de remédiation cognitive en réalité virtuelle proposent une nouvelle alternative aux interventions traditionnelles qui sont actuellement utilisées par les professionnels (papier-crayon, ordinateur). Cette alternative permettrait aux professionnels d'offrir une intervention d'avantage interactive et immersive aux patients qui pourraient avoir une meilleure motivation et un meilleur engagement dans les soins proposés. Les résultats quant à la bonne faisabilité et acceptabilité de *ThinkTactic VR* dans un contexte de recherche permet de croire qu'il pourrait être adopté dans les centres de santé mentale offrant des soins aux personnes vivantes avec un trouble psychotique. Les caractéristiques acceptables de cette intervention en réalité virtuelle pour cette population pourraient donc susciter l'intérêt des professionnels à intégrer cette technologie dans les soins offerts.

Prise en charge des patients

Les résultats montrent également une tendance initiale de l'efficacité sur l'amélioration des domaines neurocognitifs, de cognition sociale et sur le fonctionnement quotidien. Ce programme pourrait ainsi permettre aux individus de mieux fonctionner dans leur quotidien et de vivre de manière indépendante. L'impact fonctionnel des résultats supportant l'efficacité initiale de ce programme est important, puisqu'il montre que ces individus peuvent développer leurs capacités à accomplir des tâches de la vie quotidienne et à s'intégrer à leur milieu de manière plus autonome. Cette indépendance peut ainsi se traduire par un moins grand besoin de mesure de soutien dans le quotidien de ces individus (Crawford et al., 2019).

Retombés pour autres troubles

ThinkTactic VR possède plusieurs retombées cliniques spécifiques pour les individus vivant avec un trouble psychotique. Toutefois, ce programme en réalité virtuelle pourrait inspirer les travaux dans d'autres domaines de santé mentale afin d'intégrer la réalité virtuelle aux traitements de troubles cognitifs et sociaux. En effet, cette étude pourrait servir de modèle pour les soins en santé mentale des individus vivant avec un trouble bipolaire, un trouble dépressif majeur, un trouble du spectre de l'autisme, un trouble du déficit de l'attention et d'hyperactivité alors qu'ils sont tous caractérisés par des déficits cognitifs et/ou sociaux (Trivedi et al., 2006).

3.5. Forces de l'étude

L'essai doctoral présenté comporte plusieurs forces à souligner. Il s'agit d'une étude innovatrice où la plus récente technologie est utilisée afin de pallier les difficultés importantes vécues par des individus psychotiques. Il s'agit d'un nouveau programme qui est étudié pour la première fois et qui cible des améliorations à la fois au niveau de la neuro cognition et de la cognition sociale, ce qui n'a jamais été fait auparavant en réalité virtuelle chez cette population. Le devis de recherche expérimentale et longitudinale constitue une force méthodologique de l'étude,

puisque les participants ont été assignés aléatoirement aux groupes d'intervention et de contrôle, ce qui réduit les biais de sélection et garantit que les groupes sont comparables au départ. La présence d'une séquence temporelle permet également de bien mesurer l'influence de variable indépendante (la condition assignée et le temps de mesure) sur les variables dépendantes (les mesures des domaines cognitifs). Le choix du groupe contrôle impliquant également une exposition en réalité virtuelle constitue une force, puisque, de cette manière, il est possible de contrôler les effets de l'interaction avec le thérapeute et les effets de l'exposition à la réalité virtuelle sur les fonctions cognitives.

3.6. Limites et recherches futures

Certaines limites doivent toutefois être considérées dans l'interprétation et la généralisation des résultats obtenus dans cette étude. Tout d'abord, considérant la basse prévalence des troubles psychotiques dans la population et le faible taux d'engagement de ces individus dans les traitements, le recrutement a connu des difficultés. Bien que la taille de l'échantillon recrutée soit suffisante pour un essai doctoral et obtenir des tailles d'effet, il est nécessaire de relever que celle-ci n'est pas optimale pour la comparaison des groupes pour évaluer l'efficacité du programme de remédiation cognitive. Les résultats ne peuvent donc pas encore être généralisés à l'ensemble de cette population clinique, vu le manque de puissance statistique. La continuité de l'étude dans le laboratoire permettra d'obtenir une taille d'échantillon complète afin de poursuivre l'étude pilote entamée. Il est aussi possible de penser que les multiples critères d'exclusion dans la sélection des participants font en sorte que l'échantillon recueilli dans cette étude n'est pas nécessairement représentatif de la population touchée par un trouble psychotique.

De plus, l'utilisation de tâche à l'ordinateur ou de questionnaires pour évaluer les différents domaines neurocognitifs et de cognition sociale limite la validité écologique des résultats. En effet, malgré une bonne validité interne des instruments de mesure sélectionnés pour évaluer les différents domaines cognitifs, ils ne permettent pas une évaluation de la représentativité de ces domaines dans la vie de tous les jours. Il est donc difficile d'affirmer avec certitude que l'évaluation des fonctions cognitives est représentative du fonctionnement réel dans la vie quotidienne des participants. Les études futures pourraient utiliser une mesure cognitive en réalité virtuelle afin d'évaluer les fonctions cognitives dans des situations de la vie quotidienne. Par exemple, la mesure *The Cognition Assessment in Virtual Reality* (CAVIR) permet d'évaluer les domaines neurocognitifs dans des situations de la vie quotidienne, représentant ainsi une mesure écologique (Miskowiak et al., 2022). Dans le même sens, une mesure du fonctionnement quotidien pourrait également être intégrée en réalité virtuelle afin d'optimiser la validité écologique. La mesure The Virtual Reality Functional Capacity Assessment Tool (VRFCAT) est un instrument de mesure validée auprès d'une population ayant un trouble psychotique qui permet de démontrer les habiletés de fonctionnement dans le monde réel en utilisant différents scénarios en réalité virtuelle (Keefe et al., 2016).

Additionnellement, puisque cette étude évalue l'efficacité initiale de *ThinkTactic VR*, les environnements en réalité virtuelle étaient mis à l'épreuve pour la première fois. Il est donc arrivé à quelques reprises que des problèmes techniques soient survenus lors de l'administration de l'intervention auprès des participants. Ces difficultés technologiques ont parfois interrompu les sessions de réalité virtuelle auprès des participants, ce qui fait en sorte que certaines sessions ont été plus courtes que prévu. Il est possible que le temps d'exposition plus court et interrompu par des problèmes techniques ait impacté l'efficacité du programme. Les problèmes techniques

survenus lors de cette étude pilote ont été compilés et serviront à améliorer la prochaine version de *ThinkTactik VR.*

Les essais cliniques concernant l'application d'un programme de remédiation cognitive en réalité virtuelle auprès d'une population vivant avec des troubles psychotiques se font encore très rares. Cette étude a toutefois permis d'obtenir de premiers résultats intéressants et encourageants. Dans cet essai clinique, le groupe contrôle était invité à participer à des jeux commerciaux en réalité virtuelle afin de contrôler l'effet de la réalité virtuelle et l'interaction avec un thérapeute sur les participants. Il serait toutefois intéressant, dans les études futures, de comparer le groupe recevant *ThinkTactic VR* à un groupe recevant un programme de remédiation cognitive traditionnel. Ce type d'étude permettrait de voir si la réalité virtuelle permet un plus grand engagement et de plus grands effets sur les domaines cognitifs et le fonctionnement quotidien comparativement à ce qui est traditionnellement administré. Cette comparaison permettrait ainsi de mieux connaitre les mécanismes d'action derrière l'amélioration des fonctions cognitives.

De plus, certaines études montrent que les effets de la remédiation cognitive peuvent survenir plus tard après l'intervention (Best et al., 2019). Il s'avère ainsi pertinent d'évaluer les gains cognitifs et fonctionnels plusieurs mois suivant l'intervention. Une étude parallèle, présentement en cours, examine les effets à long terme des gains obtenus à la suite de ThinkTatic VR (3 mois post intervention) afin de détecter tout effet cognitif tardif.

Le programme *ThinkTactic VR* pourrait également avoir quelques améliorations afin d'optimiser son efficacité lors de prochaines études futures. En prenant compte des commentaires des participants ayant participé à *ThinkTactic VR,* il serait pertinent d'ajouter des étapes plus difficiles dans certains environnements virtuels pour s'assurer que chaque individu participant à ce programme se retrouve dans une zone optimisant l'apprentissage. En effet, selon la théorie de Browne et al., (2021), les tâches effectuées par les participants doivent représenter un défi

modéré afin d'obtenir un engagement actif de leur part et qu'ils puissent apprendre en obtenant le soutien de la thérapeute les accompagnant. L'intégration de tâches plus difficiles pourrait ainsi potentiellement permettre de meilleures améliorations au niveau cognitif. Par ailleurs, des ajustements au programme pourrait être faits afin d'améliorer le taux de complétion de devoirs assignée dans *ThinkTactic VR.* Le thérapeute assistant les participants aux séances de réalité virtuelle pourrait leur remettre une note avec le devoir inscrit dessus afin que le participant ait un rappel avec lui des tâches à effectuer à la maison. Une étude ayant intégré cette technique a eu un plus haut de complétion de devoir, ce qui pourrait potentiellement améliorer les résultats obtenus dans notre étude (Medalia et al., 2021).

CHAPITRE IV - CONCLUSION

4.1. Conclusion

Les troubles psychotiques sont une condition de santé mentale impliquant des difficultés concernant les différents domaines de la neurocognition et de la cognition sociale, impactant directement le fonctionnement quotidien. Peu de traitement soutenant les fonctions cognitives sont offertes à ce type de population. La présente étude visait à investiguer la faisabilité, l'acceptabilité et l'efficacité préliminaire d'un programme de remédiation cognitive en réalité virtuelle auprès d'une population vivant avec un trouble psychotique. Cet essai clinique a d'abord montré que *ThinkTactic VR* semble être une intervention faisable et acceptable pour les individus vivant avec un trouble psychotique. L'essai clinique supporte que *ThinkTactic VR* permet d'améliorer le fonctionnement quotidien de ces individus. Les résultats préliminaires suggèrent également que cette intervention tend à améliorer la théorie de l'esprit. Les conclusions concernant l'efficacité du programme sur les fonctions cognitives seront clarifiées une fois la collecte de donnée de l'étude globale finalisée

Bien que l'étude globale soit encore en cours, les résultats prometteurs de cette recherche appuient la pertinence et la nécessité de poursuivre l'étude. Un échantillon plus important permettra d'évaluer l'efficacité de ce programme. Dans un contexte où les fonctions cognitives sont peu prises en charge chez cette population malgré les impacts importants sur leur vie quotidienne, le développement d'intervention efficace est d'une nécessité primordiale.
Cette recherche permet ainsi de contribuer efficacement à l'avancée des traitements possibles et au développement d'intervention cognitive afin de favoriser un meilleur fonctionnement quotidien et une meilleure satisfaction de vie chez les individus vivant avec un trouble psychotique.

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ANNEXE A: Supplementary Materials

Supplementary Methods I - Research Assistant Intervention Manual

Cognitive Remediation in Virtual Reality Study
Research Assistant Intervention Manual

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GENERAL RECOMMENDATIONS

Overview

This manual provides an overview of how to deliver the virtual reality cognitive remediation program. The manual also includes content that was created for two cognitive remediation clinical trials led by Dr. Synthia Guimond: Cognitive Rehabilitation in Schizophrenia and Depression and Cognitive Remediation in Forensic Mental Health Care.

Across the two conditions, training sessions comprise an initial check-in followed by the administration of computerized exercises and, lastly, strategy coaching and bridging, with reference to the exercises just completed. Below are some suggestions on how to interact with participants through each phase of each session.

Check-in

- Ask the participant to confirm their continued consent to participating, and that they are not at risk of harming themselves or others. Report the continued consent in the participant's study record (checklist form) on REDCap.
    - If the participant is feeling mildly unwell (e.g., a common headache), offer them the possibility to reschedule the session and encourage them to follow up with someone in their circle of care.
- If a participant chooses to continue with the session, remind the participant that they can take as many breaks as they wish and that they may end the session early (if necessary) without penalty. Continue to monitor the participant and prompt them with a break, as needed.
    - If the participant is feeling severely unwell or are at risk of harming themselves or others, contact switchboard to page the on-call physician or call 9-1-1. If participants are at risk of harming themselves or others upon completion of the session, follow the same protocol and make sure to complete a serious adverse event (SAE) form for the REB.
- Ask the participant whether he has any questions concerning the scope or study procedures.
- Begin by explaining the structure of the session (only a brief reminder from the second session onward) - an example script is provided in session #1.

Reflect on Homework (from session 2 onwards)

- Ask participants about the homework for the past week. Specifically, invite them to reflect on whether and how they were able to use any of the strategies learned in the previous session(s), whether they found those strategies helpful, whether they believe that the exercises helped them improve in a specific life domain.
    - For example, consider asking how the activity went, if they completed it, which exercises they completed, how often, for how long, on which days, how they felt about them, whether they had a positive outcome in their day, whether they found them helpful in general as well as during a challenging situation.
- If the participant was not able or forgot to do the homework, ask them if there were any reasons for this, or to reflect on why it may have slipped their mind.

    - For the next homework, ask them if there is anything that they can do to boost their likelihood of being able to/remembering to do the homework for that week (i.e., setting a specific time to do the homework, asking someone to remind them, writing it down, etc.).
- Record homework compliance in the participant's study record on REDCap.

During the Exercises

- The participant will complete different exercises in virtual reality (VR) each session. The participant will complete 15 minutes of VR before taking a break for 5 minutes before continuing for another 15 minutes of VR. Afterwards, the participant and study staff transition to a 10 to 15 minutes bridging conversation.
- At the beginning of the session, explain to the participant how to use the VR (headset and controllers) slowly.
    - Make sure that they are comfortable with the VR equipment prior to starting the VR session.
- Instruct participants that they will start at level 1 or where they left off during a previous session when they practice the same level. The scope is to obtain a good balance between cognitive challenge and positive reinforcement, to keep participants engaged and avoiding that they get discouraged.
- Time participant once they start the exercise (each VR block is about 15 minutes).
    - Encourage participants as they complete the exercise.
- Pause about 5 minutes into the exercise (make sure to let them finish the interaction they are having) to briefly discuss the participant's initial thoughts and/or any strategies they may be using.
    - If participants are unable to name any strategies that they have used or could start using, provide them with a strategy offered in the manual or in the training program itself (there are some strategies that are only introduced in the program). Inform participants that the exercises can be difficult, and it is normal not to score 100%. Remind them that they are learning new skills and, therefore, making mistakes is part of the process!
- If the participant has trouble in a level, do not skip to the other level. You should redo the same level until the participant succeeds in the different tasks.
    - After 3 failed attempts in VR (i.e., the participant does not successfully complete a level), intervene and offer the participant a break. During the break, ask the participant how they are finding the training program, provide validation, and review the strategies they were using. Based on their response, modify the strategies they were using or propose a new strategy before asking the participant if they would like to try the VR level again.

Following the Exercises

- Engage in a brief conversation on the exercise that participants have just completed. Ask participants their thoughts or questions concerning the exercise and the skills they used to complete it. For example: How did you find the exercise? What did you enjoy? What did you find challenging? What were some strategies that you used to succeed in the task? Are there any other strategies you could have used?
- Recap what participants have mentioned 5 minutes into the exercise.

- If the participant needed guidance to complete the exercise, discuss specifically about the strategies that you have helped them to come up with.

Strategy Coaching and Bridging

- This discussion should take about 10-15 minutes. Using simple language, introduce the topic, the strategies, their importance, and relate them to real-life situations.
- Ask participants to contribute, e.g., by coming up with examples of how they use, or how they could use, a certain strategy in their daily life, and formulate the discussion based on the content brought up by the participant (e.g., ask them questions about it, and build upon it).
    - Keep the conversation flowing based on the information they provide you with. Allow participants to speak openly and remind them to take notes.
- Normalize challenging aspects of tasks or activities, examples could include: “everybody finds it difficult to keep in mind multiple things while completing a task, but we can improve with practice.”
- Avoid directing, providing solutions, or telling participants what they "should do" (unhelpful), and do not warn, blame, ridicule, or label (unacceptable).

End of Session

- Remind participants about the topics covered and things they have learned. Ask participants whether there are topics that have particularly interested them, what they are going to remember most from your time together, and whether they have any questions or feedback.
    - Collaborate with the participant in determining their homework for the next session and tailoring it to the participant themself.
- Remind participants that you will discuss the homework during their next session. If they frequently have difficulty completing the homework, ask them how they plan to get this week’s homework done.
- Make sure to take a positive approach during discussions so participants feel encouraged to do their homework and want to come back for the next session.

SESSION 1 - RESTAURANT MODULE

1. Introduction

- "Hi, my name is _____. Thank you for being a part of this study. I will be your coach for the next 12 sessions."
- "All of our sessions are set up in the same way. In the sessions, we will be using a VR program that feature day-to-day tasks that will train your thinking and social skills."
- "You will first start with 15 minutes of VR before taking a break for 5 to 10 minutes. During this break, you can grab a drink of water, go to the washroom, stretch, etc. We will also briefly chat about how you are finding the VR program and the strategies you are using before continuing for another 15 minutes of VR. In total, you will spend around 30 minutes using the VR program. The second part of the session involves a 10 to15-minute chat about the strategies you used in the VR program, and how to apply them to your day-to-day life."
- "If at any point you feel uncomfortable, please let me know. Your comfort is our priority."

2. Introduce the Module

- "For the next two sessions, you will be immersed in a VR environment called the restaurant module. In this module, you will act as a server in a restaurant. You will be asked to remember the food orders from different tables. There are 4 levels in the module, and each level features one table each."
- "After hearing the food order from the table, you need to walk back to the cashier and repeat out loud the food order."
- "The second part of today's session is that we will have a conversation on memory."
- "Any questions? Are you ready to begin?"

3. Middle Break Conversation

- "You have completed the first few levels for today. Great job!"
- "Now that you have completed about half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"
    - "What did you learn from them?"
    - "What were some strategies that you used to succeed in the task?"

4. Discussion with the participant: Strategies to improve verbal memory

- "Great job today! How did you find the restaurant module?"
- "All the tasks that you encounter in the program are designed to train your thinking and social skills in common daily life scenarios."
- "What does memory mean to you?"
    - *If a response is provided:* "That is a good point. What made you think of this?"
    - *If there is difficulty providing a response:* "When we talk about memory, we are talking about storing a piece of information in our mind and how we use this information later on."

- "We use our memory in many different situations, like remembering a shopping list or remembering someone's name. What other situations do you use your memory?"
    - *Allow active exploration.*
- "When we try to learn information, we are trying to 'encode' it. Encoding is a process where information from our senses and environment is changed into a form that can be stored in our mind."
- "Depending on the strategy we use for encoding, we can improve or even worsen our memory.
- "How do you find your ability to memorize information?"
    - *Provide normalization and empathy.*
- "There are many different memory strategies we can use, and in this training program, we will cover some of the common ones. The memory strategies someone will use really depends on what they like and the situation. Our goal is to introduce different memory strategies, so that when you encounter a situation where you have difficulty remembering something or need to remember something, there are many strategies you can use."
- "In the restaurant module, you had to remember different food orders. What did you do to help remember?"
    - *If a response is provided:* "That is a good strategy! Is this a strategy you use often?"
        - "What other strategies can you use to help remember the food order?"
            - *Examples include verbalization, repetition, chunking, visualization.*
    - *If there is difficulty providing a response:* "A big part of the training program involves learning different memory strategies, you can use! For example, grouping food together based on a similar aspect can help you remember things more easily."
- "When I reorganized my drawers in my room, I like grouping my clothes together based on their type, like shirts and pants. Do you find yourself using the grouping strategy in your day-to-day life?"
- "What other strategies have you learned today that you can use in your day-to-day life to help remember a piece of information? In which situation will you use it?"
    - *If a response is provided:* "That's a good strategy!"
    - *If there is difficulty providing a response:* "It can be difficult to think about what memory strategies you use on the spot, especially since this is our first session together. Maybe this is something we can think about for the at-home activity today."

5. At-Home Activity

- "This has been a great session! At the end of each session, we will come up with an at-home activity together for you to practice on your own before we see each other again. The purpose of the at-home activity is to help transfer the knowledge and strategies you worked on in the sessions to your day-to-day life."
- "What is one at-home activity that you can do to practice your memory strategies?"
    - *Suggested activities:*
        - *Think about what activities require memory.*
        - *Reflect on the strategies they use in their daily life to remember information.*

        - *If there is difficulty providing a response: "When you need to remember a telephone number or items on your grocery list, it presents a great opportunity to practice and improve your memory skills. Using strategies such as repetition or chunking can be helpful when attempting to remember information, much like the techniques you employ while learning in VR."*
- "In our next session, we will build on today's topic by discussing more in detail the specific type of memory strategy called chunking or grouping items together."
- "Do you have any questions about today's session or about your at-home activity?"

SESSION 2 - RESTAURANT MODULE

1. Reflect on At-Home Activity

- "Welcome back! How are you doing today?"
- "Let us start off today by discussing your at-home activity. How did it go?"
    - *If the participant did not complete the at-home activity:* "Can you think of some situations over the past week where you had to use your memory?"

2. Introduce the Module

- "For today's session, you will be using the restaurant module again. This module is a real-world simulation where you will be a server in a restaurant. In this restaurant, you must remember different table's food orders, and then repeat the order out loud to the cashier."
- "Just like last session, we will start with 15 minutes of VR, followed by a 5-minute break where I will check in with you and briefly chat about strategies you were using. Then, we will continue for another 15 minutes of VR before moving to our conversation today about a memory strategy called chunking."
- "Do you have any questions before we begin?"

3. Middle Break Conversation

- "We are halfway through the VR exercises for today. How are you finding it so far?"
- "What strategies did you use to help you remember different table's food order so far?"
    - *Regardless of response:* "One strategy that can be helpful is to group information by categories. When you need to recall the food's order, you can mentally go through each group that you made and remember the items within it more easily."
- "What did you find difficult?"
    - "What did you learn from them?"
    - "What were some strategies that you used to succeed in the task?"

4. Discussion with the Participant: Chunking

- "Great job completing all the exercises today! How did you find it?"
- "We talked about memory last time already, and today I would like to expand on the different strategies to help remember a piece of information."
- "In the VR program, you had to remember different food orders. What strategies did you use to help?"

    - *If a response is given:* "Great example! Did you find it was helpful all the time, most of the time, or only some of the time?"
- "For today, we will be talking about **grouping items together**. How would you explain the strategy of grouping items together to someone?"
    - *If there is difficulty providing a response:* "Grouping is where we take a larger piece of information and break it down into smaller chunks."
    - *If a response is given: Elaborate on the explanation.*
- "One example of chunking is when someone is trying to remember a phone number. When trying to remember a series of numbers, we can use this chunking strategy to create smaller groups of 3 to 7 digits. How can we chunk this number: 613-722-6521?"
    - *If a response is given: "*Great job!"
    - *If there is difficulty providing a response:* "Using the grouping strategy takes practice but becomes easier over time. Like the other new things you try, it is initially a bit harder, but over time it becomes easier. This is a training program where we aim to learn different memory strategies that you can apply to your day-to-day life rather than 'winning' the program."
        - "The number we are trying to remember, 613-722-6521, is 10 digits long, and we want to break it down into smaller chunks of 3 to 7 numbers. One chunk we can create is the area code, 613. What other chunks can you create with the rest of the numbers?"
            - *If a response is given:* "Exactly, great job!"
- "Can you think of another example of grouping?"
    - *Allow active exploration.*
- "One type of chunking is where someone **groups items together based on a similarity**. This involves grouping items together based on a similarity. That way, when we think about the name of the category, we are more likely to remember the items grouped together."
- "Can you think of a time where you used grouping in the VR program?"
    - *If a response is given:* "Great example!"
    - *If difficulty providing a response:* "One example of grouping similar items together is when trying to remember the food orders of each table. We can group food together based on their category, like drinks, starters, and desserts."
- "I am going to say out loud a list of food items - how would you chunk them? Items: ham and cheese sandwich, a soup of the day, tomato juice, chicken noodle soup, an egg sandwich, and a can of coke."
    - *Answer:* starter (soup of the day, chicken noodle soup), main (ham and cheese sandwich and egg sandwich), and drink (tomato juice and coke).
    - *Reframe the groups based on participant's answer; for example, they may give a "sandwich" category. Study staff can reply that smaller chunks can be used to create a bigger chunk, like a main course.*
- "These strategies that you use in the VR program can also be applied to day-to-day life. For example, how can you use grouping when buying groceries?"

    - *If a response is given:* "That is a great way we can use chunking when grocery shopping."
    - *If difficulty providing a response:* "Say that you are grocery shopping, and you have a long list of items to buy. You can use the grouping strategy so that you buy all your fruits and vegetables at one time, then your meat products, and finally your dairy. That way, you reduce the amount of time spent walking around the store!"
- "What other areas of your life can you apply the chunking strategy?"
    - *Allow active exploration.*
    - *Examples include: daily medication tracking, phone numbers, organizing what items they need before leaving for the day, etc. Give the participant prompts to elaborate on the answer.*
- "Why do you think chunking is helpful?"
    - *Regardless of response:* "Sometimes when remembering a lot of information, it can be difficult to remember every single item. When you use the grouping strategy, you can make smaller chunks of items together. It can be easier to remember a series of smaller chunks rather than one large piece!"

5. At-Home Activity.

- "Good job on the VR exercises today, and I enjoyed our conversation about chunking. Taking what we discussed today, what is an at-home activity that involves using the chunking strategy before our next session?"
    - *Suggested activity: to use the chunking strategy 2-3 times, and to see if it helped the participant remember the info.*
- "Do you have any questions about today's session or about your at-home activity?"

SESSION 3 - APARTMENT

1. Reflect on At-Home Activity

- "Welcome back! Before beginning for today, I want to make sure that you still consent to participate in the study?"
- "How did your at-home activity from last session go?"
    - "Did you find some situations where you could use the chunking strategy? In which ones?"
    - "Did you find that chunking strategy helped you? In what way?"

2. Introduce the Module

- "During this session, you will use a new VR environment, the apartment module! The apartment module takes place in a home setting and includes tasks like reheating food in the microwave."
- "We will start with 15 minutes of VR, followed by a 5-minute break. At the 5-minute break, we will briefly chat about how you are finding the apartment module and then continue for another 15 minutes of VR."

- "The second part of today's session is a 10 to 15-minute discussion about emotion regulation."
- "Do you have any questions before we begin?"

3. Middle Break Conversation

- "You have completed the first few levels for today. Great job!"
- "What is your first impression of the apartment module? Are there any module aspects that you like or dislike?"
- "What did you find difficult?"
    - "What did you learn from them?"
    - "What were some strategies that you used to succeed in the task?"

4. Discussion: Emotion Regulation

- "You have finished the last level for today. Great job!"
- "How did you find the apartment module? Were there any tasks that you found more difficult?"
    - *Provide validation if the participant experienced any difficulty on a task.*
- "You may be wondering how these exercises relate to your daily life; the abilities you have used in these exercises are abilities that you use in your daily life. Sometimes when we are tired or not in a good mood, it can affect our thinking skills."
- "It can be helpful to regulate our emotions when we feel like they take too much place in a situation. By regulating our emotions, we can make more efficient decisions by reducing the impact of intense emotion and we can communicate more easily with our friends and family."
- "For today we will talk about emotion regulation. How would you explain emotion regulation?"
    - *If the participant responds adequately:* "That is right! Great explanation."
    - *If the participant has difficulty responding or has never heard about it:* "Emotion regulation is the ability to react to a situation while keeping our feelings in check. This link may be quite difficult to see, so I will briefly explain. If at any point you are not comfortable discussing something please let me know, it is absolutely fine."
- "Our lives are filled with happy, sad, angry, and surprising experiences. We all have different thoughts and experiences that guide our reactions and behaviour in different situations."
- "Were there any times in the apartment where you found you had to regulate your emotions to perform the tasks?"
    - *If the participant has difficulty responding:* "For example, in the apartment, you may have experienced some stressful situations, such as the flood in the kitchen. How did you feel when you faced that situation?"
    - *If the participant responds adequately:* "Exactly! That is a great example of when you had to regulate your emotions. How did you find the situation where there was the flood in the kitchen?"
- "In the situations where you have to respond quickly and are a bit stressed, what strategies do you use?"

    - *If a response is given:* "Thanks for sharing! Do you find that the strategy is effective all the time?"
    - *If there is difficulty providing a response:* "It's hard to think of an answer on the spot!"
- "In stressful situations, such as a flood in the kitchen, it can be difficult to identify what emotions you are experiencing. We all do this, but it is important to learn from these experiences, to be able to attend differently, and improve the ability to regulate our emotions for future situations."
- "One way to help us is through **STOP-PLAN-ACT**."
- "Have you heard of this strategy?
    - *If a response is given*: "That is great! How would you describe the strategy?"
- "We can take the strategy and break it down into smaller parts. The first part is STOP - this is where we take a pause and stop what we are doing. Afterwards, we move to the second part, plan, meaning we focus on figuring out what are the next steps we should take. After we have an action plan in place, we move to the act part where we carry out the next steps."
- "This strategy is about using the three cue words to help when we feel overwhelmed or stressed and are unsure of how to react to an unexpected situation. Why may the STOP-PLAN-ACT strategy be helpful?"
    - *Regardless of response*: "It is helpful to stop before planning our next steps to avoid feeling overwhelmed. Now, let us go through an example to practice this new technique."
- "Going back to the flood in the kitchen situation, how can we apply this strategy?"
    - *If a response is given*: "Great job! That is a good way to apply the STOP-PLAN-ACT strategy."
    - *If there is difficulty providing a response*: "We would start by stopping what we are doing and taking a step back from the kitchen. We can take deep breaths to relax and focus on our next steps. The next steps will be to call someone who can repair the flood."
- "STOP-PLAN-ACT can be helpful in day-to-day situations. Let us say you are working on your laptop on an important document, and suddenly your laptop goes black and turns off, you are not able to turn it back on, what could you do in this situation?"
    - *If there is difficulty providing a response*: "Using the STOP-PLAN-ACT technique, we would start by stopping what we are doing and taking a step back from the computer. We can take deep breaths to relax and focus on our next steps. What are the next steps you could take?"
        - *Answer should be planning out some solutions (e.g., bringing the laptop to a shop, looking at Google for help) and then acting out on that plan.*
    - *If a response is given*: "Great job!"
- "What are some situations where you can apply the strategy to help regulate emotions?"
    - *If there is difficulty providing a response:* "Are there any tasks you need to do in the next couple of days?"

5. At-Home Activity & End of Session.

- "This has been a great session, and I hope you enjoyed the apartment module!"

- "For today's at-home activity, how can you apply the STOP-PLAN-ACT strategy before the next time we see each other?"
- "Do you have any questions about today's session or about your at-home activity?"

SESSION 4 - APARTMENT

1. Reflect on At-Home Activity

- "Welcome back!"
- "How did your at-home activity from last session go?"
- "How was it to keep track of the emotion you felt all week?"
    - "How do you think this exercise was able to help you?"
- "What do you think can be done to improve this exercise?"

2. Introduce the Module

- "Just like last session, we will focus on the apartment module. We will start with 15 minutes of VR, followed by a 5-minute break, and then continue for another 15 minutes of VR."
- "For today's discussion, we will talk about coping with high levels of stress that can impact thinking skills and in social interaction."
- "Are you ready to begin?"

3. Middle Break Conversation

- "You have completed the first few levels for today. Excellent job!"
- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"
    - "What did you learn from them?"
    - "What were some strategies that you used to succeed in the task?"

4. Discussion with the participant: Coping with Stress or Anxiety

- "You have finished the last level for today. Excellent job!"
- "How did you find that exercise?"
- "When completing tasks, our mental state can affect our ability to do that task well. For example, when we feel tired, it can be harder to complete a task. Another example is stress - when we feel stressed, it can affect our physical health, mental health, and ability to do tasks well."
- "Today we are going to discuss several different ways we can help reduce our levels of anxiety or stress to improve our thinking skills."
- "How would you describe stress or anxiety?"
    - *If the participant has difficulty responding: "*Both stress and anxiety are a type of emotional strain. It is a physiological response that is triggered by the body when faced with a perceived or actual danger. We could also feel like the challenge is larger if we feel like we do not have the abilities to face it. For example, someone may feel stressed before attending a psychiatrist or psychologist appointment, but then they do not feel stressed after the appointment."

    - *If the participant responds adequately:* "Exactly! That is a great explanation of stress and anxiety."
- "Stress can be both good and bad for our thinking skills. How may stress impact someone's thinking skills?"
    - *If the participant has difficulty responding:* "Some stress can help improve someone's thinking skills. For example, if you had an upcoming exam or deadline in school, stress could help your performance. But, when there is too much or too little stress, it can negatively affect our thinking skills. When we feel stressed, it makes it harder to think clearly and to make rational decisions. It also results in difficulty in learning new things and retaining information."
    - *If the participant responds adequately:* "Great explanation!"
- "Can you give me an example of a situation that makes you feel stressed or anxious?"
    - *If there is difficulty responding:* "was there a time in the session today or an earlier session where you felt stressed?"
    - *Normalise: Provide a personal example of a situation that makes you feel stressed or anxious. Nothing too revealing but something that has affected you. This example can also be about someone you know if you do not want to share a personal example.*
- "Now, when faced with this situation, how do you feel? How are your thinking abilities when you are stressed?"
- "What strategies do you use to help reduce your stress?"
    - *If a response is provided:* "That's a great strategy!"
    - *If there is difficulty responding or not necessarily a good strategy*: "Some strategies are often used by a lot of people to reduce stress like exercising, mediation, relaxation technique…"
- "One strategy that some people find helpful is a **breathing exercise**. Let me explain it first and then we can try it together."
    - ***Explain:***
        1. "Take a slow breath in through the nose; breathe into your lower belly (for about 4 seconds)."
        2. "Hold your breath for 1 or 2 seconds."
        3. "Exhale slowly through the mouth (for about 4 seconds)."
        4. "Wait a few seconds before taking another breath."
        5. "About 6-8 breathing cycles per minute is often helpful to decrease our stress or anxiety."
- "The important thing about this breathing exercise is that you can tailor it to a rhythm you find comfortable. Other breathing rhythms people find helpful are 6-3-6."
- "Do you have any questions about the breathing exercise? We can run through an example together, and then an example by yourself."
    - *Go through a breathing rhythm together and then prompt the participant to go through an additional rhythm independently.*
- "This breathing exercise can be done anywhere and at any time. It makes our bodies feel relaxed and allows our minds to relax as well. It is helpful to become aware of the presence of stress and know how to regulate it to better use our thinking skills, such as memory, attention, and decision-making, since these abilities are impacted when we experience stress."

5. At-Home Activity

- "This has been a great session, and we're about ⅓ way through the training program!"
- "How can you apply the breathing strategy to your daily life?"
- *Potential at-home activities:*
- *Breathing exercise at the beginning of each day*
- *Breathing exercise when feeling stressed and/or not feeling stressed*

SESSION 5 - BUS

1. Introduce the module.

- "During this session, you will complete one of the VR program modules, the bus module. This module involves the stimulation of going on a public transportation system, such as choosing a route from point A to point B. There are 4 levels in the bus module that build on each other. We will start with 15 minutes of VR, followed by a 5-minute break, and continue for another 15 minutes of VR."
- "For today's discussion, we will talk about the thinking skill, planning, and how we can apply planning strategies to your life."
- "Do you have any questions before we begin for today?"
- "Are you ready to begin?"

2. Middle break conversation

- "You have completed the first few levels for today. Great job!"
- "What is your first impression of the bus module?"
- "Were there any tasks that you found difficult?"
    - "What did you learn from them?"
    - "What were some strategies that you used to succeed in the task?"

3. Discussion with the Participant: Planning

- "You have finished the last level for today. Wonderful job!"
- "How did you find the exercises?"
    - "What did you find difficult?"
- "What strategies did you use to help you with the VR exercises?"
- "Now that we have completed those exercises, you may be wondering how they can help you in your daily life. In these exercises you were asked to do planning for some tasks."
- "How would you describe planning to someone?"
    - *If the participant has difficulty responding:* "Planning often involves setting goals, and then organizing the steps to reach that goal."
    - *If the participant gives a definition*: "That is right. Great explanation."
- "You used your planning skills in different tasks in the bus module. Can you think of an example in the VR program where you used your planning skills?"
    - *If the participant has difficulty responding: "*For example, when you need to choose the effective route from point A to point B, it asked you to use planning."
    - *If the participant gives a good example:* "Yes, exactly!"

- "One task where you used your planning skills was when selecting the most efficient bus route from point A to point B. One strategy that can help to effectively plan activities is to plan what we are going to do before acting - that is, we use **plan before acting**."
- "How can you use this strategy to plan a bus route that has the least amount of time and stops?"
    - *If a response is given*: "Excellent work!"
    - *If there is difficulty providing a response:* "Like any new skill you are trying to learn, it is common to experience some difficulty. But, as we continue practicing this strategy repeatedly, the strategy will come easier."
- "What other tasks in the VR program can you apply the planning before acting strategy to?"
    - *If a response is provided*: "Great example!"
        - *If an example is provided but not elaborated on:* "How can you apply the strategy, planning before acting, in this situation?"
    - *If difficulty providing a response:* "One task where I noticed you using your planning skills was when deciding how to respond when the stranger approached you and asked for the bus route. In this situation, you may have taken some time to review which response was the most appropriate before selecting one."
- "Why may it be helpful to think before acting?"
    - "When trying to make a decision when you have many options, it is helpful to take time to evaluate the various options available to you before responding. It can also help with reaching your goal faster."
- "When looking at the bus map, you can take a mental step back to look at the information there before making a decision and choosing a bus route. We can also **break down the task into smaller pieces**. When making your decision, what are some of the info you can look at on the bus map?"
    - *Example responses:* the bus route that will take the participant to the designated stop, travel time, and number of stops.
    - *Regardless of response:* "Exactly! Once we look at [insert what the participant said], we can look at the other info on the map, like the travel time and number of stops. Afterwards, you can look at each option on the map to see which bus route has the least amount of stops and the shortest time. That way, you can choose the most efficient bus route."
- "Why may it be helpful to break down the task into smaller steps?"
    - *Regardless of the response:* "Instead of doing a large and overwhelming task all at once, breaking it into smaller and more manageable steps allows for a clearer and more organized approach. Breaking a plan into smaller steps can also help in figuring out what specific actions you need to do for each step."
- "Can you think of an example where you can apply the two strategies, planning before acting and breaking a task into smaller steps, in some of your activities in your daily life?"
    - *If an example is provided:* "That's a good example where you can apply this strategy!"
    - *If there is difficulty providing a response:* "It can be difficult to think right on the spot! For example, I wanted to try a new recipe yesterday, which I needed to check the ingredients that I have and the ones I need to buy. I also need to plan the

different steps to take when I am going to cook the meal before actually starting the cooking process. How can I use the breaking a task into smaller steps strategy in trying a new recipe?"

- "Is there a strategy you use to help you plan your activities in your daily life? Can you tell me more about it?"
    - "Thanks for sharing this with me!"

4. At home activity

- "For this week, I would like you to become aware of the things you need to plan. When you have an activity or a task that needs to be planned, try to take a mental step back of the situation and review all the information available in the environment. After you have some time to think and evaluate all the options you have, you can act. You can write down the different options you think about if it helps you."
- "Another strategy you can try is to break down the task into smaller steps to achieve the overall goal. You can either write these steps down on paper or simply visualize them in your mind. This process of breaking down a larger task into more manageable components can assist you in successfully completing it."
- "Do you have any questions before you leave?"
- "Thank you for all of your input today, this has been a great conversation."

SESSION 6 - BUS

1. Reflect on At-Home Activity

- "Welcome back! Do you have any questions before we begin for today?"
- "We are about halfway through the training program! How are you finding it?"
    - *If needed, discuss ways to tailor the program to the individual (e.g., changing the amount of time spent on the VR program)*
- "How did your at-home activity from the last session go?"
    - "Were you able to plan an activity or a task you had this week?"
    - "Was it difficult to take a step back and look at all the information to make a decision about how to move forward?"
    - "Did it help you to actually plan an activity?"
- "What do you think can be done to improve this exercise?"

2. Introduce the module.

- "Just like last time, we will focus on the bus module for today. We will start with 15 minutes of VR, followed by a 5-minute break, and then continue for another 15 minutes of VR."
- "For today's session, we will be talking about a type of social skills called attribution bias. Attribution bias is where someone else's behaviour is thought to be caused by the person, rather than the environment. Later this session, we will discuss more about attribution bias, everyday examples, and some strategies."
- "Are you ready to begin?"

3. Middle break conversation

- "You have completed the first few levels for today. Great job!"
- "We are halfway through completing the VR component of today's session. Can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"
    - "What did you learn from the activity?"
    - "What were some strategies that you used to succeed in the task?"

4. Discussion with the participant: Attribution bias

- "You have finished the level for today. Great job!"
- "How did you find that exercise? Did you find it hard?"
    - "What strategies did you use in the VR exercises?"
- "In the VR program, there are different tasks that also target your skills relating to interacting with others, or your social skills. For today, we will talk about one type of social skills, called attribution bias. Before our session today, have you heard about attribution bias?"
    - *If yes:* "How would you explain it to someone else?"
        - *Regardless of response:* "When talking about this term, we are referring to how we explain the cause of someone's behaviour. When someone uses attribution bias, they would say the cause of a behaviour is because of the person, rather than the environment."
        - "For example, if I am walking outside when it is raining and someone steps in front of me. I may attribute their behaviour to the person being rude, rather than seeing that the person was trying to avoid a puddle."
- "Can you think of another example of jumping to conclusions?"
    - *If there is difficulty providing a response*: "Did it ever happen that you thought someone was rude and it was because of you or something you must have done?"
- "Is there a task in the module where someone may engage in an attribution bias?"
    - *If the participant responds adequately:* "Exactly!"
    - *If there is difficulty providing a response:* "For example, when the stranger approached you and started asking for the correct bus route."
- "Why may it be helpful to not use an attribution bias?"
    - *If the participant responds adequately:* "Exactly!"
    - *If there is difficulty providing a response*: "By reducing the tendency to jump to conclusions without considering all the possible explanations for the other person's behavior, it is possible to improve relationships with others through greater understanding. As a result, there is likely to be less conflict with others due to an open mind regarding explanations of the situation."
- "Another example of attribution bias is if someone is rude to you, someone may think it is because of something they did. Someone can be rude to someone else, and it can have nothing to do with them."
    - "For example, if we join a group of friends who are having a conversation and we decide to participate and notice that one of our friends starts to become distant and uninterested. We may think that we did something wrong, causing our friend to be distant. However, it is possible that the reason our friend is distant is because they had a long and difficult day. Their behavior may have nothing to do with us."

- "Did it ever happen to you where you thought someone was rude because of you or something you did?"
- "What strategies can you use to help with attribution bias?"
    - *If a response is provided:* "Why do you think it's helpful?"
    - *If difficulty providing a response:* "Part of the training program is to learn different strategies!"
- "There are two strategies that can help reduce attribution bias; the first one is **focusing on the events themselves rather than our feelings**. This is not to say that your feelings are not valid, but it helps us view the event from an objective point of view."
- "The second strategy is to look at the situation from an outside perspective and **ask clarifying questions** about the interpretation of the situation. For example, we can ask ourselves: "do I have enough information to understand the situation" and "what other reason could there be for this situation?""
- "Going back to the example earlier about the stranger asking for the bus route, what are some clarifying questions we can ask ourselves?"
    - *If there is difficulty providing a response:* "For example, instead of thinking that the reason why the person acted that way is because they are rude, another explanation is that they are late for work."
    - *If a response is given:* "You did a great job trying to find different possibilities."
- "When asking clarifying questions, we do not have to actually ask the person, especially if it is someone you do not know. By thinking to ourselves the different clarifying questions could help explain why the person is acting the way they are."
- "Another example where someone may use attribution bias is when boarding on the bus, they may think that the other passengers are staring at them. How can you apply the attribution bias strategies to this situation?"
    - *If there is difficult providing a response:* "For example, I can ask myself whether the passengers are looking at me or at a poster behind me."
- "Can you think of an example of a situation where you and had a misunderstanding with someone?"
    - *If the participant has difficulty responding:*
        - "Maybe this is something you could think about in your own time and if you're able to remember a situation, you could think about more explanation and use perspective taking when you interpret other people's behaviors."
    - *If the participant provides an example:*
        - "Thanks for sharing. Do you think the result may have been different if you had interpreted the person's behavior in another way?"

5. At-Home Activity

- "Thank you for all your input today, this has been an enjoyable conversation. Being careful with attribution bias is important in social interactions and relationships, as it enables us to misinterpret others' intentions and behaviors."
- "For this week, I would like you to pay attention to the attribution biases that you make and note some examples of how you explain a social event, or an action made by another person. You can note your thoughts about it and how you explain this event."
- "Do you have any questions before we end for today?"

SESSION 7 - RESTAURANT

1. Reflect on At-Home Activity

- "Welcome back!"
- "How did you find completing your at-home activity?"
- "Would you like to tell me a little bit more about an example where you had to explain a social event, or an action done by another person?"
    - "How did you proceed?"
    - "Have you used some strategies like focusing on the events themselves rather than your feelings? Or did you ask yourself if there were other explanations to the situation than what you were thinking first?"
    - "Was this activity helpful to you?"
- "Any questions before we begin for today?"

2. Introduce the Module

- "For this session and next session, you will complete the restaurant module. Do you remember what the restaurant module is like?"
    - *If a response is provided:* "That's a great description of the restaurant module!"
    - *If there is difficulty providing a response:* "The restaurant module is a stimulation where you need to remember food orders from different tables. Then, you walk to the cashier and repeat aloud, so that I can hear the food order."
- "The main task is to remember food orders from different tables. The task engages in a type of memory called working memory. Working memory means that you are remembering a piece of information for a short time (a couple of seconds)."
- "What memory strategies can you use to help remember the food orders?"
    - *If difficulty providing a response:* "One memory strategy is called chunking, where we group items together instead of remembering each individual item. We can also group items together based on a similar characteristic."
- "We will start with 15 minutes of VR, followed by a 5-minute break where I will check in with you and briefly chat about the strategies you were using. Then, we will continue for another 15 minutes of VR before moving to our conversation today about combining two memory strategies, repetition, and chunking."
- "Do you have any questions before we begin?"

3. Middle Break Conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"
    - "What did you learn from them?"
    - "What were some strategies that you used to succeed in the task?"

4. Discussion with the Participant: Repetition & Chunking

- "You have completed the levels for today. Excellent job! How did you find the restaurant module?"

    - *If the participant experienced difficulty:* "It can be difficult to remember a lengthy list of items, and that is completely normal! Everyone experiences times where it is more difficult to remember something, [*insert personal example here*]."
- "Everyone can benefit from using memory strategies, and it takes time to practice different memory strategies, but the more we practice these strategies, the more natural they will become. So, at the times when we need to remember something, we are more likely to use these strategies without thinking."
- "What strategies did you use to remember the food orders?"
    - *If a response is given:* "Great! That is a helpful strategy, and you can try it in this task."
- "One good strategy to train our thinking skills and help us remember is a strategy called **repetition**. For this strategy, someone repeats the items they are trying to remember repeatedly. You can repeat the items in your head or aloud, whichever you find more helpful."
- "Let us practice! I am going to say a list of words to you. Try repeating them as you hear them, either in your head or aloud, and at the end I will ask you to say as many of the words as you can remember: DOG, SNOW, HAMMER, RAIN, CAT, NAIL, BIRD, SCREWDRIVER, FISH, HAIL. Now, which words can you remember?"
    - *If the participant remembered 5 or more:* "Great job! You can try this strategy in the task to help you remember the food items."
    - *If there is difficulty providing a response, or less than 5 items remembered*: "The more you repeat the items, the more you will remember. Try repeating the items as much as possible to help you remember the food items in the task."
- "When using the repetition strategy, a key component is ensuring that the information you are repeating is accurate and there are no mistakes. If we repeat something that is not right, there is a higher chance that we may remember it instead of the correct information that we are trying to remember."
- "Memory strategies can also be combined! Why may it be helpful to combine strategies?"
    - *Regardless of response:* "Combining strategies is a great way to boost the chances of remembering a piece of information. All the memory strategies we will be discussing in the program can be combined with a different strategy. This also helps with coming up with a couple of strategies that work best for you."
- "One of the memory strategies that can be combined with repetition is **grouping.** What are some chunks, or groups, you can create related to remembering a food order?"
    - *Examples: beverages, appetizers, main courses, and desserts.*
    - "If one person asks for a cappuccino and a doughnut, and a second person asks for a tea and a piece of apple pie, you can group the cappuccino and the tea together as beverages, and the doughnut and the piece of apple pie together as desserts. So, if you repeat (1) cappuccino and a tea, and (2) doughnut and apple pie in your mind, it will be easier to remember afterwards because the items are grouped into categories. Do you have any questions?"
        - *If the participant does not understand, explain again and/or use a simpler example (i.e., coffee, coke, doughnut, cookie).*
- "Now, let us practice this strategy! If I say milk and a sugar pie, tea, and a carrot cake, how would you group these items together?"
    - *If correct response:* "Great job!"

- *If incorrect response:* "Great try! The milk and tea are both beverages, so they can be grouped together. The sugar pie and carrot cake are both deserts, so they can be grouped together."
- "In what areas of your life can you apply the repetition and chunking strategies together?"
  - *Examples include: phone numbers, shopping, etc.*

5. At-Home Activity

- "Good job on the VR exercises today! Taking what we discussed today, what is an at-home activity for you to do on your own before seeing each other again?"
  - *Suggested activity: to use the repetition and chunking strategy 2-3 times and see if it helped the participant remember the info.*
- "Do you have any questions about today's session or about your at-home activity?"

SESSION 8 - RESTAURANT MODULE

1. Reflect on At-Home Activity

- "Welcome back! Do you have any questions before we begin for today?"
- "How did your at-home activity, combining the grouping and repetition strategies from the last session go?"
  - "Were you able to use these strategies in different contexts of your life?"
  - *If the activity was completed:* "Did you find it helpful? What do you think can be done to improve this exercise?"
  - *If homework were not completed:* "Were there any situations where you could have used the chunking and repetition strategies together?"

2. Introduce the module.

- "Today is the last time we will be completing the restaurant module! Like our previous session, you will start with 15 minutes of VR, followed by a 5-minute break. During this break, we will briefly chat about how you are finding the restaurant module before continuing for another 15 minutes of VR. Today's session will end with a conversation about a memory strategy called associations, and how we can combine it with chunking."

3. Middle break conversation

- "You have completed the first few levels for today. Great job!"
- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"
  - "What did you learn from them?"
  - "What were some strategies that you used to succeed in the task?"

4. Discussion with the participant: Visualization and Grouping items.

- "So, how did you find the exercises?"
- "What did you do to help remember the information this time?"
  - *Note anything they say, allow them to speak.*

- "One strategy that can help you remember things) is to **create pictures in your mind of the items** you are trying to remember."
- "Why may making mental pictures help with memory?"
    - *If difficulty providing a response:* "Mental pictures can help make information clearer and easier to remember. It can help you see connections between ideas."
    - *If a response is provided:* "Exactly!" *and elaborate on definition.*
- "How could you have used the mental picture strategy in the restaurant module?"
    - *Allow active exploration*.
- "We can also combine the mental image strategy and the **grouping** items together strategies. How would you combine the two strategies to memorize a food order?"
    - *If there is difficulty providing a response:* "You can make a picture in your mind of the different groups of food. For example, you can make a mental picture of all the appetizers together, the drinks together and the same for the main meals."
- "Let us run through an example from the restaurant module and work together in applying the mental pictures and grouping strategies together. One of the table orders was a club sandwich, French fries, coke, chocolate cake, beer, chicken burger, French fries, vanilla pudding, beer, cheese pizza, Cesar salad, strawberry cake. How would you use these two strategies together?"
    - *If there is difficulty providing a response:* "I can picture in my mind all the desserts together, so the chocolate cake, vanilla pudding, and strawberry cake. What other groups of food can you picture in your mind?"
- "We can apply the mental imagery strategy to your daily life. One example is if you are at a grocery store, you can use the mental imagery strategy by itself or the mental imagery and grouping strategies together. What strategies would you use to help remember the following list of food items: STRAWBERRY, SPINACH, YOGURT, BRUSSEL SPROUTS, MILK, BANANAS, and CHEESE."
    - *If a response is provided:* "Great job using the mental picture and grouping strategies!"
    - *If there is difficulty providing a response:* "To help you remember food items, you can try to create visual images of every item I told you and try to visualize each item in a category. For example, I can try to create a picture of the strawberries and bananas together because they are both fruits. What other foods can you group and picture together?"
- "What are some other areas of your life where you can apply the mental pictures or a combined mental picture and grouping strategies?"
    - *Examples: looking for your favourite piece of clothing, remembering what medications to take in the morning vs. afternoon, etc.…*
- "Have you ever experienced a time where you needed something to grab an item from a different room, but as soon as you left the room you forgot what you needed to pick up?
    - *If there is a response:* "How can you apply the mental pictures strategy to this situation?"
        - *If a response is provided:* "Great!"
        - *If there is difficulty providing a response:* "One way to apply the mental pictures strategy is to picture in your mind the item you need to pick up."
- "In the restaurant module, you learned and practiced different memory strategies. Since this is the last time you will be completing the restaurant module, let us review the two

other memory strategies we talked about. For each memory strategy, we can reflect how you found it and ways you can apply it to your daily life."

- *Directions: when reflecting on a memory strategy, ask the user questions to promote insight and reinforce that the memory strategies used in daily life situations differ based on the preference of the user and context.*
  - Chunking
  - Repetition

5. At-Home Activity.

- "Good job on the VR exercises today, and I enjoyed our conversation about mental pictures and grouping. For this week's homework, I encourage you to practice the various memory strategies we covered in the restaurant module, including grouping, repetition, and visualization."
- "You can attempt to practice each strategy once or twice before our next session. In which situations do you think you can apply these strategies?"
- "Do you have any questions about today's session or about your at-home activity?"

SESSION 9 - APARTMENT

1. Reflect on At-Home Activity

- "Welcome back! Do you have any questions before we begin for today?"
- "How did your at-home activity, combining the chunking and repetition strategies from the last session go?"
- "Were you able to use these strategies in different contexts of your life?"
  - *If the activity was completed:* "Did you find it helpful? What do you think can be done to improve this exercise?"
  - *If homework were not completed:* "Were there any situations where you could use the grouping, repetition or mental picture strategies?"

2. Introduce the module.

- "Today we will be completing the apartment module! Do you remember what the apartment module is like?"
  - *Regardless of response:* "The apartment module involves a series of tasks that take place in a home setting. For example, ordering take out, heating up food in the microwave, and interacting with guests."
- "Similar to our previous session, you will start with 15 minutes of VR, followed by a 5-minute break. During this break, we will briefly chat about how you are finding the apartment module before continuing for another 15 minutes of VR."
- "Today's session will end with a conversation about theory of mind, which is a type of social skill."

3. Middle break conversation

- "We are about halfway through the VR exercise component of today's session. How are you finding the apartment module?"
- "Was there anything you enjoyed in the apartment module?"

- "What did you find difficult?"
    - "What were some strategies that you used to succeed in the task?"

4. Bridging conversation: Theory of Mind

- "Great job with today's apartment module!"
- "How did you find social interaction with other people in the environment? What were you thinking when the delivery person gave you the wrong change back?"
    - *Validate their feelings.*
- "Today's topic is about a specific type of social skill called theory of mind. Have you heard about theory of mind?"
    - *If yes:* "How would you describe theory of mind?"
    - *If no:* "Theory of mind means understanding that other people have different thoughts, desires, and beliefs than you do. For example, if I am at a grocery store to buy ice cream and my favourite ice cream flavor is chocolate. Recognizing that my friend's favorite ice cream flavor is not chocolate, but instead vanilla, is an example of theory of mind."
- "Theory of mind is also known as perspective-taking. It is like knowing that a person might see things differently from another person. We use theory of mind when interacting with others, and sometimes we misinterpret how someone else sees things."
- "Can you think of an example in the VR module where you or someone else uses theory of mind?"
    - *If difficulty providing a response:* "What about when the roommate's friend asked if there was any food in the fridge? Were you hungry when the friend asked you that question?"
        - "Recognizing that your roommate's friend is hungry while you are not hungry is an example of theory of mind."
- "Another example of theory of mind can be applied in the last level, where when the delivery person drops off the food and they give you the wrong change back."
- "What strategies can you use when it is possible to misinterpret a situation?"
    - *If a response is provided:* "How does that strategy help?"
- "One strategy that we can use is perspective-taking or **looking at the situation from an outside perspective**. This helps us recognize that someone may have a different viewpoint or a different belief about the situation."
- "How can we apply this strategy to a delivery person giving you the wrong change back?"
    - *Allow active exploration.*
    - *Example answers could include that the person thought they gave back the right amount of change.*
- "Part of theory of mind is recognizing that we or another person does not have all the information in a situation. One strategy that we can use is to ask ourselves or ask the person **clarifying questions**."
- "Going back to the delivery example, what are some clarifying questions we ask ourselves or the delivery person?"
    - *If a response is given:* "Great! That question would help clarify the issue."
    - *If there is difficulty providing a response:* "For example, you can ask: 'Did you mean to give me $XXX in change?"

- "Sometimes, people make simple mistakes, and it is possible that the worker did not mean to give you the wrong change. By asking a clarifying question like this, the worker may realize that they meant to give you the correct change but accidentally did not. So, this would easily solve the problem at hand!"
- "Can you think of a time where you misinterpreted a situation?"
    - *If response is provided:* "Thank you for sharing. How could you have applied the 2 strategies to this situation?"
    - *If difficulty providing a response:* "It can be difficult to think right on the spot! Maybe this can be your at-home activity to reflect on a time where you misinterpreted a situation and if the outcome could have been different if you used a theory of mind strategy."
- "What aspects of your life could you apply the theory of mind strategies to?"
    - *Examples include: interacting with friends or family, if they are participating in a group therapy session, volunteering, etc.*

5. At-Home Activity

- "Good job on the VR exercises today, and I enjoyed our conversation about theory of mind. Taking what we discussed today, what is an at-home activity for you to do on your own before seeing each other again?"
    - *Suggested activities based on discussion and participant:*
        - Reflect on a past situation where they could have applied theory of mind strategies.
        - Apply perspective-taking/clarifying questions to an upcoming social interaction.
- "Do you have any questions about today's session or about your at-home activity?"

SESSION 10 - APARTMENT

1. Reflect on At-Home Activity

- "Welcome back!"
- "Last session we talked about 2 theory of mind strategies. How did your at-home activity go?"
- "Was it helpful to do these exercises in terms of interpretation of different situations?"
    - "How do you think this exercise was able to help you?"
- "What do you think can be done to improve this exercise?"

2. Introduce the module.

- "Today is the last time we will be completing the apartment module! Just like last session, we will start with 15 minutes of VR, followed by a 5-minute break. Then we will continue for another 15 minutes of VR and then chat about problem-solving."
- "Do you have any questions before we begin for today?"

3. Middle break conversation

- "You have completed the first few levels for today. Great job!"

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"
    - "What did you learn from them?"
    - "What were some strategies that you used to succeed in the task?"

4. Bridging conversation: Problem-solving

- "You have completed the first levels for today. Great job!"
- "How did you find the exercises?"
- "What did you do to successfully complete the exercise? Did you find yourself using any strategies to help you accomplish the task?"
- "Now that we completed those exercises, you may be wondering how these exercises help you in your daily life. In these exercises you were asked to solve problems about different topics, like what food to order from the restaurant and how to respond to a flood in the kitchen."
- "How would you describe problem solving?"
    - *If a response is given:* "Exactly! That is a great explanation of problem solving."
    - *If there is difficulty providing a response:* "Problem solving is something we have to do when we face a difficulty. When we have a problem in our daily lives, we take different actions to stop facing this problem, which we call problem solving."
- "Can you think of a time when you had to solve a problem in the apartment module?"
    - *Regardless of response*: "There were a few situations where you had to solve problems. For example, when you needed to choose the food to order on a budget, you had to solve a problem."
- "One of the strategies you can use to help with problem-solving, including choosing what food to buy, is to **break it down into smaller steps.** How can you break the task of budgeting food into smaller steps?"
    - *If there is difficulty providing a response:* "The first thing you can do is to look at all the coupons to see what your options are to buy food."
- "What could be the next step?"
    - *If a response is given:* "Excellent!"
    - *If there is difficulty providing a response:* "Second, you can look at each coupon to see if it fits your $20 budget. That way, you can remove the food options that are over $20. If you are left with more than one food option, you can then choose the one you prefer."
- "Breaking down the task into smaller steps may require focus and attention. To help you complete each step of food budgeting, you can say your steps or your thinking process out loud."
- "Why could saying things out loud help?"
        - *If a response is given:* "That is a great reason!"
        - *If there is difficulty providing a response:* "By talking out loud about what you're doing, you can concentrate better and not let things around you bother you."
    - "You can combine all of these strategies - breaking the task in smaller steps, materialization and verbal-instruction to help you budget different things or to solve any problem."

- "Can you think of a situation in your life when you needed to solve a problem and you could have used these strategies?"
    - *If there is difficulty providing a response:* "For example, in your daily life, there may come a time when you have to deal with a clogged toilet and you need to find a solution to fix it. In that situation, you can use the strategy 'break it down into smaller steps' to find out how to resolve the situation."
    - *If a response is given*: "Exactly! That is a good example."
- "This was the last time you will be completing the apartment module. Let us go through a couple of tasks you encountered in the module. For each task, we can reflect and discuss how you found the task. Then, if there were any other strategies you could use to help complete the task."
    - *Directions: review 1-2 of the below tasks, depending on what level the participant reached and if there was a task the participant experienced more difficulty with. When reflecting on task performance, ask the participant questions to promote insight. Each task has multiple strategies the participant can use; refer to earlier strategies and the VR program.*
    - Reheating food in the microwave.
        - *Example strategies: breaking it down into smaller steps, planning before acting.*
    - Flood in the kitchen.
        - *Example strategies: STOP-PLAN-ACT, breathing exercise.*
    - Delivery person giving the participant the incorrect change.
        - *Example strategies: Looking at the situation from an outside perspective, asking clarifying questions.*

5. At-Home Activity:

- "For your homework this week, I would like that if a problem arose before we meet again, you try to keep track (either mentally or by writing it down) of what you did to solve the problem. For example, if you try to solve a problem by using the strategy "break it down into smaller steps," you can write all the steps in which you have deconstructed your problem. Then, the next time we visit, we can discuss the situation and how you approached it, as well as the possibility of finding other ways to solve the problem."
- "If you encounter a problem and feel stressed or overwhelmed by emotions, you can also try learned techniques such as breathing exercises or the stop-plan-act method."
- "Thank you for all of your input today, this has been a great conversation."
- "Do you have any questions before you leave?"

SESSION 11 - BUS

1. Reflect on At-Home Activity

- "Welcome back! Are you ready to begin for today?"
- "Were you able to use some of the strategies we saw together to solve a problem you encountered?"
- "Which one did you use?"
    - "Did you keep track of what you did to solve the problem? How did you succeed to solve it?"

- "How do you think this exercise was able to help you?"

2. Introduce the module.

- "For today, we will be completing the bus module. Do you remember what the bus module was like?"
  - *Regardless of response:* "In the module, you are trying to go to a destination in the city, like the mall by bus. You need to select the bus route that will take you to your destination in the least amount of time and least amount of stops."
- "What are some strategies that can help you select the most efficient bus route that takes you to your destination in the least amount of stops and time?"
  - *Some strategies: breaking down the task into smaller parts, planning before acting, process of elimination.*
- "Similar to our previous sessions, you will start with 15 minutes of VR followed by a 5-minute break. We will then continue for another 15 minutes of VR before moving on to talk about response inhibition."
- "Do you have any questions before we begin for today? Are you ready to begin?"

3. Middle break conversation

- "You have completed the first few levels for today. Great job!"
- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"
  - "What were some strategies that you used to succeed in the task?"

4. Discussion with the Participant: Response Inhibition

- "You have finished the level for today. Excellent job!"
- "How did you find the exercises? Did you find them hard?"
- "What did you do to successfully complete the exercise?"
  - "Did you find yourself using any strategies to help you finish the activity?"
- "Today's topic is about inhibition. Have you heard about inhibition? How would you define it?"
  - *If the participant has difficulty responding or never heard about it:* "There are two types of inhibition. First, inhibition can be when you ignore things that are not important and only focus on the important things. The second type is when we stop saying something or acting in a way that is inappropriate."
  - *If the participant responds adequately:* "That is right. Great explanation."
- "When did you need to use your inhibition in the bus module?"
  - *If the participant has difficulty responding:* "Was there anything distracting, you in the bus module?"
    - *If further guidance is needed:* "Some people can find it distracting with the loud music and people talking loudly on the bus. How did you find it?"
      - "When you had to deal with annoying and distracting sounds and focus on a task at the same time, it asked you to use inhibition."
  - *If the participant responds adequately:* "Exactly! That is a great example of when you used inhibition."

- "What strategies can you use to avoid paying attention to things that are not important to your task or distracting?"
    - *If response is given:* "That is a good strategy to avoid distraction!"
- "One way is to use **sensory reduction** strategy. Have you heard of this before?"
    - *If a response is given:* "What is an example of a sensory reduction strategy?"
- "Sensory reduction is where we limit the number of things we are paying attention to in our environment. That way, we can focus our attention on fewer things in our environment. Sensory reduction can be used as a physical or mental strategy. A physical sensory reduction strategy involves doing something that reduces the number of distracting things in your environment."
    - "What are some examples of a physical sensory reduction strategy?"
        - *If a response is given:* "Great!"
        - *If there is difficulty providing a response:* "One example is to move further away from the distracting sounds. For example, if you are sitting close to a loud, distracting person or sound, you could move to another seat on the bus which is farther away from the person or sound so that it is less distracting."
- "A mental strategy that can help you concentrate is to **focus inwards.** To do this, try focusing on yourself and what you are doing instead of the people and noises around you. This way, you can more easily focus on the tasks that you have to complete."
- "In the bus module, what are some things we can pull our attention away from to help us direct our attention inwards?"
    - *Example answers include but are not limited to: people staring at the user, music, baby crying.*
    - "We can block out any noises or visual objects in the bus that might make it hard to remember what bus stop to get off at, but we should not block out any information that will help us to remember our stop."
- "Response inhibition can also be applied in social situations, where you may stop from saying something or acting inappropriately. One strategy that we can do is to create some mental distance - that is, we **pause before acting or saying something (or focussing on one thing at a time?)**."
- "Are there some situations in your life where you can use response inhibition?"
    - *If response is provided:* "What type of response inhibition can be applied to this situation? How can you apply the strategies that we discussed today to this situation?"
    - *If difficulty providing response:* "Can you think of a time where you felt distracted on a task? Or a situation where you wanted to say something?"
- "Why is response inhibition an important skill to practice?"
    - *Regardless of response:* "Response inhibition is important because it helps us from saying or doing things that are inappropriate in a given situation. It can also help us keep on track and reach our goals!"

5. At home activity

- "For this week's homework, I want you to think of a situation in your daily life when you could practice response inhibition. It could be a difficult relationship you had or activities you find distressing."

    - *If it is a situation where they need to ignore what they want to say*: "In this situation, try to stop and have some thoughts about what is going on. You can think about what you can say before doing anything. Ask yourself what effect it will have when you will be doing the action you plan to do."
    - *If it is in a situation where they need to direct attention inward*: "Try focusing on yourself and what you are doing instead of what is going on around you. Try to remember what task you need to complete."
- "We will review and discuss your strategies at our next session."
- "Thank you for all your input today, this has been a great conversation. Inhibition is an important skill for being able to complete tasks and you used inhibition in the last exercise when you had to ignore the background music in the bus to focus on the bus stops."

SESSION 12 - BUS

1. Reflect on At-Home Activity

- "Hi, welcome to our last session! Before we begin, I want to make sure if you consent to continue with our last session together?"
- "How are you feeling?"
- "Last session we talked about the two different types of response inhibition. Do you remember an example of response inhibition?"
    - *Allow them to speak.*
    - *If there is difficulty to respond:* "Inhibition can be when you ignore things that are not important and only focus on the important things or when you put a brake on your behaviors and thoughts."
- "We also talked about the different strategies relating to the several types of response inhibition. How did your at-home activity go?"
    - *If it was implemented:* "Great! Did you find it helpful or not so helpful?"
    - *If it were not implemented:* "Was there a time where you could have used response inhibition?"
        - *If there is further difficulty:* "Today, we are completing the bus module one last time. How could you practice response inhibition in this module?"

2. Introduce the Module

- "Today is the last time you will be completing the bus module! Do you remember an example of a task and a strategy that you can use to help complete the task?"
    - *If a response is provided:* "Great example!"
    - *If there is difficulty responding:* "One of the main tasks is to select the most efficient bus route, that is the route with the least amount of time and spots, from point A to point B. What strategy could you use to help select the most efficient bus route?"
- "We will first start off with 15 minutes of completing the bus module before taking a small break. During this break, we will briefly chat about how you are finding the bus module and it is also an opportunity for you to stretch or drink some water."
- "Then, we will continue for another 15 minutes before moving onto our last discussion where we will be discussing cognitive flexibility."

- "Are you ready to begin?"

3. Middle Break Conversation

- "We are halfway through the VR exercise. How are you finding the bus module?"
- "Were there any tasks you were experiencing some difficulty?"
    - *If yes:* "It is common to experience difficulties with these tasks! What strategies did you use to help?"
    - *If no:* "What strategies were you using in the bus module?"

4. Discussion with the Participant: Cognitive Flexibility

- "That was the last VR exercise, great job! How did you find the bus module?"
- "Were there any tasks that you found difficult?"
- "Our last topic is about mental flexibility. How would you describe cognitive flexibility to someone?"
    - *If a response is provided:* "Great explanation!"
    - *If difficulty providing a response:* "Cognitive flexibility, also called mental flexibility, is the ability to change our plans or our strategies when we encounter challenges to try to find a more effective solution."
- "Why is cognitive flexibility a good skill to learn?"
    - *If a response is provided:* "That is a good point. What made you think of it?"
    - *Regardless of response:* "Cognitive flexibility is a good skill since if one approach is not working, maybe another approach would help. Overall, cognitive flexibility helps with creating new ways of approaching a problem or reaching a goal. Cognitive flexibility can help us find a solution!"
- "What do you think are some cognitive flexibility strategies?"
    - *If a response is provided:* "Great example! Is this a strategy that you like to use?"
- "One cognitive flexibility is taking a step back to **plan before acting**. By creating some mental distance, you can think about what is not working and come up with some alternatives or different approaches."
- "Was there a task that you found difficult in the bus module?"
    - *If yes:* "It is normal to experience difficulty! When having trouble on this task, you can take a step back and plan before acting. That is, you take some time to plan what strategies you have been using and what new strategies you could use. For this task, what other strategies could you use?"
        - *Build on the scenario by referencing the strategies introduced earlier in the training program and in the VR program.*
    - *If no:* "How did you find the grocery store task in the last bus level where you had to remember what groceries to pick up and the order number?"
        - "If one memory strategy was not working, what other strategies could you have used?"
- "A situation can engage many different types of thinking skills and social skills. In the training program, the strategies you learned in the VR program and discussed in these sessions can be applied to many different situations. What strategy you apply to a situation really depends on your personal preference, the reason you are experiencing difficulty in the situation, and the context of the situation."

- "Let us go through a couple of tasks you encountered in the bus module. For each task, we can reflect and discuss how you found the task. Then, if there were any other strategies you could use to help complete the task."
    - *Directions: review 1-2 of the below tasks, depending on what level the participant reached and if there was a task the participant experienced more difficulty with. When reflecting on task performance, ask the participant questions to promote insight. Each task has multiple strategies the participant can use; refer to earlier strategies and the VR program.*
    - Selecting the most efficient bus route.
        - *Example strategies: planning before acting, directing attention inwards, counting number of stops.*
    - Remembering the name of the correct bus stop or remembering what groceries to pick up.
        - *Example strategies: chunking, repetition, verbalization, breathing exercise (for emotion regulation and stress reduction).*
    - Interacting with rude strangers.
        - *Example strategies: breathing exercise (for emotion regulation and stress reduction), perspective-taking, asking clarifying questions.*
- "How can you practice cognitive flexibility in your day-to-day life?"

5. Wrap-Up

- "We are coming to the end of the training program - thank you for participating! It has been great getting to know you and discussing different thinking and social skill strategies."
- "Taking everything we have discussed over the last 6 weeks, what do you think is the take-home message for you?"
    - *Regardless of response:* "In our day-to-day life, we encounter situations that engage our thinking and social skills. In these situations, there are multiple strategies that you can use, and you can apply the same strategy to different situations."
- "What strategies are you planning to keep using?"
    - *Based on their response, prompt them with:* "How are you going to use these strategies?" "What could stand in your way of using these strategies?", or "How can you remind yourself of what you have learned?"
- "The last steps to your study participation are that you are going to meet my colleague next week where you will complete some questionnaires and assessments related to your thinking and social skills. This visit is around 2 hours long, and you will receive $30 for your time."
- "My colleague will also collect some feedback on how you found these training sessions, such as your thoughts on the VR program, what you liked, and what you disliked. Everything is confidential, including your feedback on the VR program. Then in 3 months, you will meet my colleague again to complete the same questionnaires and assessments about your thinking and social skills."
- "Do you have any questions or comments before we end our last training session?"

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ACTIVE CONTROL CONDITION

SESSION 1

1. Introduction

- "Hi, my name is _____. Thank you for being a part of this study. I will be your coach for the next 12 sessions."
- "All of our sessions are set up in the same way. In the sessions, you will be immersed in the VR program, which involves engaging nature walks."
- "You will first do 15 minutes of VR before taking a break for 5 to 10 minutes. During this break, you can grab a drink of water, go to the washroom, stretch, etc. We will also briefly chat about how you are finding the VR program before continuing for another 15 minutes of VR. In total, you will spend around 30 minutes immersed in VR. The second part of the session involves a 10 to 15-minute chat about healthy life habits and how to apply these strategies to your day-to-day life. For today, we will be talking about physical activity."
- "If at any point you are uncomfortable with a topic, we are discussing please let me know. Your comfort is our priority."
- "Do you have any questions before we begin for today?"

2. VR Navigation Instructions

- "In one of your earlier visits, you completed a brief introduction into virtual reality. How did you find it? Before that visit, how familiar were you with virtual reality?"
- "Virtual reality is an immersive and interactive experience in a 3D simulation. It is immersive because you will only see and hear what is displayed in the headset, instead of watching a video on a TV screen that you see on a table in your room. Also, when you move your head left and right, the computer will display what is around you in the environment according to your movements. You might feel like you are surrounded by a new environment and immersed within it."
- "There are two parts of the virtual reality equipment: the controllers and the headset. First, let's take a look at the controllers." [*Give the participant the controllers.]*
- "You will use the left controller to move around in the virtual reality environment. Do you see this joy stick here?" [*point to the joy stick*]
- "You will use this joy stick to change your viewpoint – instead of moving your head to look in another direction, you can use the joy stick instead. For example, if you want to look left, you will push the joy stick left rather than moving your head. If you want to look right, you will push the joy stick to the right." *[Demonstrate the motion for the participant.*]

- "You will also use the left controller to move forward. To do this, you want to use the left trigger button [*show the participant the left trigger button*]. As long as you are holding down the left trigger button, you will move forward in the direction you are facing."
- "Say that I want to move left, I will first use the joy stick and press it left to change the view, so that I am looking left. Then, I would press down on the left trigger button to move."
- "Do you have any questions about the left controller?"
- "You can also use the right controller in the virtual reality environment [*give the participant the right controller]*. The right controller has this option to teleport you long distances in the environment, rather than walking."
- "To teleport, you will press and hold the right trigger button. An arc will appear and will show you where you will be teleported to. You can change how far you will teleport by moving your hand up and down. When you are happy with the distance, you can let go of the right trigger button."
- "Do you have any questions about the controllers?"

[Give the participant the headset]

- "You will also wear a headset, which fits over your head like a helmet. You will see the virtual reality environment like you are seeing it in real life. The headset will also play some music."
- "Do you have any questions? In the first 15-minute block, you can take the time to explore the environment and really attend to what you are seeing and feeling in the moment."
- "Let's try both the headset and controllers and move around for a bit. Once you are comfortable, we can start with exploring the first nature environment."

[Participant puts headset and controllers on]

- "Let's practice changing your viewpoint first. If you want to look left, how would you do it in virtual reality? [*Participant uses the joy stick to look left*]. How would you look right in virtual reality?"
- "Let's practice moving in virtual reality. How would you move forward?" [*Participant uses joy stick to move forward*]."
- "Why don't we try the first level now for 15 minutes."

3. Middle break conversation

- You have completed half of the session. Great job!"
- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"
- "In the second 15-minutes virtual reality block, you will explore the same environment by walking around. In this block, you can also add different nature features, like trees and plants, to the environment. When you were immersed in the environment, did you see the glowing circles around you?"

- "When activated, each circle will add a new feature to the environment. You can use either the left or right controller. To grab onto a circle, you want to hold down the button on the handle and reach out, like you are grabbing onto it. While holding onto the circle, you want to make a flick motion (like you are throwing a ball), and then release the button."

[Show a demonstration]

- "I encourage you to try out the different circles to see what nature features you can add to the environment and continue exploring."

4. Discussion with the participant: Physical Exercise

- "How did you find the VR experience today?"
- "Today, we will discuss physical exercise."
- "How would you describe your physical health?"
    - *Note anything they say, allow them to talk.*
- "Regular exercise also has many physical benefits. What do you think are some benefits of physical activity?"
    - *Regardless of response:* "Exercising reduces the risk of developing some diseases. For example, regular physical activity can lower the blood pressure and improve cholesterol levels, which reduces the risk of having heart disease and having a stroke. Exercising also reduces the risk of developing type 2 diabetes and many forms of cancer including breast cancer, kidney cancer, stomach cancer and many more."
- "When talking about physical exercise, it will look different for everyone. There are some people who like going to the gym and exercising 5 days per week while other people prefer to do daily walks and gardening. Physical exercise can be customized to your preferences and ability."
- We are going to talk today about three types of exercise. The first type is low-intensity activity. While doing a low-intensity activity, you can easily talk in full sentences. Can you think of an example of a low-intensity activity?"
    - *If there is difficulty providing a response:* "It can be difficult to think on the spot, especially in our first session! Two examples of a low-intensity activity are walking and gardening."
    - *If a response is given:* "That is a great example! Is this something you do?"
- "Moderate intensity activity is another type. While doing a moderate-intensity activity, you can still talk in full sentences, but not as easily. For example, someone may enjoy doing a light jog. What are some other examples of moderate intensity activity?"
    - *If there is difficulty providing a response:* "One example is a brisk walk. Does this help you think of another moderate intensity exercise?"
    - *If a response is given:* "Exactly!"
- "The last type of exercise is vigorous intensity. While doing a vigorous intensity activity, you are too breathless to speak in full sentences. If someone is running and they can not speak a full sentence, they are doing a vigorous intensity exercise. Can you think of any other example of a vigorous intensity exercise?"
    - *If there is difficulty providing a response:* "Maybe this is something we can focus on for the at-home activity this week."
    - *If a response is given:* "What made you think of this example?"

- "Intense physical activity is not required to experience all the benefits of physical exercise. Moderate physical activity is enough to feel the effects and is safe for most people."
- "Are there any sports or physical activities that you like to do or want to practice more often?"
    - *Note anything they say, allow them to talk.*
    - *Examples: walking, jogging, swimming, biking, dancing, climbing, etc.…*
- "Would you say that usually, the physical activities you are doing are low, moderate or vigorous intensity?"
    - *Note anything they say, allow them to talk.*
- "No matter the physical activities you decide to do, it is important to always listen to your body. If you ever feel pain or discomfort while exercising, you need to stop and rest before continuing. It can be helpful to go slowly and increase the intensity of your physical exercise progressively."

5. At-Home Activity

- "This has been a great session and I enjoyed talking with you about physical exercise! At each session, we will be working together in coming up with an activity for you to do on your own before our next session. At the next session, we will briefly chat how you found your at-home activity."
- "Taken what we discussed today, what is an activity you can do before our next session?"
    - *Suggestions for at-home activities: practice identifying the type of physical exercise the participant engages in, identifying 2-3 activities for each type of activity, engaging in physical exercise.*
- "Do you have any final questions today?"

SESSION 2

1. Reflect on at-home activity

- "Welcome back! At the beginning of each session, I will check in with how you are doing and make sure that you still want to participate in the study."
- "So, I wanted to catch up with you. I was wondering how the at-home activity went this past week, were you able to include some exercise time in your week?"
- How did you find it? How did you feel about it?"

2. Introduce the module

- "Similar to our previous sessions, you will start with 15 minutes of VR followed by a 5-minute break. In this 15-minute block, you will explore the nature environment. We will then continue for another 15 minutes of VR before moving on to talk about physical activity."
- "Do you have any questions before we begin? Are you ready to begin?"

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience, what you enjoyed?"
- "What did you find difficult?"
- "In the second block of virtual reality, you can add different nature features to the environment."

4. Discussion with the participant : Physical exercise II

- "For today's chat, we are going to continue talking about physical exercise."
- While doing physical exercise, it is good to keep in mind to not forget to take care of yourself. You need to make sure to balance energy in and energy out. The energy in is the form of calories you put in your body by food and beverages. The energy out is the calories you are burning by some basic bodily functions such as heart breathing, digesting, and by physical exercises."
- "Did you think about eating and drinking before your physical exercise last week?"
    - *Note anything they say, allow them to talk.*
- "For some people, it is not easy to find the time to do physical exercise regularly. Making a schedule of your week for your work and your family time can help you find some free time where you can exercise."
- "There are many strategies that exist to help you start exercising. Do you have some ideas about strategies that can help you start exercising?"
    - *Allow them to speak.*
- "For example, you can pair it with something you enjoy. "If you do not like working out very much, you can try to combine physical exercise with something that you love to do. Doing so can help you see working out from a more positive perspective. Is there an activity you like doing?"
    - *If an answer is provided:* "What are your thoughts on ways to combine it with physical exercise?"
    - *If there is difficulty providing a response:* "For example, you can choose to do some physical exercise from home and watch a movie or a tv show that you like at

the same time. That way, it might be easier for you to start exercising and adopt the habits of working out regularly. Can you think of an activity you like to do that may be combined with exercise?"
        - *If there is further difficulty:* "Do you like listening to music? Another option is to go for a walk or a run while listening to some music at the same time."
- "You can also turn exercise into a social activity."
    - "You can ask a friend or family member to join you. Sometimes, it is hard to start exercising, you either do not want to or simply do not have the time. If you are not alone and schedule a specific time to exercise with someone, then there is a higher chance that you feel more motivated."
- "Do you have some ideas of how you can make physical exercise more fun for you?"
    - *Note anything they say, allow them to talk.*
- "Finally, when doing an intense physical activity, do a small warm up session before. This helps prepare your body for the work out, prevent injuries and improve athletic performance. It can also be helpful to have a cool down session after the physical activity. That way, you restore your normal breathing patterns and reduce the chance of feeling muscle soreness."

6. At-Home Activity

- "This week, the homework will be like the one last week. I will ask you to do a 20 to 30-minute work-out/activity of your choice. This time, I want you to note what you drink/eat before your physical exercise. I also encouraged you to pair your exercise with something you love, so it would be easier and more fun.
- "We can talk about this at-home activity in our next sessions."

SESSION 3

1. Reflect on at-home activity

- "So, I wanted to catch up with you. I was wondering how the at-home activity went this past week, were you able to include some physical exercises in your habit? What did you do? Did you pair it with something you like?"

2. Introduce the module

- "Similar to our previous sessions, you will start with 15 minutes of VR followed by a 5-minute break. We will then continue for another 15 minutes of VR before moving on to talk about sleep quality."
- "Do you have any questions before we begin? Are you ready to begin?"

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience, what you enjoyed?"
- "What did you find difficult?"

4. Discussion with the participant: Sleep Quality

- "You have completed the first environment. Excellent job!"
- "So, how did you find the exercises?"
- "Today we're going to talk about the topic of sleep. For today, we are going to look at what a sleep cycle is, and some benefits associated with sleep. At the next session, we chat about different sleep strategies you can include in your day-to-day life ."
- "Have you ever heard about the sleep cycle?"
    - *Allow them to speak.*
- "The brain and body have a built-in clock that controls our sleep. It is like a small control center in the brain that keeps track of the time of day and tells our body when it is time to sleep and when it is time to wake up. When our sleep schedule is inconsistent, it can disrupt this internal clock and make it difficult for us to stay or to fall asleep. This can lead to problems like fatigue. To maintain a healthy sleep routine, we need to establish good sleep habits that align with our body's natural clock."
- "On average how many hours do you sleep at night? Do you have difficulty falling asleep?"
    - *Note anything they say, allow them to speak.*
- "It is also helpful to have sleep timing. If you go to bed and wake up at consistent times, it can help to regulate your body's internal clock and improve your quality of sleep. It can help you to fall asleep more easily and to wake up from bed without the need of an alarm clock."
    - "The recommended amount of sleep for adults is between 7 and 9 hours per night, but this can vary depending on your individual needs. Too much or too little sleep can have negative effects on a person's health and well-being."
- "Do you have a sleep schedule? Usually, what time you go to bed and what time you wake up."
    - *Note anything they say, allow them to speak.*
- "In your opinion, what are the benefits of sleep?"

    - *If a response is given:* "Yes! You have named some benefits to having a good sleep."
    - *If there is difficulty providing a response:* "There are many benefits to having a good sleep. For example, it lowers blood pressure and helps you stay relaxed throughout the day."
- "Can you think of any other benefits that a good sleep can have on your body or your mind?"
    - *If a response is given:* "Yes, that is another benefit to good sleep."
    - *If there is difficulty providing a response:* "It can also have a positive effect on thinking, as we are less tired. It allows our bodies to recover each day and to gain back some energy."
- "There are different habits someone can do to help them sleep or feel rested. Can you think of some examples of sleep habits?"
    - *If a response is given:* "Yes! These are great habits to have to experience a better sleep. Is this something you do to help sleep or feel rested?"
    - *If there is difficulty providing a response*: "At the next session, we will talk more about different sleep strategies! We talked about a sleep cycle and one of the ways we can help establish it is to have a sleep schedule where they go to sleep and wake up at a certain time. What strategies could you do to create a sleep schedule?"
        - *Examples include setting an alarm, wind-down routine, etc.*

5. At-Home Activity & End of Session

- "For your at-home activity, I encourage you to include a healthy sleep pattern. Taking what we discussed today, what is an at-home activity you could do before our next session?"
    - *Example at-home activities are:*
        - *Reflecting on how to create a sleep schedule.*
        - *Incorporating a strategy, the participant brought up into sleep.*
        - *Reflecting on the benefits of sleep and activities that impact it.*
    - "We will discuss this at-home activity at our next session."
- "Do you have any questions about today's session or about your at-home activity?"

SESSION 4

1. Reflect on at-home activity

- "Welcome back!"
- "I wanted to catch up with you and discuss last week's at-home activity."
- "Last session, I encouraged you to try to include a healthy sleep pattern."
- "Were you able to adopt a sleeping schedule?"
- "Was it hard for you to create this schedule and to follow it?"
- "How did it make you feel?"

2. Introduce the module

- "This session will be just like last week's session. You will start with 15 minutes of VR. Following a 5-minute break, we will continue with another 15 minutes of VR. We will then finish our session by talking about sleep quality."
- "Do you have any questions before we begin for today? Are you ready to begin?"

3. Middle break conversation

- "Half of the session is now completed. How do you feel? Are you enjoying it so far?"
- "Is there anything you found difficult?"

4. Discussion with the participant: Sleep Quality

- "Do you have any questions about today's session or about your at-home activity?"
- "You have completed the first environment. Wonderful job!"
- "So, how did you find the exercises?"
- "Today will be discussing how certain things we do (e.g., sleep) can affect the way we feel and think. If at any point you are not comfortable discussing something please let me know, it is fine."
- "Do you face any challenges when you try to get a good sleep?"
    - *Note anything they say, allow them to talk.*
- "In your opinion, what strategies can help you have a better sleep when some challenges are encountered?"
    - *If a response is given: "*That is a good point! Have you tried this strategy? Did it help?"
    - *If there is difficulty providing a response:* "If we have difficulty with sleep, there are several things we can try. For example, you can create a relaxing bedtime routine that helps you calm down and relax before bed."
- "Can you think of any activities that can help you relax?"
    - *If a response is given:* "These are great examples of relaxing activities!"
    - *If there is difficulty providing a response:* It can be taking a warm bath, reading a book, or listening to calming music."
- "Do you have a relaxing bedtime routine?"
    - *Note anything they say, allow them to talk.*
- "Another hint is making the room dark and conducive to sleep; do you have curtains? We can also do things to make the bed more comfortable; do you have sheets and a blanket? What kind of pillow do you use? Try to make sure that you are comfortable.

- "Watching TV or looking at a screen before sleeping can keep us awake. Reducing screen time before sleep can positively affect our sleep. Are there any alternative screen-free activities you do before going to bed?"
    - *If a response is given:* "Yes. Is it something that you do sometimes before going to bed?"
    - *If there is difficulty providing a response:* "For example, reading a book or listening to music can be alternatives to watching tv."
- "If you have any trouble sleeping at night, you can try to avoid napping during the day, as this can make it harder to fall asleep at night."
- "Finally, eating habits also have effects on sleep. We will talk about that subject later, but consuming food with high levels of sugar and fat is linked to disrupted sleep patterns. You can also reduce caffeine and alcohol before bedtime before they can disrupt the heartbeat and interfere with sleep quality."
- "From our discussion, is there anything you can think of or do to make your sleep better?"
    - *Example: you can try counting while laying in bed or you can take deep, slow breaths until you feel sleepy.*

6. At-Home Activity & End of Session

- "For your at-home activity, I encourage you to try a strategy to improve your sleep. It can be one that we discuss together today, or it can be something else that you do think will be good for your sleep habits."
- "We will discuss this at-home activity at our next session."

SESSION 5

1. Reflect on at-home activity

- "Welcome back!"
- "I wanted to know how your at-home activity went this past week."
- "Last week's at-home activity was to try a strategy to improve your sleep."
- "Was there a time this past week where you were able to try one of the sleep habits we talked about?"
- "Do you feel like it helped you fall asleep or made you sleep better?"

2. Introduce the module

- "We will start this session with 15 minutes of VR followed by a 5-minute break. We will then continue with another 15 minutes of VR, and lastly, we will talk about eating habits."
- "Do you have any questions before we begin?"

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"

4. Discussion with the participant: Eating habits

- "You have completed the whole environment today. Great job!"
- "So, how did you find it?"
- "In the last couple of sessions, we talked about physical exercise and sleep. Today we will discuss eating habits. If at any point you are not comfortable discussing something please let me know, it is fine."
- "A part of good physical health is eating well. Eating well can mean different things to different people."
- "How would you describe your eating habits? What does eating well mean to you?"
    - *Note anything they say, allow them to speak.*
- **"**For some of us, healthy eating can mean having three meals a day, while to others it can mean having a balanced diet. No matter what it means, eating well makes us feel good and helps us remain physically healthy."
    - "Is there a meal or certain food you would like to eat? Or one you would like to eat more often? Or something you would like to cut out?"
        - *Note anything they say, allow them to speak.*
- "Is there a specific eating goal you would like to reach or an eating goal you would like to continue to do?"
    - If there is difficulty providing a response: "Some eating goals that a person may make is to do more of something, like drink more water. Is there a food you would like to eat more or less?"
- There are a lot of small actions that you can do to have a healthier diet. In your opinion, what can they be?"
    - *If a response is given*: "Yes, it's a good way to eat healthier."

    - *If there is difficulty providing a response*: "For example, you can eat fresh fruit at least once a day, eat breakfast at least twice a week, or eat fast food only twice a week."
- "Most of the time, it is the preparation method and the type of ingredients used that make our meals unhealthy. For that reason, eating unprocessed foods like fruits, vegetables, and fresh meat is a good start when trying to have a healthy diet."
- "One strategy is to plan your meals in advance. If someone is trying to drink more water, they may carry a water bottle with them. How could we apply the strategy of planning your meals to your eating goal?"
    - *If a response is provided:* "Can you describe what your planning looked like? Do you feel like it helped you?"
        - *Note anything they say, allow them to speak.*
    - *If there is difficulty providing a response:* "For some people, creating a detailed meal schedule is a good strategy to help them balance their diet and their everyday life. Preparing some of the ingredients of the meal in advance can make the preparation easier at the end of a long day."
- "In your opinion, what are some other strategies that you could use?"
    - *If a response is given*: "Yes, these are great strategies! What are your thoughts on trying out these strategies?"
    - *If there is difficulty providing a response*: "You can try to eat smaller portions or even eat your meal slowly. If you eat too fast, you might not have the time to notice if you are still hungry or not."
- "Another component of healthy eating is to drink water. How much water do you estimate you drink every day? What are your thoughts on the amount of water you drink, like are you happy with the amount you drink?"
    - *Note anything they say, allow them to speak.*
- "A common experience is that a lot of people do not drink enough water. When you are not drinking enough water, you might get dehydrated."
- "Drinking more water is especially important when the temperature is hot, when you are doing physical exercise, or when you are feeling sick."

5. At-Home Activity

- "Your homework for this week will be to try to eat more healthily. This could mean trying to add one of the healthy habits we talked about today."
- "What is something you can do over the next few days to improve your eating habits?"
    - *If the participant has difficulty responding*: "What do you think about drinking a little more water than you usually do?"
    - *If the participant suggests an idea*: "That is a great idea! You can try to add this to your eating habits, and we will talk about it the next time we see each other."
- "Do you have any questions about today's session or your at-home activity?"

SESSION 6

1. Reflect on at-home activity

- "Welcome back!"
- "Last week, your at-home activity was to try to eat more healthily."
    - "What healthy eating habits did you try to include this week?"
- "Did you find it difficult?"
- "How did you feel about adding this to your routine?"

2. Introduce the module

- "Just like last session, we will start with 15 minutes of VR, followed by a 5-minute break, and then continue for another 15 minutes of VR."
- "For today's discussion, we are going to talk about what is self-esteem."
- "Do you have any questions before we begin?"

3. Middle break conversation

- "We have now completed half of the session. Can you tell me a little bit about how it went? Is there anything that you enjoyed or disliked?"
- "What did you find difficult?"

4. Discussion with the participant: Self-Esteem

- "You have completed the whole environment today. Wonderful job!"
- "So, how did you find it?"
- "Today we will discuss self-esteem and strategies to improve self-esteem. If at any point you are not comfortable discussing something please let me know, it is absolutely fine."
- "How would you describe self-esteem?"
    - *If a response is given*: That is a great explanation!"
    - *If there is difficulty providing a response:* "Self-esteem is how you see yourself and the value, you bring to yourself. Self-esteem describes the level of confidence you have in your abilities, your characteristics, and your worth. "
- "Why do you think having good self-esteem is helpful ?"
    - *If a response is given*: Yes, these are all good reasons!"
    - *If there is difficulty providing a response:* "Self-esteem affects how you view life, how you make decisions, and how you relate to others. It also affects your overall well-being and your capacity to tell others your opinions and share your needs.
- "Motivation can also be affected by the level of self-esteem. Why may self-esteem affect motivation and how?"
    - *If a response is given:* "Yes, you are right!"
    - *If there is difficulty providing a response:* "It affects how much you believe you can do something. The more self-esteem individuals possess, the more they feel they have the skills to take on new challenges and excel."
- "Can you tell me a bit more about your self-esteem?"
    - *If a response is given*: "Thank you for sharing this with me."
    - *If there is difficulty providing a response:* "There are certain characteristics that can detect whether individuals have good self-esteem. For example, how do you feel when you receive a compliment or criticism? "

- "Can you think of some strategies that can help you improve your self-esteem?"
    - *If a response is given*: "Yes! These are great strategies to improve your self-esteem! Have you ever tried one of these? Did it help you to improve your self-esteem?"
    - *If there is difficulty providing a response:* "There are a lot of strategies, you can apply to improve your self-esteem. For example, you can identify the negative thoughts and beliefs you have about yourself. Once it is done, you can take a moment to ask yourself if these really represent who you are."
- "Another example is to remember all the things you accomplish and identify positive things about yourself. For example, I am proud of finishing school. Is there anything that you did in your life that makes you proud?"
    - *If a response is provided:* "What happened? How does it make you feel when you are thinking about it now?"
    - *If there is difficulty providing a response:* "Maybe this is something you could focus on for next session."
- "Another thing you can do to improve your self-esteem is to accept new challenges. Do you sometimes accept doing new things that bring you out of your comfort zone?"
    - *Allow them to speak*.
- "Even if it looks difficult to achieve, you can accept these new challenges. So, when you succeed, you will be proud of yourself, and it will show you can achieve a lot of things."

5. At-Home Activity

- "For your at-home activity, I encourage you to try a strategy to improve your self-esteem.
    - *Example at-home activities:*
        - *Writing down one little success you accomplish in your day.*
        - *Identifying negative thoughts about oneself and asking if they are accurate.*"
- "We will discuss this at-home activity at our next session."
- "Do you have any questions about today's session or about your at-home activity?"

SESSION 7

1. Reflect on at-home activity

- "How are you doing today?"
- "We are about halfway through the training program! How are you finding it?"
    - *If needed, discuss ways to tailor the program to the individual (e.g., changing the amount of time spent on the VR program)*
- "I was wondering how the at-home activity went this past week?"
    - *If it was completed*: "How did you feel about this? Did it help you feel better?"
- If it were not completed: "What are some strategies you could do to help complete the at-home activity?"

2. Introduce the module

- "For today's session, you will complete various exercises. We will do 15 minutes of VR, have a break of 5 minutes, and then continue for another 15 minutes of VR. Then, we will talk about self-care before coming up with an activity for you to do on your own."

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"

4. Discussion with the participant: Self-care

- "You have completed the session for today. Great job!"
- "How did you find the environment?"
- "Today we will be speaking about self-care.
- What does "self-care" mean to you?"
    - *Note anything they say, allow them to speak.*
- "Taking care of ourselves can mean a lot of things. When talking about self-care, we are referring to the habits an individual does to look after their own health and well-being, like , food, lifestyle, hygiene, and social habits. Everyone's self-care habits can be different; one person may focus on taking a shower while another person may focus on exercise."
- "What are some examples of self-care?"
    - *If no response is provided:* "There are many different self-care activities, and what one person likes, another person may not like. For me, I like to go on nature walks. Does this example help you think of what a self-care activity could look like?"
    - *If a response is provided:* "Thank you for sharing. How often are you practicing this activity?"
        - *Note anything they say, allow them to speak.*
        - *Do not congratulate them as this can sound patronizing. Just thank them for sharing and then use their example as you talk about other areas of self-care.*
- "What do you think are some benefits of self-care?"
    - *Regardless of response*: "We can feel more positive, more confident, less stressed, or even have thoughts that are more positive. Our lives can be incredibly busy, and

we can easily forget to take care of ourselves, so self-care allows us to focus on ourselves. I We can take the time to put ourselves first and to take a break from the many responsibilities that we have."

- "Today, we will be talking about two different types of self-care: emotional and physical."
- "Have you heard of emotional self-care before? How would you describe it?"
    - *Regardless of response:* "Emotional self-care is spilt up into two parts: the first part is being aware of how you are feeling. Afterwards, someone will then find a way to channel those feelings so they will be beneficial for your health. Your emotions have a direct impact on your daily life. Being aware of them and understanding them can help you be more equipped for obstacles in your life."
- "Emotional self-care are the activities that help you relax and allows you to not feel overwhelmed by your emotions. For example, having a short break from a task if you feel like you have been working on it for too long or practicing gratitude."
- "Can you think of other types of emotional self-care activities?"
    - *Allow active exploration.*
    - *Example activities include: taking some alone time to do activities that you love like reading or watching a movie, having lunch with friends and family members, and saying no to a request made by someone else if you already have too many things to do.*
- "Another type of self-care is physical self-care. There is a strong connection between the body and the mind, and it can be helpful to take care of your basic physical needs."
- "Physical self-care regroups activities that focus on the health of our body and makes sure that it has everything it needs to work well. What are some types of physical self-care activities?"
    - *Examples: taking the time to have good personal hygiene. This can include brushing our teeth, washing our hair and body, and wearing clean clothes.*
- "Physical self-care also includes activities such as attending healthcare appointments and taking any prescribed medications."
- "The main component of self-care is listening to yourself, to your body and to your needs. By being aware of your own limits, you can make sure that you do not overwork yourself. Self-care is also different for everyone. Each person needs to find what allows them to feel good, and it might change from day to day."
- "We talked about a lot of self-care activities today. Are there one or two activities that interest you that you think you could add to your routine to further integrate self-care to your life?
    - *Allow them to speak.*

5. At-Home Activity

- "Your at-home activity will be to add emotional and physical self-care activities to your routine."
- "Do you have an idea of which one of the activities we talked about you would like to add to your life?"
    - *If the participant gives an idea*: "That's a great idea!"

SESSION 8

1. Reflect on at-home activity

- "How are you doing today?"
- "Great! So, I wanted to catch up with you. I was wondering how the at-home activity went this past week, were you able to include some self-care activities in your routine?"
    - *If the participant completed the homework*: "Great! How did you feel about adding these new habits? What did you do as emotional and physical self-care activities?"
    - *If the participant did not complete the homework:* "Do you think there is something that could have helped you to add self-care activities to your routine?"

2. Introduce the module

- "During this session, you will complete various exercises. Just like last session, we will be focusing on tasks in the same environment as last time. We will do 15 minutes of VR, have a break of 5 minutes, and then continue for another 15 minutes of VR. Is that good for you?"

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"

4. Discussion with the participant: Social media use

- "You have completed the levels for today. Great job!"
- "So, how did you find the exercises?"
- "Today we will be speaking about social media use. "To start, can you tell me a little more about your use of social media, like the ones you use? How often do you use them?"
    - *Note anything they say, allow them to speak.*
- "Having healthy social media habits can mean a lot of things. Social media can have positive effects on us when we use it a certain way, but it can also have negative effects if we are not thoughtful about our use of it."
- "One example of a positive effect social media can have been that it can help you stay connected to your friends and family. Can you think of any other positive effects social media may have?"
    - *If a response is provided:* "That is a great example! Why may it be helpful?"
- "How do you think excessive use of social media can have a risk on different aspects of our lives?"
    - *If the participant responds adequately:* "Absolutely! These are all possible risks if we have an unhealthy use of social media."
    - *If the participant responds adequately: "*Do not worry about it, it is something that few people know! One of the possible risks of excessive use of social media near sleep time is the possibility of reduced sleep quality. Also, if you spend a lot of time on social media, your quality time with those around you may decrease and your satisfaction with your relationships may be lower."
- "The impact of social media depends on how a person uses it. Can you think of some examples of healthy social media habits that we can have?"
    - *Note anything they say; allow them to speak.*

    - *If the participant responds adequately:* "Yes! Those are great examples of good social media habits." *Explain other strategies if necessary.*
    - *If the participant has difficulty responding:* "It can be helpful to limit the time you spend on social media. To reduce the time we spend on social media, we first have to be aware of the time we spend on it per day."
- "How much time do you spend on social media?"
    - *No matter what the response is:* "It is good that you have an idea of how much time you spend on it. Do you think you spend too much time on social media or is it an appropriate amount of time? "
- "What would be a reasonable amount of time for you to use social media?"
    - *Note anything they say, allow them to speak.*
- "One strategy is to limit the amount of time spent on social media and when someone uses it. For example, someone may choose to not spend time on social media 30 minutes before they go to sleep. How could you apply this strategy to your life?"
    - *Possible strategies: not checking social media when waking up in the morning, goal of how many hours to spend each day, refrain from social media before going to sleep, etc.*
- "Another social media habit is to interact with people that bring positivity to your life. It may be appropriate to unsubscribe from pages and people that bring us negative emotions. Following people and pages that bring us joy will improve the relationship we have with social media."
- "Finally, you can also disable notifications during a certain time of the day. This will help you limit your time on social networks and focus on the things you consider more important in your life."
    - "Do you think that you would be able to disable notifications? Do you think it can help you?"

5. At-Home Activity & End of Session.

- "For your at-home activity, I will ask you to try to spend a little less time on social media than you usually do. Was there a specific social media habit that stood out to you?"
- *If there was a habit identified by the user:* "That is a great idea! You can try to implement this habit this week and we will talk about it next time we see each other."

SESSION 9

1. Reflect on at-home activity

- "Welcome back!"
- "How are you?"
- "Great! We will begin by talking about your homework from last week."
- "I wanted to know how your at-home activity from last session went?"

2. Introduce the module

- "For this session, you will complete various exercises. Today we will begin a new environment. We will do 15 minutes of VR, have a break of 5 minutes, and then continue for another 15 minutes of VR."
- "Is that good for you? Do you have any questions?"

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"

4. Discussion with the participant: Procrastination

- "You have completed the session for today. Excellent job!"
- "How did you find the environment?"
- "Today we will discuss procrastination. How would you describe procrastination?"
    - *Note anything they say, allow them to speak.*
- "Procrastination is when you delay or postpone something that you have to do. "
- "Can you think of a moment in your life when you delayed something you had to do? It can be either at work, at school or in your everyday life."
    - *Note anything they say, allow them to speak.*
    - *If a response is provided*: "Thank you for your sharing! Did this delay have any consequences?"
        - *If the response is "no":* "Can you think of any consequences that procrastination may have on your life?"
- "Procrastination can have a negative impact on someone's life. What do you think are some of the ways that procrastination can impact someone's life or well-being?"
    - *Regardless of response:* "Procrastination is a common problem and can lead to worse academic performance, increased interpersonal relationship issues, reduced wellbeing, and worse mental and physical health. Many of these issues are connected. For example, procrastination can cause stress which can then lead to worse physical health or even worse professional performance."
- "Do you have an idea of an explanation about why people can procrastinate? Why do people procrastinate?"
    - *Note anything they say, allow them to speak.*
    - "For many people, procrastination is a way to avoid any negative emotions that can come with long and difficult tasks. Sadness, doubt, and anxiety usually come with the fear of failing a task. One way to avoid those potential negative emotions is to never start the task."

- "Stopping procrastination can help break the endless cycle of consequences that it can cause. If you delay a task that has a deadline, it will most likely increase your stress level. This stress will lead you to continue delaying the task and therefore your stress level will continue to increase.
- "What do you think are some strategies to reduce procrastination?"
    - *If a response is provided:* "How may the strategy help reduce procrastination? Is this something you do?"
    - *If there is difficulty providing a response:* "There are different techniques that can help reduce procrastination and limit its negative effects. For today, we will cover 2 strategies."
- "One strategy is to t reward yourself after you have completed a long and challenging task. How may rewarding yourself help with lowering procrastination?"
    - *Regardless of response:* "Rewarding yourself is a great way to motivate yourself to accomplish difficult tasks. It does not have to be a huge reward. You can decide to reward yourself after every small step, or once the task is completed. Whichever option suits you, the reward needs to be something that you like and that will help you feel good about what you have accomplished."
- "Can you think of any reward you could give yourself once you've completed a task?"
    - *Note anything they say, allow them to talk.*
    - *Allow active exploration. Examples of rewards include: taking a small break before starting a new task, watching a movie you have been wanting to see for a while, or spending time with your loved ones.*
- "How could you apply this strategy of rewarding yourself after completing a task to your day-to-day life?"
- "To avoid procrastination, we can also cut out distractions. What are some ways you can limit distractions while completing a task?"
    - *If a response is provided:* "Is this a strategy you like to do?"
    - *If there is difficulty providing a response:* "Do you keep your phone or another electronic device on you? How could you limit any notifications from these devices?"
- "Some ways we can limit distractions is to do a task in a room where you are by yourself and would not be distracted by others around you. Another way is to turn off your app notifications on your phone or turn the device off.""

5. At-Home Activity

- "Your at-home activity will be to try to reduce your procrastination. Is there a task that you need to do later this week?"
    - *If there is a task:* "we covered two strategies today - rewarding yourself after completing the task and limiting your distractions. How could we apply one of these strategies to help complete the task?"
    - *If there is difficulty responding:* "do you need to do any household cleaning or chores this week? How could we apply either rewarding yourself after completing the task and limiting your distractions to this situation?"
- "We will discuss this at-home activity at our next session."

SESSION 10

1. Reflect on At-Home Activity

- "Welcome back!"
- "So, I wanted to catch up with you. I was wondering how the at-home activity went this past week, were you able to include some anti-procrastination techniques? What were they? How did you feel about them?"
- "How do you think they help you?"
- "What do you think can be done to improve this exercise?"

2. Introduce the module

- "During this session, you will complete various exercises. We will be focusing on tasks in the same environment as last time. We will do 15 minutes of VR, have a break of 5 minutes, and then continue for another 15 minutes of VR. Is that good for you?"

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"

4. Discussion with the participant: Motivation

- "You have completed the levels for today. Great job!"
- "How did you find the exercises?"
- "Today we will be discussing motivation. "What does motivation mean to you?"
    - *Note meaning and exchange ideas.*
    - *Regardless of response:* "Being motivated can have many meanings. In general, being motivated means that we feel we have a reason for doing something. That is, we want to do it, and we do it."
    - "Can you give me an example of a situation when you were motivated?"
        - *Note anything mentioned.*
        - *Do not correct them. Allow them to speak.*
- "Are there certain areas in which you would like to be more motivated?"
    - *Prompt:* "Many activities like cleaning a room, reading, and playing a game all require motivation. What is your motivation like when completing these activities?"
    - *If the participant is unable to provide an example, ask*: "Can you think of a situation where you had trouble with your motivation?"
    - *Normalize the situation with a personal example. This shows that we all experience this from time to time.*
- "There are many strategies we can use to help feel motivated or maintain our motivation levels. Are there any strategies you like to use?"
    - *Note anything the participant mentions; allow them to speak.*
- "We will spend a few minutes talking about three strategies that can help us feel motivated. The first strategy is to reflect on past accomplishments. How may reflecting on past accomplishments help with motivation?"

    - *Regardless of response*: “By highlighting past accomplishments, it can l help you remember all the progress you have made. This will help you believe in your abilities and make you feel capable of accomplishing new challenges, which will help you feel more motivated.”
- “When reflecting on accomplishments, the focus is on you reaching them, rather than how big or small they seem to be.”
- “The second strategy is to make “to-do” lists, which can give you a good idea of what needs to be done. As you complete and check off on the tasks on the list, it can help motivate you to continue completing the rest of the tasks.”
- “Did you ever try to make a to-do list to help you accomplish the task you have to do? Did it help you to be more motivated?”
    - *Regardless of response:* “Are there any tasks you need to do in the next couple of days?”
- “The final strategy is to ask yourself what are the 3 main reasons I want to do this? By asking yourself this question, it acts as a reminder of why you started the task.”
    - “Are there any tasks you are completing, and what are your main reasons behind it?”
- "Now that we've seen some strategies together to help increase motivation, which one do you think would be most effective for you?"
    - *Note anything they say, allow them to speak.*
    - *Therapists need to AVOID:*
        - *Ordering, directing, commanding, warning, or threatening, advice, suggestions, providing solutions, preaching, telling clients what they "should do", disagreeing, judging, criticizing, blaming, shaming, ridiculing, labeling, interpreting, or analyzing history.*

5. At-Home Activity & End of Session

- “Your at-home activity will be to try to include more motivating exercises in your daily life that help you accomplish your goals. How could we apply one of these three strategies to your day-to-day life?”
- Example tasks: *cleaning your room, organizing your fridge, doing an at-home activity, or even helping those around you.* ”Do you have any final questions today?”

SESSION 11

1. Reflect on at-home activity

- "Welcome back!"
- "How are you?"
- "Great! We will begin by talking about your homework from last week."
- "How did the at-home activity go this past week?"
- "Did you feel as though it helped you be more motivated? How are you feeling today?"

2. Introduce the module

- "Today, we will be completing another module! Just like last session, we will start with 15 minutes of VR, followed by a 5-minute break. Then we will continue for another 15 minutes of VR and then chat about goal setting."
- "Do you have any questions before we begin for today?"

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"

4. Discussion with the participant: Self-compassion

- "You have completed the levels for today. Great job!"
- "How did you find the exercises?"
- "Today we will be discussing self-compassion. How would you describe self-compassion?"
    - Allow them to speak.
    - *Regardless of the response:* "Self-compassion means being kind to yourself when things are difficult. It is understanding that having difficulties is normal and that you deserve care just like anyone else. It is also about being aware of our feelings and behaviors without judging them too harshly."
- "How do you think you can incorporate more self-compassion into your daily life?"
    - *Allow them to speak.*
- "There are a couple of strategies that can increase self-compassion. One strategy is to do things you enjoy love when you are having a difficult moment or challenge. In these situations, what are some activities you could do??"
    - *Allow them to speak.*
    - *If there is difficulty providing a response:* "You can do anything you enjoy. For example, I like taking a walk or drinking tea. Do you have any favourite activities or food?"
- "When you give yourself permission to do things you enjoy, it is like being kind and caring to yourself. It can bring you comfort, relief, and support when things are tough. Taking time for activities that make you happy is a way of recognizing that you deserve moments of joy even when life is more difficult."
- "Another strategy is to forgive yourself when you are making a mistake and remember that everybody will experience some failures."
    - "When you make a mistake or experience failure, how do you react? "

        - *Allow them to speak.*
    - "Thank you for sharing with me. What can you say to yourself to have more self-compassion?"
        - *Examples of things we can say: "It's okay to make mistakes. Failure is a part of learning and growing." "I am not defined by my failures. I have many strengths and abilities."*
- "The last strategy we will be talking about today is to be kind to yourself. How can you be kind to yourself?"
    - *Allow them to speak.*
    - *Regardless of response:* "Being kind to yourself involves offering encouragement and having positive thoughts about yourself. It also means to reduce self-criticism and negative self-talk by replacing them with kinder and more supportive words."
- "What encouragement could you say to yourself?"
    - Allow them to speak.
    - Examples of things we can say: "I am proud of myself for who I am and how far I've come." "I am deserving of love, compassion, and understanding.

6. At-Home Activity & End of Session

- "Your at-home activity will be to integrate more self-compassion by using one of the techniques we talked together today. It can be to do things you love when you are having difficult moments, to be kind to yourself or to forgive yourself more easily when you are making mistakes."
- "We will discuss how you integrate those elements at our next session."

SESSION 12

1. Reflect on at-home activity

- "Welcome back!
- "Today is our last session together - how are you feeling?"
- "Let us begin by talking about your homework from last week. I was wondering how the at-home activity went this past week? How did you incorporate more self-compassion?"

2. Introduce the module

- Just like last session, we will start with 15 minutes of VR, followed by a 5-minute break. Then we will continue for another 15 minutes of VR and then chat about positive thinking."
- "Do you have any questions before we begin for today?"

3. Middle break conversation

- "Now that you have completed approximately half of the session, can you tell me a little bit about your experience and what you enjoyed?"
- "What did you find difficult?"

4. Discussion with the participant: Positive thinking

- "You have completed the levels for today. Great job!"
- "So, how did you find the exercises?"
- "Today we will be discussing positive thinking. "How would you describe positive thinking?"
    - *Note anything they say, allow them to speak.*
    - *Regardless of the response:* "When talking about positive thinking, it does not necessarily mean that you are ignoring the negative aspects of a situation. Rather, positive thinking is a balance between acknowledging a negative or distressful part of a situation with refocusing on a positive aspect (think about changing your mindset)."
- "What effect do you think positive thinking can have?"
    - Note anything they say, allow them to speak.
    - "Positive thinking throughout our day can help reduce our stress. It can help us see and experience fewer negative things in our lives."
        - "For example, the daily gratitude journal-keeping exercise was shown to increase levels of positive states of alertness, enthusiasm, determination, attentiveness, and energy.
- "There are many different ways we can incorporate positive thinking into our lives. What do you think are some ways?"
    - *Allow them to speak.*
- "For today, we are going to go through 3 common positive thinking strategies. The first one is a simple appreciation and acknowledging any successes. When engaging in simple appreciation and acknowledging any successes, the focus is that you have completed it rather than how "big" or "small" it is."
    - "One exercise is to note 3 positive things each day, no matter how small. For example, I woke up today without hitting the snooze button on my alarm, I ate a

donut, and I cleaned my room. You can either note these 3 things to yourself or write it down in a journal."
    - "Can you think of3 simple appreciations or successes you have completed recently?"
- "The second strategy for having positive thinking is to practice gratitude. How would you describe gratitude?"
    - *Regardless of response*: "Gratitude is about having a mindset of appreciation for the positive aspects of life. For example, expressing gratitude by thanking someone, such as a bus driver. Gratitude involves recognizing the impact of the actions of others. It encourages us to focus our attention from what is lacking or negative to what is present and positive. By integrating gratitude into our daily lives, we can experience its effects on our well-being."
- Can you think of a time where you expressed gratitude?"
    - *Allow them to speak.*
    - "Another exercise is to express gratitude each day and keep track of your gratitude's in a journal. That way, when you are experiencing some difficulty in practicing positive thinking, you can look at the journal to remind yourself."
- "The final strategy is to savor good moments. Savoring is about intentionally stopping in a moment and carefully feeling the positive emotions we experience. For example, when walking outside, taking the time to look at the trees, sky, and grass allows us to connect with nature and find beauty in the simple things. It allows us to slow down and appreciate the positive aspects of our lives.
- "Can you think of a time recently where you savoured a good moment?"
    - *If there is difficulty providing a response:* "Another example of savouring a good moment is to fully immerse ourselves in the scenes of a favorite movie, allowing us to engage with the emotions and storyline. Do you have a favourite activity to do?"
        - *If a response is provided:* "Taking the time to stop in the moment and immersing yourself in what you are feeling is an example of savouring a good moment."
- "A related strategy is mindfulness. Have you heard of mindfulness?"
    - *Regardless of response:* "Mindfulness is an exercise where we allow things to happen. There are things we cannot change and sometimes it is better to acknowledge and accept them. For example, we cannot change the weather. If it is raining or snowing, instead of being upset, we can acknowledge the weather and continue with our day."

5. Wrap-Up

- "We are coming to the end of the training program - thank you for participating! It has been great getting to know you and discussing different thinking and social skill strategies."
- "Taking everything we have discussed over the last 6 weeks, what do you think is the take-home message?"
    - *Regardless of response:* "There are a multitude of lifestyle habits that we can integrate into our lives to improve our personal and interpersonal well-being. "
- "What strategies are you planning to keep using?"

    - Based on their response, prompt them with: “how are you going to use these strategies,” “what could stand in your way of using these strategies,” or “how can you remind yourself of what you have learned.”
- “The last steps to your study participation are that you are going to meet my colleague next week where you will complete questionnaires and assessments related to your thinking and social skills. This visit is around 2 hours long, and you will receive $30 for your time.”
- “My colleague will also collect feedback on how you found these training sessions, such as your thoughts on the VR program, what you liked, and what you disliked. Everything is confidential, including your feedback on the VR program. Then in 3 months, you will meet my colleague again to complete the same questionnaires and assessments about your thinking and social skills.”

“Do you have any questions or comments?”

Supplementary Methods II – Details of ThinkTactic VR Module and control condition

Restaurant module.

The first module is taking place in a restaurant. In the first level, the participant must move around the restaurant tables to ask customers what they want to eat and drink and recall orders to repeat them in the kitchen. Encoding strategies are explained to help them better memorize items. In level two, participant performs the same tasks as in Level 1. However, the task is distracted by music and conversation in the background to solicited divided attention. In the next level, the participant is again asked to perform the same tasks and has the same distractions as in the previous two levels. However, customer orders contain more elements to be memorized. Finally, level four increases in difficulty compared to level three, by adding items to the orders.

Apartment module.

The second module is taking place in an apartment. In the first level, the avatar introduces the apartment and explains how the module works. The participant must move towards the objects that are illuminated to use them. In level two, the participant must choose a healthy meal from the fridge and reheat it within an appropriate time. The participant must solve a plumbing problem by contacting the appropriate person. He must then recall what he was doing before this event to finish what he had started. In the next level, the participant must interact with and introduce himself to a stranger. He will then take part in a game with his roommate and friend where general knowledge will be solicited. He must also choose a meal according to dietary constraints before returning to the game and recalling what was happening. Finally, in the last level, the participant must hold a conversation with a stranger. He will have to play the same game as in previous level. He will then have to order food for three people on a set budget and re-enter the game. He'll also have to pay a deliveryman, leave a tip and interact with him when the wrong amount of change is given.

Bus module.

The last module was a bus environment. In the first level, the participants must select the most efficient bus route to reach his destination. They must also memorize the name of their bus stop so they can get off at the right time. In level two, the participant must also select the most efficient bus route, from among three choices. He will also have to give directions to an individual asking for help with the bus route. He'll then have to disembark at the right bus stop, surrounded by a variety of noises. In addition of these tasks, in level three, the participant will have to change route following an unforeseen event on the bus. The participant will have to interact with individuals in situations that may make him or her uncomfortable (with a woman, while her baby is crying, and with a disgruntled passenger). Finally, in the last level, the participant needed to get off the bus and go to the grocery store to buy bread on the way home. Throughout the session, he must remember the names of his stops so that he disembarks at the right time. Later, the participant will be given an additional task in which he must remember the contents and number of his roommate's grocery order. There will also be a task where the cashier will give him the wrong change following his purchase, and he will have to choose how to intervene with him. In addition, the participant will have to choose how to react to passengers who stare and whisper to each other during the journey.

Table 1.

Content of the sessions for the intervention condition:

	Session 1	***Session 2***
Week 1	***Module**:* Restaurant ***Targeted cognitive domains:*** Working memory, semantic encoding ***Post-VR discussion topic*:** Working memory	***Module**:* Restaurant ***Targeted cognitive domains*:** Working memory, semantic encoding ***Post-VR discussion topic*:** Encoding strategy of segmentation
	Session 3	***Session 4***
Week 2	***Module**:* Apartment ***Targeted cognitive domains:*** Information processing, daily functioning skills, problem solving, social cognition, attention, memory ***Post-VR discussion topic*:** Emotion regulation	***Module**:* Apartment ***Targeted cognitive domains:*** Social cognition, attention, memory, multitasking, executive functions, working memory, short-term memory ***Post-VR discussion topic*:** Coping with stress and anxiety
	Session 5	***Session 6***
Week 3	***Module**: B*us ***Targeted cognitive domains:*** Executive functions, attention, decision making, social cognition ***Post-VR discussion topic:*** Planning	***Module**: B*us ***Targeted cognitive domains:*** Working memory, executive functions, attention, decision making, cognitive flexibility, problem solving, social cognition ***Post-VR discussion topic*:** Attribution bias
	Session 7	***Session 8***
Week 4	***Module**:* Restaurant ***Targeted cognitive domains:*** Working memory, semantic encoding ***Post-VR discussion topic:*** Encoding strategy of repetition and segmentation	***Module**:* Restaurant ***Targeted cognitive domains:*** Working memory, semantic encoding ***Post-VR discussion topic:*** Encoding strategy of association and segmentation
	Session 9	***Session 10***
Week 5	***Module**:* Apartment ***Targeted cognitive domains:*** Information processing, daily functioning skills, problem solving, social cognition, attention, memory ***Post-VR discussion topic:*** Theory of mind	***Module**:* Apartment ***Targeted cognitive domains:*** Social cognition, attention, memory, multitasking, executive functions, working memory, short-term memory ***Post-VR discussion topic*:** Problem solving
	Session 11	***Session 12***
Week 6	***Module**:* Bus ***Targeted cognitive domains:*** Executive functions, attention, decision making, social cognition ***Post-VR discussion topic:*** Inhibition	***Module**: B*us ***Targeted cognitive domains*:** Working memory, executive functions, attention, decision making, cognitive flexibility, problem solving, social cognition ***Post-VR discussion topic:*** Cognitive flexibility

VR = Virtual Reality

Details of the control condition

Table 2.

Content of the sessions for the control condition:

Week 1	***Session 1*** ***Module** : Nature environnent 1* ***Post-VR discussion topic**:* Physical activities	***Session 2*** ***Module** : Nature environnent 2* ***Post-VR discussion topic**:* Physical activities
Week 2	***Session 3*** ***Module** : Nature environnent 3* ***Post-VR discussion topic:*** Sleep quality	***Session 4*** ***Module** : Nature environnent 4* ***Post-VR discussion topic**:* Sleep quality
Week 3	***Session 5*** ***Module** : Nature environnent 5* ***Post-VR discussion topic**:* Eating habits	***Session 6*** ***Module** : Nature environnent 6* ***Post-VR discussion topic**:* Self esteem
Week 4	***Session 7*** ***Module** : Nature environnent 7* ***Post-VR discussion topic**:* Personal care	***Session 8*** ***Module** : Nature environnent 8* ***Post-VR discussion topic**:* Social media use
Week 5	***Session 9*** ***Module** : Nature environnent 9* ***Post-VR discussion topic**:* Procrastination	***Session 10*** ***Module** : Nature environnent 10* ***Post-VR discussion topic**:* Motivation
Week 6	***Session 11*** ***Module** : Nature environnent 11* ***Post-VR discussion topic**: Goal setting*	***Session 12*** ***Module** : Nature environnent 12* ***Post-VR discussion topic**:* Positive thinking

VR = Virtual Reality

Supplementary Methods III – Questionnaire information

Clinical assessments

The Mini-International Neuropsychiatric Interview (MINI)
This structured interview consists of yes/no questions and takes approximately 15 minutes to administer the psychotic module. The MINI has good validity and reliability properties (Sheehan et al., 1998). The psychotic disorder module has a kappa coefficient (k = 0.76) with the structured clinical interview of the DSM-V (Sheehan et al., 1997). This module also has adequate sensitivity (k = 0.86), specificity (k = 0.74), and good test-retest reliability (k = 0.83) (Sheehan et al., 1998).

The Positive and Negative Syndrome Scale (PANSS)
These 30 items semi-structured interview contains seven items for the positive symptoms subscale, seven items for the negative symptoms subscale, and 16 items for the general psychopathology subscale (Kay et al., 1987). Each symptom is rated on a Likert scale from 1 ("absent") to 7 ("extreme"), with higher scores indicating greater symptom severity (Kay et al., 1987). Internal consistency is good for the three subscales ($\alpha = 0.73$; $\alpha = 0.83$; $\alpha = 0.79$), and criterion and construct validity are also adequate (Kay et al., 1987).

The Wechsler Abbreviated Scale of Intelligence (WASI)
This test is designed to estimate IQ and measure intelligence and cognition in adults (Wechsler, 2011). The Vocabulary subscale was used to measured word knowledge and verbal concept formation, while the Matrix Reasoning subscale was used to measure fluid intelligence, visual-spatial abilities, perceptual processing, and organization (Wechsler, 2011). These scales have excellent internal consistency ($\alpha = 0.95$) and a good correlation with the Wechsler Adult Intelligence Scale (r = 0.85) (Axelrod, 2002).

Feasibility and acceptability assessments

The Working Alliance Inventory (WAI-S)
This 12 items questionnaire is used to measure the alliance between the participant and the therapist on the agreement on the tasks to be performed, agreement on the goals of the treatment, and the development of an affective bond (Munder et al., 2010). Each item is rated on a Likert scale of 1 (Never) to 7 (Always). The range of possible values for the total score is 7-84 and a higher score indicates a greater working alliance (Munder et al., 2010).

The Treatment Acceptability/Adherence Scale (TAAS)
This ten-item instrument measures treatment acceptability and adherence (Milosevic et al., 2015). Each item is rated on a seven-point Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). The range of possible values for the total score is 7-70 and higher score indicates a greater acceptability of the treatment. The instrument has good reliability ($\alpha = 0.88$) and adequate convergent and divergent validity (Milosevic et al., 2015).

Neurocognitive assessments

The Cambridge Neuropsychological Test Automated Battery (CANTAB)

The CANTAB evaluation has demonstrated good sensitivity in detecting changes in neuropsychological performance using tests that measure attention, working memory, executive functions, verbal and visual episodic memory, information processing speed, mental control, and social aspects like emotion recognition (CANTAB, 2016). The subtests used will be those recommended for individuals with schizophrenia: Reaction Time (RTI), Paired Associates Learning (PAL), One Touch Stockings of Cambridge (OTS), multitasking test (MTT), Rapid Visual Information Processing (RVP), Emotion Recognition Task (ERT), Spatial Working Memory (SWM), Verbal Recognition Memory (VRM), and Delayed Matching to Sample (DMS). This instrument has good validity and acceptable test-retest reliability ($r = 0.6 – 0.8$) (Barnett et al., 2007).

The Subjective Scale to Investigate Cognition in Schizophrenia – Brief
This 14-item self-assessment tool is used to evaluate participants' subjective perception of their cognitive abilities (Cella, Bodnar, et al., 2020). Each item is rated on a four-point scale from 0 "never" to 4 "very often," with a total score ranging from 0 to 56, where higher scores indicate greater perceived difficulty in various cognitive domains (Cella, Bodnar, et al., 2020). This instrument has good internal consistency ($\alpha = 0.86$) and good construct validity (Stip et al., 2003).

Social cognition assessments

The Hinting Task
This task includes 10 short stories that is verbally read to the participant (Corcoran et al., 1995). Participants are then asked to infer what the characters really mean when they make certain comments (Corcoran et al., 1995). Each story is scored from 0 to 2, allowing for a total score out of 20. A higher score indicates a better theory of mind. This instrument has adequate internal consistency in individuals with schizophrenia ($\alpha = 0.73$) (Pinkham et al., 2016). It also has good discriminant and construct validity (Pinkham et al., 2016).

The PENN Emotion Recognition Test
This 40 items task ask participants to identify the emotion shown in a photograph of a face representing joy, sadness, anger, fear, or a neutral expression (Kohler et al., 2003). Each item is scored as 0 or 1 allowing for a total score out of 40. A higher score indicates a greater recognition of emotion. This instrument has good convergent, divergent, and concurrent validity and good internal consistency in individuals with schizophrenia ($\alpha = 0.75$) (Pinkham et al., 2015).

The Ambiguous Intentions Hostility Questionnaire
Participants read fifteen hypothetical negative social situations and explain why they think the situation occurred by answering various questions (Combs et al., 2007). They rate the other person's intent on a Likert scale from 1 to 6, their level of anger, and how much they would blame the other person on a Likert scale from 1 to 5 (Combs et al., 2007). The total score ranges from 45 to 240, with higher scores indicating higher levels of blame, anger, and perceived intent (Combs et al., 2007). This instrument will be used to assess the likelihood of the participant expressing paranoia and/or a hostility bias in their social life. The instrument has internal consistency indices ranging from good to excellent ($\alpha = 0.63$-0.90) and good convergent, divergent, and construct validity.

Emotion Regulation Questionnaire
This questionnaire is a 10-item scale designed to measure emotion regulation strategies used by the respondent in two ways: tendency to regulate emotions through cognitive reappraisal or expressive suppression (Gross & John, 2003). Each item is rated by the interviewer on a Likert scale ranging from 1 "strongly disagree" to 7 "strongly agree". This instrument has good validity and internal consistency for cognitive reappraisal (α=0.79) and for expressive suppression (α=0.73) (Kimhy et al., 2012).

Global functioning assessments

Global Assessment of Functioning
This assessment consists of a semi-structured interview to evaluate how serious a mental illness is and how it is affecting individuals 'life (Schwartz, 2007). The person doing the interview rate the individual functioning on a scale of 0 to 100. Lower score indicates that the person's illness is affecting their day-to-day life. The Global Assessment of Functioning have a good internal validity, and a high inter-rater reliability can be easily achieved (Kölher et al., 2016).

Role Functioning Scale
The Role Functioning Scale is an interviewer-rated assessment where the individual is evaluated on four different domains: working productivity, degree of independence, the social network (immediate and extended; Goodman et al., 1993). Each domain is evaluated on a scale of 1 (minimal role functioning level) to 7 (optimal role functioning level) and a total score of 28 reflects the global functioning. A good internal consistency is found for this assessment with α=0.92.

UCSD Performance-based Skills Assessment Brief
The UCSD Performance-based Skills Assessment Brief is a role-play test to evaluate the functional capacity of individuals living with a severe mental illness (Mausbach et al., 2006). This role-play test includes a variety of tasks where participants must demonstrate their abilities in accomplishing everyday task like counting changes, paying a bill, reschedule an appointment, call for necessary services, etc. Every task is corrected as a point score of 0 or 1 and produce a total score from 0 to 100. A good internal consistency is found for UPSA-B with α=0.88.

Supplementary Methods IV – CANTAB analysis procedure

Following the CANTAB, several sub-scores for each of the nine tests appear in a report generated automatically by the software. For each sub-test, the recommended scores to be used are selected and a Z-score transformation is performed. We used the mean and standard deviation of a group of 100 healthy people performing the same tasks to obtain a Z-score ((Patient score – Mean score of healthy control)/Standard Deviation of Healthy Control). For each task performed, the Z-scores for each sub-component assessed are averaged. Finally, for each cognitive subdomain (attention, executive, memory, etc.), an average of the different tasks assessing each of these domains was performed. All cognitive subdomain scores were averaged to obtain a score representing global cognition.

Supplementary Results I. – Sociodemographic Information Table

Table 3.

Sociodemographic Information for Both Groups with the Complete Sample.

	Control Group (N=9)	ThinkTactic VR (N=8)	t/χ2	*p*
Age				
M (SD)	36.44 ± 9.74	35.63 ± 9.49	0.176	0.863
[Min, Max]	[25.00, 48.00]	[24.00, 53.00]		
Sex				
Male	6 (67.00 %)	6 (75.00 %)	0.000	1
Female	3 (33.00 %)	2 (25.00 %)		
Ethnic Group				
Asian	2 (22.00 %)	1 (12.00 %)	1.333	0.721
Black	2 (22.00 %)	2 (25.00 %)		
White/Caucasian	4 (44.00 %)	4 (50.00 %)		
Autre	0 (0.00 %)	1 (12.00 %)		
Employment Status				
Employed	2 (22.00 %)	4 (50.00 %)	3.620	0.164
Student	3 (33.00 %)	0 (0.00 %)		
Unemployed	4 (44.00 %)	4 (50.00 %)		
Diagnosis				
Schizoaffective disorder	5 (56.00 %)	1 (12.00 %)	1.811	0.178
Schizophrenia	4 (44.00 %)	7 (88.00 %)		
Year of post education				
M (SD)	1.11 ± 1.69	1.25 ± 1.49	-0.180	0.859
[Min, Max]	[0.00, 5.00]	[0.00, 3.00]		
PANSS - Total				
M (SD)	64.56 ± 14.60	62.63 ± 12.69	0.292	0.775
[Min, Max]	[36.00, 81.00]	[48.00, 86.00]		
PANSS - Positive Symptoms				
M (SD)	15.67 ± 5.15	14.63 ± 4.81	0.431	0.672
[Min, Max]	[7.00, 23.00]	[9.00, 23.00]		
PANSS - Negative Symptoms				
M (SD)	16.22 ± 5.24	18.50 ± 5.61	-0.862	0.403
[Min, Max]	[10.00, 24.00]	[13.00, 29.00]		

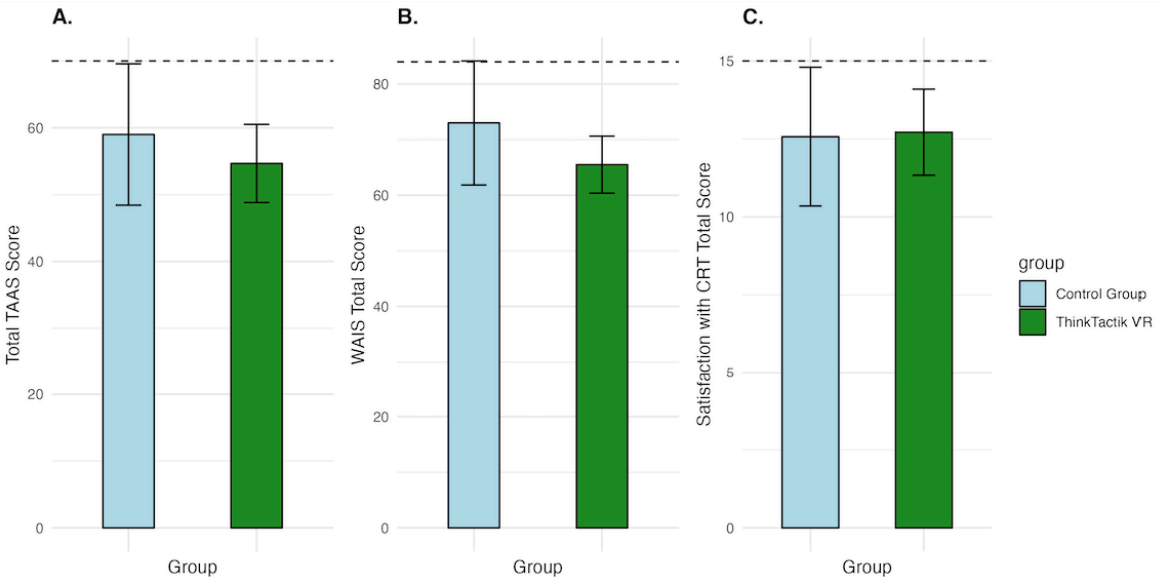
	Control Group (N=9)	ThinkTactic VR (N=8)	t/χ2	*p*
PANSS - General Symptoms				
M (SD)	32.67 ± 6.73	29.50 ± 5.63	1.056	0.308
[Min, Max]	[19.00, 42.00]	[23.00, 39.00]		
IQ estimate				
M (SD)	98.75 ± 14.44	95.88 ± 10.32	0.458	0.655
[Min, Max]	[79.00, 116.00]	[76.00, 111.00]		

Note. PANSS = Positive and Negative Syndrome Scale (Score on a scale of 7 to 49 for Positive symptoms and Negative Symptoms; Score on a scale of 16 to 112 for General Symptoms; Score on a scale of 30 to 210 for Total Score); IQ = Intellectual Quotient estimated with WASI.

Supplementary Results II. – Acceptability Results Figure

Figure 1.

Overall Scores on the Acceptability Questionnaire for both Groups.



Note. Dashed line represents the maximum score. The error bars represent the standard deviation. 7 participants are included in the control group (illustrated in blue) and 7 participants in ThinkTactic VR group (illustrated in green).

Supplementary Results III – Global Functioning results

Table 4

Pre-Training and Post-Training Mean Score of Community Functioning Outcomes.

	Control Group		ThinkTactic VR	
	Pre-training (N=6)	Post-training (N=6)	Pre-training (N=7)	Post-training (N=7)
UPSA-B				
M (SD)	87.37 ± 5.11	76.35 ± 10.06	73.16 ± 11.64	82.11 ± 7.79
[Min, Max]	[79.80, 94.44]	[58.59, 84.34]	[53.03, 84.34]	[68.69, 94.44]
GAF				
M (SD)	44.33 ± 23.12	41.00 ± 24.54	34.57 ± 17.37	47.57 ± 23.58
[Min, Max]	[20.00, 80.00]	[10.00, 81.00]	[7.00, 58.00]	[7.00, 81.00]
RFS - Working productivity				
M (SD)	4.00 ± 1.26	3.83 ± 1.72	4.14 ± 1.77	4.57 ± 1.72
[Min, Max]	[2.00, 5.00]	[2.00, 6.00]	[2.00, 6.00]	[2.00, 7.00]
RFS - Independance				
M (SD)	3.83 ± 1.94	3.50 ± 1.38	4.57 ± 1.13	5.71 ± 1.25
[Min, Max]	[2.00, 7.00]	[2.00, 6.00]	[3.00, 6.00]	[4.00, 7.00]
RFS - Immediate Social Network				
M (SD)	5.67 ± 1.03	5.83 ± 1.47	5.29 ± 1.38	5.43 ± 1.51
[Min, Max]	[4.00, 7.00]	[3.00, 7.00]	[3.00, 7.00]	[3.00, 7.00]
RFS - Extended Social Network				
M (SD)	4.67 ± 1.75	3.50 ± 1.76	4.29 ± 1.50	5.14 ± 1.86
[Min, Max]	[2.00, 7.00]	[1.00, 6.00]	[2.00, 6.00]	[2.00, 7.00]
RFS - Total				
M (SD)	18.17 ± 2.32	16.67 ± 3.33	18.29 ± 3.50	20.86 ± 4.18
[Min, Max]	[15.00, 22.00]	[13.00, 22.00]	[13.00, 24.00]	[15.00, 25.00]

Note. GAF = Global Assessment of Functioning; RFS = Role Functioning Scale; UPSA = UPSA = UCSD Performance-Based Skills Assessment. Role Functioning Scale give five scores, one for each scale (Work Productivity, Independence, Immediate Social Network and Extended Social Network) and one total score.

Table 5

Linear mixed model for community functioning outcomes

Outcome	Interaction	Estimate (b)	95% CI Low	95% CI High	p-value	Effect Size (η^2)	F_value
GAF	Timepoint × Group	16.33	5.29	27.38	0.01	0.49	10.59
RFS – Work Productivity	Timepoint × Group	0.60	-0.19	1.38	0.12	0.20	2.77
RFS – Independance	Timepoint × Group	1.48	0.42	2.53	0.01	0.46	9.46
RFS – Immediate Social Network	Timepoint × Group	-0.02	-0.73	0.69	0.94	0.00	0.01
RFS – Extended Social network	Timepoint × Group	2.02	0.01	4.04	0.05	0.31	4.90
RFS - Total	Timepoint × Group	4.07	1.09	7.05	0.01	0.45	9.03
UPSA	Timepoint × Group	19.97	11.62	28.33	0.00	0.45	27.70

Note. GAF = Global Assessment of Functioning; RFS = Role Functioning Scale; UPSA = UPSA = UCSD Performance-Based Skills Assessment. Role Functioning Scale give five scores, one for each scale (Work Productivity, Independence, Immediate Social Network and Extended Social Network) and one total score.

Supplementary Results IV – Neurocognitive and social cognitive domains pre-training and post-training mean score.

Table 6

Pre-Training and Post-Training Mean Score of the CANTAB Cognitive Domains Measures.

	Control Group		ThinkTactik VR	
	Pre-training (N=6)	Post-training (N=6)	Pre-training (N=7)	Post-training (N=7)
Attention and Processing Speed				
Mean (SD)	-0.96 ± 0.79	-0.59 ± 0.40	-2.3 ± 2.3	-2.2 ± 2.3
[Min, Max]	[-2.2, 0.059]	[-1.3, -0.30]	[-6.3, -0.24]	[-6.9, -0.44]
Executive function				
Mean (SD)	-0.82 ± 0.63	-0.73 ± 0.56	-1.4 ± 1.6	-0.83 ± 1.0
[Min, Max]	[-1.4, 0.071]	[-1.8, -0.25]	[-4.6, -0.29]	[-2.9, 0.034]
Emotion Recognition				
Mean (SD)	-0.31 ± 0.95	-0.47 ± 0.79	-0.93 ± 0.39	-0.90 ± 0.50
[Min, Max]	[-1.8, 0.77]	[-1.5, 0.46]	[-1.5, -0.29]	[-1.8, -0.29]
Memory				
Mean (SD)	-0.64 ± 0.51	-0.47 ± 0.66	-0.70 ± 0.47	-0.57 ± 0.61
[Min, Max]	[-1.3, 0.22]	[-1.6, 0.25]	[-1.3, -0.077]	[-1.4, 0.38]
Visual Episodic Memory				
Mean (SD)	-0.47 ± 0.62	-0.24 ± 0.79	-0.47 ± 0.24	-0.35 ± 0.52
[Min, Max]	[-1.4, 0.28]	[-1.8, 0.49]	[-0.88, -0.16]	[-1.1, 0.33]
Working Memory				
Mean (SD)	-0.72 ± 0.98	-0.71 ± 0.56	-0.83 ± 0.91	-0.67 ± 1.2
[Min, Max]	[-2.1, 0.24]	[-1.6, -0.010]	[-1.8, 0.46]	[-2.9, 0.39]
Verbal Episodic Memory				
Mean (SD)	-0.91 ± 1.4	-0.70 ± 1.1	-1.0 ± 1.1	-0.91 ± 1.2
[Min, Max]	[-2.7, 0.70]	[-2.0, 0.71]	[-2.5, 0.47]	[-2.6, 0.59]
Global Score				
Mean (SD)	-0.72 ± 0.44	-0.55 ± 0.57	-1.2 ± 0.96	-1.0 ± 0.86)
[Min, Max]	[-1.4, -0.15]	[-1.6, -0.046]	[-3.2, -0.49]	[-2.3, -0.12]

Table 7

Pre-Training and Post-Training Mean Score of Social Cognitive Domains

	Control Group		ThinkTactic VR	
	Pre-training (N=6)	Post-training (N=6)	Pre-training (N=7)	Post-training (N=7)
Hinting Task				
M (SD)	14.67 ± 3.33	14.67 ± 2.16	12.00 ± 4.16	15.29 ± 1.50
[Min, Max]	[9.00, 18.00]	[12.00, 18.00]	[6.00, 17.00]	[13.00, 17.00]
ERQ - Expressive				
M (SD)	-15.50 ± 5.54	-15.50 ± 4.46	-16.29 ± 2.81	-14.00 ± 3.21
[Min, Max]	[-24.00, -7.00]	[-22.00, -10.00]	[-19.00, -12.00]	[-16.00, -8.00]
ERQ - Cognitive supression				
M (SD)	26.67 ± 7.09	23.67 ± 8.04	28.43 ± 6.70	27.29 ± 3.45
[Min, Max]	[18.00, 39.00]	[14.00, 34.00]	[20.00, 37.00]	[23.00, 32.00]
PENN - Emotion Recognition				
M (SD)	32.67 ± 1.75	32.83 ± 1.83	29.71 ± 4.68	27.43 ± 4.58
[Min, Max]	[30.00, 35.00]	[31.00, 35.00]	[23.00, 35.00]	[19.00, 34.00]
AIHQ - Accidental				
M (SD)	-9.61 ± 4.48	-10.22 ± 4.96	-11.67 ± 5.23	-10.90 ± 3.87
[Min, Max]	[-15.33, -5.00]	[-16.33, -5.00]	[-18.33, -5.33]	[-16.67, -5.33]
AIHQ - Intentional				
M (SD)	-16.56 ± 6.52	-17.11 ± 7.19	-17.05 ± 6.21	-17.86 ± 4.82
[Min, Max]	[-23.33, -7.00]	[-24.33, -6.67]	[-23.33, -4.67]	[-22.33, -8.33]
AHIQ - Ambiguous				
M (SD)	-13.44 ± 5.50	-14.28 ± 6.56	-13.05 ± 5.57	-12.71 ± 4.52
[Min, Max]	[-18.33, -6.00]	[-21.33, -6.33]	[-21.33, -4.67]	[-17.00, -6.67]

Note. ERQ = Emotion Recognition Questionnaire; PENN = Penn Emotion Recognition Task; AIHQ = The Ambiguous Intentions Hostility Questionnaire.

Supplementary Results V – Linear mixed model analysis for neurocognitive and social cognitive domains

Table 8.

Linear mixed model for CANTAB outcomes

Outcome	Interaction	Estimate (b)	95% CI Low	95% CI High	p-value	Effect Size (η^2)	F_value
Attention - Processing Speed	Timepoint × Group	-0.25	-1.93	1.43	0.75	0.01	0.11
Executive Functioning	Timepoint × Group	0.50	-0.38	1.38	0.24	0.12	1.56
Emotion Recognition	Timepoint × Group	0.20	-0.53	0.93	0.56	0.03	0.36
Memory	Timepoint × Group	-0.04	-0.62	0.53	0.87	0.00	0.03
Working memory	Timepoint × Group	0.14	-1.10	1.38	0.81	0.01	0.06
Verbal Episodic Memory	Timepoint × Group	-0.10	-1.34	1.13	0.86	0.00	0.03
Visual episodic memory	Timepoint × Group	-0.11	-1.03	0.81	0.81	0.00	0.06
Global Score	Timepoint × Group	0.06	-0.45	0.56	0.81	0.01	0.06

Table 9.

Linear mixed model for social cognition outcomes

Outcome	Interaction	Estimate (b)	95% CI Low	95% CI High	P value	Effect Size (η^2)	F value
Hinting Task	Timepoint × Group	3.29	-0.78	7.35	0.10	0.22	3.16
ERQ - Expressive Supression	Timepoint × Group	2.29	-3.21	7.78	0.38	0.07	0.84
ERQ - Cognitive Reappraisal	Timepoint × Group	1.86	-5.55	9.27	0.59	0.03	0.30
PENN - Emotion Recognition	Timepoint × Group	-2.45	-5.80	0.90	0.14	0.19	2.60
AIHQ accident	Timepoint × Group	1.37	-1.84	4.58	0.37	0.07	0.89
AIHQ ambiguous	Timepoint × Group	1.17	-1.68	4.01	0.39	0.07	0.81
AIHQ intention	Timepoint × Group	-0.25	-3.77	3.26	0.88	0.00	0.03

Note. ERQ = Emotion Regulation Questionnaire; AIHQ = Ambiguous Intentional and Hostility Questionnaire

ANNEXE B: Formulaire de Consentement

INFORMED CONSENT FORM FOR PARTICIPATION IN A RESEARCH STUDY

Study Title:	Examining the Efficacy of a Virtual Reality Cognitive Remediation Program for People Living with Psychosis
Principal Investigator:	Synthia Guimond, Ph.D., Scientist, The Royal's Institute of Mental Health Research Phone: [redacted] Email: [redacted]
Co-investigator:	Alexandra Baines, MD, Psychiatrist, Royal Ottawa Mental Health Centre Phone: [redacted] Email: [redacted]
Study Coordinator:	Ahmad Alftieh, MSc, Research Coordinator, The Royal's Institute of Mental Health Research Phone: [redacted] Email: [redacted]
Sponsor/Funder:	FRQS chercheur boursier & IMHR
REB Number:	2023001
Clinical Trials Identifier:	[redacted]

INTRODUCTION

You are being invited to participate in a clinical trial (a type of study that involves research). You are invited to participate in this trial because you have been diagnosed with a psychotic disorder. This consent form provides you with information to help you make an informed choice. Please read this document carefully and ask any questions you may have. All your questions should be answered to your satisfaction before you decide whether to participate in this research study.

Please take your time in making your decision. You may find it helpful to discuss it with your friends and family.

Taking part in this study is voluntary. Deciding not to take part or deciding to leave the study later will not result in any penalty or affect current or future health care.

WHAT IS THE BACKGROUND INFORMATION FOR THIS STUDY?

Individuals living with psychotic disorders, such as schizophrenia, seem to experience more difficulties with their thinking and social skills. These changes can affect day-to-day functioning, such as grocery shopping and employment. The present study tests whether we can improve thinking and social skills through a cognitive training (called cognitive remediation) program that is based in virtual reality.

This study will help inform future interventions in improving thinking skills for people living with psychotic disorders and other conditions where thinking skills may also occur.

HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?

It is anticipated that about 52 people will take part in this study. All research activities will be completed at the Royal Ottawa Mental Health Centre (ROMHC).

This study should take 2.5 years to complete, and the results should be known in about 3.5 years.

WHAT WILL HAPPEN DURING THIS STUDY?

WHAT IS THE STUDY INTERVENTION?

Cognitive remediation is an intervention that uses exercises to train your thinking and social skills. In this study, these exercises will be done through virtual reality. This means that you will put on a headset that looks like a pair of googles and be transported into a virtual environment. You will also use two remote hand controllers to move around in the environment.

If you decide to participate, you will be "randomized" into one of two groups. Randomization means that you are put into a group by chance (like flipping a coin). There is no way to predict which group you will be assigned to. In your assigned group, you will do virtual reality exercises that were intentionally developed to either train or not train your thinking and social skills.

This is a double-blind study, which means that neither you, nor a majority of the study staff will know which group you are in. The only one who will know which group you are in is the study staff who will be delivering the intervention. Your group assignment can be identified if medically necessary. Requests to reveal your assignment for your information will not be considered until this study has been completed and the results are known.

WHAT ARE THE STUDY PROCEDURES?

Prior to coming in for your study visit, you first talked to a study member about potentially participating in the study, who assessed whether you are eligible to participate in the study. After you were found to be eligible, you were assigned a unique identifier (ID) that was used to store any information provided.

If you do decide to participate in the study, you will undergo the following study procedures:

- You will first decide whether to participate in the study and sign the consent form.
- You will be assigned a second, unique ID that will be used to record any information provided for the rest of the study visits.
- You will then complete a series of assessments and questionnaires designed to assess your thinking skills, social skills, and your lived experience with psychosis. Some of these assessments and questionnaires you will complete multiple times throughout your study participation. These assessments will be recorded on paper and recorded on an electronic database.
- At your first visit, we will invite you to download an app, DigiSensing, to your phone.The app will send you a 10-minute assessment to complete before you start your training, 1-week after training, and 6 months after training. The assessment will ask you some questions and a test on your thinking skills and day-to-day functioning.
    - You can complete these assessments at your own pace and time.
- Once you have completed the first set of assessments and questionnaires, you will then participate in a virtual reality training program.
- The virtual reality training program is 6 weeks long. Each week, you will meet with study stuff for 2 visits, each around 1 hour.
- After finishing the training program, you will then repeat some of the assessments and questionnaires you completed before the training visit. You will complete these assessments and questionnaires 1-week after training and 3 months after training.

Your participation in the study should last around 8 months.

In-Person Visit Schedule

Week	Visit Number	Visit Description	Time Commitment
1	1	Pre-training assessment #1	2 hours to 2.5 hours
2	2	Pre-training assessment #2	2 hours to 2.5 hours
3	3	Virtual reality training session #1	45 minutes to 1 hour
3	4	Virtual reality training session #2	45 minutes to 1 hour
4	5	Virtual reality training session #3	45 minutes to 1 hour

Week	Visit Number	Visit Description	Time Commitment
4	6	Virtual reality training session #4	45 minutes to 1 hour
5	7	Virtual reality training session #5	45 minutes to 1 hour
5	8	Virtual reality training session #6	45 minutes to 1 hour
6	9	Virtual reality training session #7	45 minutes to 1 hour
6	10	Virtual reality training session #8	45 minutes to 1 hour
7	11	Virtual reality training session #9	45 minutes to 1 hour
7	12	Virtual reality training session #10	45 minutes to 1 hour
8	13	Virtual reality training session #11	45 minutes to 1 hour
8	14	Virtual reality training session #12	45 minutes to 1 hour
9	15	Post-training assessment #1	2 hours to 2.5 hours
21	16	Post-training assessment #2 (3 month follow up)	2 hours to 2.5 hours

WHAT QUESTIONNAIRES WILL I COMPLETE?

We will invite you to complete various questionnaires and assessments throughout your study participation. The purpose of these questionnaires and assessments are to get a better understanding of your lived experience with mental health, thinking skills, and social skills. The amount of time each questionnaire and assessment vary, with some taking 5 minutes while others take 60 minutes.

The questionnaires and assessments you will be invited to complete at **visit 1**:

- Signing the consent form
- A clinical assessment to measure your lived experience with a psychosis-related condition
- Assessments to measure your general thinking skills

The questionnaires and assessments you will be invited to complete at **visit 2**:

- Assessments to measure your general thinking skills
- Questionnaires about your motivation
- Assessments to measure your day-to-day functioning
- Questionnaires to measure your social skills
- Questionnaires about your stress levels
- Questionnaires about your social support

The questionnaires and assessments you will be invited to complete at **visit 15 and visit 16:**

- Assessments about your thinking skills
- Assessments to measure your day-to-day functioning
- Questionnaires to measure your social skills

The questionnaires and assessments you will be invited to complete on the smartphone app:

- An assessment and questionnaire to measure your general thinking skills
- A questionnaire about your lived experience with a psychosis-related condition
- A questionnaire about your mood
- Questionnaires about your day-to-day functioning and recovery goal

The information you provide is for research purposes only. Some of the questions are personal and may cause some emotional discomfort. At any time during the study, you can choose not to answer questions if you wish – please let the study staff know if you choose not to the question(s).

Even though you may have provided information on a questionnaire, these responses will not be reviewed by your health care team or study team. If you wish them to know this information, please bring it to their attention.

WHAT ARE THE RESPONSIBILITIES OF STUDY PARTICIPANTS?

If you choose to participate in this study, you will be expected to:

- Attend all study visits
- Let study staff know if you would like to reschedule or cancel a study visit
- If you choose to answer a question, to provide an honest response
- Let study staff know if you would like a break or if you prefer to not answer a question
- Engage in the study visits to the best of your ability
- Do not discuss with other participants any information you learn in the training sessions

CAN PARTICIPANTS CHOOSE TO LEAVE THE STUDY?

Participation in the study is **entirely voluntary**. You can choose to end your participation in this research (called withdrawal) at any time without having to provide a reason. If you choose to withdraw from the study before your visit 16, please let the study staff know. If you would like to stop completing the app survey after your visit 16, you can delete the app from your phone. By deleting the app, you are withdrawing from the study and no more data will be collected.

If you decide to withdraw from the study, we will invite you to complete a short questionnaire about your experience with the study intervention. While it is appreciated if you could provide some feedback, it is not necessary to withdraw from the study.

You may withdraw your permission to use information that was collected about you for this study at any time by letting the study staff know. If you would like to delete any data collected through the app, you can select the "delete my data" option. However, this would also mean that you withdraw from the study.

CAN PARTICIPATION IN THIS STUDY END EARLY?

The study staff may stop your participation in the study early, and without your consent, for reasons such as:

- You experience severe cybersickness during the virtual reality intervention
- New information is revealed that suggests that it is no longer in your best interest to continue participating
- The Research Ethics Board withdraws their permission for this study to continue

If this happens, it may mean that you will not receive the study intervention for the full period described in this consent form. If you are removed from this study, the principal investigator will directly reach out to you and discuss the reasons with you.

WHAT ARE THE RISKS OF PARTICIPATING IN THIS STUDY?

Taking part in this study is considered to be **low risk**.

LOW RISK OF SEIZURES ASSOCIATED WITH VIRTUAL REALITY

A prior report suggests that about 1 in 4,000 users (0.025%) may experience severe dizziness, seizures, epileptic seizures, or blackouts triggered by light flashes or patterns, which can also occur while watching TV or playing video games. Such seizures can occur even to those with no prior seizure history and are more common in children and young people under the age of 20.

Seizure monitoring procedures will be used and if there is a seizure, a code blue will be called, 911 call will be initiated, and you will be transferred to the Emergency services at a nearby hospital.

LOW RISK OF CYBERSICKNESS WITH VIRTUAL REALITY

It is possible to feel some discomfort during or after the virtual reality training program. These symptoms are temporary and may involve visual fatigue, blurred vision, dizziness, nausea, or headache.

During the training visits, you can at any time decide to end the virtual reality exposure without compensation penalty. You will also be offered multiple breaks throughout the session.

WHAT ARE THE BENEFITS OF PARTICIPATING IN THIS STUDY?

We hope the information learned from this study will help other people living with psychotic disorders in the future.

HOW WILL PARTICIPANT INFORMATION BE KEPT CONFIDENTIAL?

If you decide to participate in this study, the principal investigator and study staff will only collect the information they need for this study.

Records identifying you at this centre will be kept confidential and, to the extent permitted by the applicable laws, will not be disclosed or made publicly available, except as described in this consent document. When you started participating in the study, a unique ID was assigned to you, and was used for all measures that collected information about you for the study (study data). The only document that links your identity to your unique ID (called a mastercode list) is password-protected and encrypted on a computer behind the Royal's network. The computer that holds the mastercode list is in a restricted area of the Royal, with restricted access.

Your study data will be stored on paper and electronically. Any paper copies are stored in locked file cabinets in a secure area of the Royal where only individuals with the principal investigator's permission may access the data. Any electronic data will be stored on a secure electronic platform and on password-protected computers at the Royal.

The DigiSensing app is created and maintained by the National Research Council and can be downloaded on your phone through one of two ways. If you have an iOS device (like an iPhone), study staff will send you a web link to download the app to your phone. No study data is collected and stored through this web link. If you have an Android phone, you will be sent an APK file to download the app to your phone.

Once you download the app onto your phone, you will be given a unique username and password to log into the app. All app data will be stored under this username, so that it is not linked to your identity. The only way to link your app data to your identifiable information is through the mastercode list stored at the Royal.

Data collected on DigiSensing (the phone app) will also be encrypted, de-identified, and anonymized. This data is stored on a server at a Canadian data centre that is maintained by the National Research Council. Your data collected through the app and stored on the server will not contain any identifiable information.

All study data will be stored for a period of 10 years after the last publication. Afterwards, it will be destroyed.

Authorized representatives of the following organizations may look at your original (identifiable) medical/clinical study records at the site where these records are held, to check that the information collected for the study is correct and follows proper laws and guidelines:

- Representatives from the Royal's Institute of Mental Health Research who oversee the safety and quality of this study;
- The Royal's Research Ethics Board, to oversee the ethical conduct of research at this location.

Study data may also be sent to the organizations listed above. Your name, address, or other information that may directly identify you will not be used. The records received by these organizations may contain your study ID.

Staff from the National Research Council may access your app data with your consent. The only reason why they may access your data is for debugging purposes, and they will not be able to link your data to your identifiable data (like your name and email address). By signing this consent form, you also authorize staff from the National Research Council to potentially access your app data for debugging any software issues.

If the results of this study are published, your identity will remain confidential. It is expected that the information collected during this study will be used in analysis and will be published and presented to the scientific community at meetings and in journals.

If you consent, your personal information can be shared with other Royal researchers about participating in other research studies. If you are contacted by a Royal researcher, you are under no obligation to participate in the study. Your decision about consenting to be contacted by other Royal researchers will not affect your eligibility to participate in the study.

WILL INFORMATION ABOUT THIS STUDY BE AVAILABLE ONLINE?

A description of this clinical trial will be available on http://www.clinicaltrials.gov. This website will not include information that can identify you. You can search this website at any time.

WHAT IS THE COST TO PARTICIPANTS?

The virtual reality cognitive remediation program and the phone app (DigiSensing) will be supplied at no charge while you take part in this study.

Taking part in this study may result in added costs to you. For example:

- There may be costs associated with study visits. For example, parking or transportation, or snacks/meals during your stay. If requested, the study staff may

be able to cover parking and bussing expenses.

- You may miss work or school as a result of participating in this study.

ARE STUDY PARTICIPANTS PAID TO BE IN THIS STUDY?

If you decide to participate in this study, you will receive $190 by the end of the study ($180 in cash and a $10 gift card). A copy of the payment schedule can be found below.

For the first 16 visits, you will receive your compensation at the end of the visit. For the $10 gift card, it will be sent to you over email or mailed to you after you complete the last EMA survey 6 months after training. If you decide to leave the study, you will receive a prorated payment for participating in the study.

COMPENSATION SCHEDULE

Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7	Visit 8
$30	$30	$5	$5	$5	$5	$5	$5

Visit 9	Visit 10	Visit 11	Visit 12	Visit 13	Visit 14	Visit 15	Visit 16
$5	$5	$5	$5	$5	$5	$30	$30

App survey
$10

It is possible that the research conducted using your study data may eventually lead to the development of new interventions. There are no plans to provide payment to you if this happens.

EMAIL OR MAILING ADDRESS FOR GIFT CARD

Email or Mailing Address _____

_____

_____

WHAT ARE THE RIGHTS OF PARTICIPANTS IN A RESEARCH STUDY?

You will be told, in a timely manner, about new information that may be relevant to your willingness to stay in this study.

You have the right to be informed of the results of this study once the entire study is complete. If you would like to receive a copy of the study results, there is an option on

the consent form where you can provide an email where study staff will send you a copy of the results once published.

Your rights to privacy are legally protected by federal and provincial laws that require safeguards to ensure that your privacy is respected.

By signing this form, you do not give up any of your legal rights against the study staff or involved institutions for compensation, nor does this form relieve the study staff, or their agents of their legal and professional responsibilities.

You will be given a copy of this signed and dated consent form prior to participating in this study.

IS THERE A CONFLICT OF INTEREST?

The cognitive remediation training program that is being tested in the study was initially created by the research lab. To minimize any biases, the staff delivering the training program is the only one who knows which training condition you are in. The staff who will be giving the questionnaires and assessments, and completing the analysis will not know what condition you are in.

There are no other conflicts of interest to declare related to this study.

HOW CAN I FIND RESULTS ABOUT THIS STUDY?

Results of the study are expected to be published in 3.5 years. If you would like, the study staff can also send you a copy of the results afterwards to the email or mailing address provided above.

A summary of the main study results will also be sent to you.

I would like a copy of the results to be sent to me	YES	NO

WHOM DO PARTICIPANTS CONTACT FOR QUESTIONS?

If you have questions about taking part in this study, or if you suffer a research-related injury, you can talk to the principal investigator who is in charge of the study at this institution. That person is:

Synthia Guimond	[redacted]
Name	Telephone

This study has been reviewed and approved by the Royal's Institute of Mental Health Research REB as study #2023001. If you have any ethical concerns about the

study, or the way it is conducted, please contact the REB office:
[redacted]

SIGNATURE PAGE

The research project has been explained to me, and my questions have been answered to my satisfaction. I have the right to not participate in this study, and I have the right to withdraw without penalty at any time during this study. The potential harms and benefits (if any) of participating in this research study have been explained to me.

I have been told that I have not waived my legal rights nor released the investigators or involved institutions from their legal and professional responsibilities. I know that I may ask now, or in the future, any questions I have about the study. I have been told that records relating to me will be kept confidential and that no information will be disclosed without my permission unless required by law. I have been given sufficient time to read the above information.

I also understand that all de-identified and anonymized data can accompany the publication of the findings in peer-reviewed scientific publications, and be shared for further investigations, to promote open and transparent science. Any personal information that could identify you, such as your name will never be associated with the publication of the data.

I consent to participate in this study. I have been told I will be given a signed copy of this consent form.

☐ I agree to be contacted by IMHR Researchers to be offered other research opportunities.

☐ I agree that all data collected in this study can be shared with other IMHR Researchers. The Principal Investigator will be the main person responsible for the data and their distribution.

Signature of Participant	Printed Name	Date

Signature of Person Conducting Consent Discussion	Printed Name	Date

ANNEXE C : Mini International Neuropsychiatric Interview (MINI)

K. PSYCHOTIC DISORDERS AND MOOD DISORDER WITH PSYCHOTIC FEATURES

ASK FOR AN EXAMPLE OF EACH QUESTION ANSWERED POSITIVELY. CODE **YES** ONLY IF THE EXAMPLES CLEARLY SHOW A DISTORTION OF THOUGHT OR OF PERCEPTION OR IF THEY ARE NOT CULTURALLY APPROPRIATE. THE PURPOSE OF THIS MODULE IS TO EXCLUDE PATIENTS WITH PSYCHOTIC DISORDERS. THIS MODULE NEEDS EXPERIENCE.

Now I am going to ask you about unusual experiences that some people have.

K1	a	Have you ever believed that people were spying on you, or that someone was plotting against you, or trying to hurt you? **NOTE:** ASK FOR EXAMPLES TO RULE OUT ACTUAL STALKING.	NO	YES
	b	**IF YES:** do you currently believe these things?	NO	YES
K2	a	Have you ever believed that someone was reading your mind or could hear your thoughts, or that you could actually read someone's mind or hear what another person was thinking?	NO	YES
	b	**IF YES:** do you currently believe these things?	NO	YES
K3	a	Have you ever believed that someone or some force outside of yourself put thoughts in your mind that were not your own, or made you act in a way that was not your usual self? Have you ever felt that you were possessed? CLINICIAN: ASK FOR EXAMPLES AND DISCOUNT ANY THAT ARE NOT PSYCHOTIC.	NO	YES
	b	**IF YES:** do you currently believe these things?	NO	YES
K4	a	Have you ever believed that you were being sent special messages through the TV, radio, Internet, newspapers, books or magazines or that a person you did not personally know was particularly interested in you?	NO	YES
	b	**IF YES:** do you currently believe these things?	NO	YES
K5	a	Have your relatives or friends ever considered any of your beliefs odd or unusual? INTERVIEWER: ASK FOR EXAMPLES. ONLY CODE YES IF THE EXAMPLES ARE CLEARLY DELUSIONAL IDEAS NOT EXPLORED IN QUESTIONS K1 TO K4, FOR EXAMPLE, RELIGIOUS, DEATH, DISEASE OR SOMATIC DELUSIONS, DELUSIONS OF GRANDIOSITY, JEALOUSY OR GUILT, OR OF FAILURE, INADEQUACY, RUIN, OR DESTITUTION, OR NIHILISTIC DELUSIONS.	NO	YES
	b	**IF YES:** do they currently consider your beliefs strange?	NO	YES
K6	a	Have you ever heard things other people couldn't hear, such as voices?	NO	YES
		IF YES TO VOICE HALLUCINATION: Was the voice commenting on your thoughts or behaviour or did you hear two or more voices talking to each other?	NO	YES
	b	**IF YES TO K6a:** have you heard sounds/voices in the past month?	NO	YES
		IF YES TO VOICE HALLUCINATION: Was the voice commenting on your thoughts or behaviour or did you hear two or more voices talking to each other?	NO	YES

K7	a	Have you ever had visions when you were awake or have you ever seen things other people couldn't see? CLINICIAN: CHECK TO SEE IF THESE ARE CULTURALLY INAPPROPRIATE.	NO	YES
	b	**IF YES:** have you seen these things in the past month?	NO	YES
		CLINICIAN'S JUDGEMENT		
K8	a	DID THE PATIENT EVER IN THE PAST EXHIBIT DISORGANIZED, INCOHERENT OR DERAILED SPEECH, OR MARKED LOOSENING OF ASSOCIATIONS?	NO	YES
K8	b	IS THE PATIENT CURRENTLY EXHIBITING INCOHERENCE, DISORGANIZED OR DERAILED SPEECH, OR MARKED LOOSENING OF ASSOCIATIONS?	NO	YES
K9	a	DID THE PATIENT EVER IN THE PAST EXHIBIT DISORGANIZED OR CATATONIC BEHAVIOUR?	NO	YES
K9	b	IS THE PATIENT CURRENTLY EXHIBITING DISORGANIZED OR CATATONIC BEHAVIOUR?	NO	YES
K10	a	DID THE PATIENT EVER IN THE PAST HAVE NEGATIVE SYMPTOMS, E.G. SIGNIFICANT REDUCTION OF EMOTIONAL EXPRESSION OR AFFECTIVE FLATTENING, POVERTY OF SPEECH (ALOGIA) OR AN INABILITY TO INITIATE OR PERSIST IN GOAL-DIRECTED ACTIVITIES (AVOLITION)?	NO	YES
K10	b	ARE NEGATIVE SYMPTOMS OF SCHIZOPHRENIA, E.G. SIGNIFICANT REDUCTION OF EMOTIONAL EXPRESSION OR AFFECTIVE FLATTENING, POVERTY OF SPEECH (ALOGIA) OR AN INABILITY TO INITIATE OR PERSIST IN GOAL-DIRECTED ACTIVITIES (AVOLITION), PROMINENT DURING THE INTERVIEW?	NO	YES
K11	a	ARE 1 OR MORE « a » QUESTIONS FROM K1a TO K7a CODED **YES**? AND IS EITHER: MAJOR DEPRESSIVE EPISODE (CURRENT, RECURRENT OR PAST) **OR** MANIC OR HYPOMANIC EPISODE (CURRENT OR PAST) CODED **YES**? HOW LONG HAS THE MOOD EPISODE LASTED? _____ HOW LONG HAS THE PSYCHOTIC EPISODE LASTED? _____ IF SUCH A MOOD EPISODE IS PRESENT, IT MUST BE PRESENT FOR THE MAJORITY OF THE TOTAL DURATION OF THE ACTIVE AND RESIDUAL PERIODS OF THE PSYCHOTIC SYMPTOMS. OTHERWISE CODE NO TO K11a. IF NO TO K11a, CIRCLE "NO" IN BOTH "MOOD DISORDER WITH PSYCHOTIC FEATURES" DIAGNOSTIC BOXES AND MOVE TO K13.	NO ↳ K13	YES
	b	You told me earlier that you had a period/periods when you felt (depressed/high/persistently irritable). Were the beliefs and experiences you just described (SYMPTOMS CODED **YES** FROM **K1a** TO **K7a**) restricted exclusively to times when you were feeling depressed/high/irritable? IF THE PATIENT EVER HAD A PERIOD OF AT LEAST TWO (2) WEEKS OF HAVING THESE BELIEFS OR EXPERIENCES (PSYCHOTIC SYMPTOMS) WHEN THEY WERE NOT DEPRESSED/HIGH/IRRITABLE, CODE NO TO THIS DISORDER. IF THE ANSWER IS NO TO THIS DISORDER GROUPING, ALSO CIRCLE NO TO K12 AND MOVE TO K13.	**NO**	**YES**
			MOOD DISORDER WITH *PSYCHOTIC FEATURES*	
			LIFETIME	

ANNEXE D: Positive And Negative Syndrom Scale (PANSS)

Structured Clinical Interview for the Positive and Negative Syndrome Scale
SCI-PANSS

L. A. Opler, M.D., Ph.D. S. R. Kay, Ph.D. J. P. Lindenmayer, M.D. A. Fiszbein, M.D.

Patient Name or ID: _____

Interviewer: _____ Date: _____ / _____ / _____

Data on "Lack of Spontaneity and Flow of Conversation" (N6), "Poor Rapport" (N3), and "Conceptual Disorganization" (P2)

Hi, I'm ... We're going to be spending the next 30 to 40 minutes talking about you and your reasons for being here. Maybe you can start out by telling me something about yourself and your background?

(Instruction to interviewer: Allow at least 5 minutes for a non-directive phase serving to establish rapport in the context of an overview before proceeding to the specific questions listed below.)

Data on "Anxiety" (G2)

1. Have you been feeling worried or nervous in the past week? _____

   IF YES, skip to question 3. IF NO, continue.

2. Would you say that you're usually calm and relaxed? _____

   IF YES, skip to question 8. IF NO, continue.

3. What's been making you feel nervous (worried, not calm, not relaxed)? _____
4. Just how nervous (worried, etc.) have you been feeling? _____
5. Have you been shaking at times, or has your heart been racing? _____
6. Do you get into a state of panic? _____
7. Has your sleep, eating, or participation in activities been affected? _____

Data on "Delusions (General)" (PI) and "Unusual Thought Content" (G9)

8. Have things been going well for you? _____
9. Has anything been bothering you lately? _____
10. Can you tell me something about your thoughts on life and its purpose? _____

11. Do you follow a particular philosophy (any special rules, teachings, or religious doctrine)? _____

12. Some people tell me they believe in the Devil; what do you think? _____

IF NO (i.e., he/she doesn't believe in the Devil), skip to question 14. IF YES (i.e., he/she does believe), continue.

13. Can you tell me more about this? _____

14. Can you read other people's minds? _____

IF NO, skip to question 16. IF YES, continue.

15. How does that work? _____

16. Can others read your mind? _____

IF NO, skip to question 19. IF YES, continue.

17. How can they do that? _____

18. Is there any reason that someone would want to read your mind? _____

19. Who controls your thoughts? _____

Data on "Suspiciousness/Persecution" (P6) and "Poor Impulse Control" (GI4)

20. How do you spend your time these days? _____

21. Do you prefer to be alone? _____

22. Do you join in activities with others? _____

IF YES, skip to question 25. IF NO, continue.

23. Why not? ... Are you afraid of people, or do you dislike them? _____

IF NO, skip to question 26. IF YES, continue.

24. Can you explain? _____

Skip to question 26.

25. Tell me about it. _____

26. Do you have many friends? _____

IF YES, skip to question 30. IF NO, continue.

27. Just a few? _____

IF YES, skip to question 29. IF NO, continue.

28. Any? .... Why? _____

Skip to question 32.

29. Why just a few friends? _____

30. Close friends? _____

IF YES, skip to question 32. IF NO, continue.

31. Why not? _____

32. Do you feel that you can trust most people? _____

IF YES, skip to question 34. IF NO, continue.

33. Why not? _____

34. Are there some people in particular who you don't trust? _____

IF NO to question 34 and YES to question 32, skip to question 41. IF NO to question 34 and NO to question 32, skip to question 36. IF YES to question 34, continue.

35. Can you tell me who they are? _____

36. Why don't you trust people (or name specific person)? _____

IF "DON'T KNOW" OR "DON'T WANT TO SAY," continue. Otherwise, skip to question 41.

37. Do you have a good reason not to trust ...?

38. Is there something that .....did to you? _____

39. Perhaps something that ... might do to you now? _____

IF NO, skip to question 41. IF YES, continue.

40. Can you explain to me? _____

41. Do you get along well with others? _____

IF YES, skip to question 43. IF NO, continue.

42. What's the problem? _____

43. Do you have a quick temper? _____

44. Do you get into fights? _____

IF NO, skip to question 48. IF YES, continue.

45. How do these fights start? _____

46. Tell me about these fights. _____

47. How often does this happen? _____

48. Do you sometimes lose control of yourself? _____

IF NO, skip to question 50. IF YES, continue.

49. What happens when you lose control of yourself? _____

50. Do you like most people? _____

IF YES, skip to question 52. IF NO, continue.

51. Why not? _____

52. Are there perhaps some people who don't like you? _____

IF NO, skip to question 54. IF YES, continue.

53. For what reason? _____

54. Do others talk about you behind your back? _____

IF NO, skip to question 57. IF YES, continue.

55. What do they say about you? _____

56. Why? _____

57. Does anyone ever spy on you or plot against you? _____

58. Do you sometimes feel in danger? _____

IF NO, skip to question 64. IF YES, continue.

59. Would you say that your life is in danger? _____

60. Is someone thinking of harming you or even perhaps thinking of killing you? _____

61. Have you gone to the police for help? _____

62. Do you sometimes take matters into your own hands or take action against those who might harm you?

IF NO, skip to question 64. IF YES, continue.

63. What have you done? _____

Data on "Hallucinatory Behavior" (P3) and associated delusions

64. Do you once in a while have strange or unusual experiences? _____

65. Sometimes people tell me that they can hear noises or voices inside their head that others can't hear. What about you? _____

IF YES, skip to question 68. IF NO, continue.

66. Do you sometimes receive personal communications from the radio or TV? _____

IF YES, skip to question 68. IF NO, continue.

67. From God or the Devil?: _____

IF NO, skip to question 83. IF YES, continue.

68. What do you hear? _____

69. Are these as clear and loud as my voice? _____

70. How often do you hear these voices, noises, messages, etc.? _____

71. Does this happen at a particular time of day or all the time? _____

IF HEARING NOISES ONLY, skip to question 80. IF HEARING VOICES, continue.

72. Can you recognize whose voices these are? _____

73. What do the voices say? _____

74. Are the voices good or bad? _____

75. Pleasant or unpleasant? _____

76. Do the voices interrupt your thinking or your activities? _____

77. Do they sometimes give you orders or instructions? _____

IF NO, skip to question 80. IF YES, continue.

78. For example? _____

79. Do you usually obey these orders (instructions)? _____

80. What do you make of these voices (or noises); where do they really come from? _____

81. Why do you have these experiences? _____

82. Are these normal experiences? _____

83. Do ordinary things sometimes look strange or distorted to you? _____

84. Do you sometimes have "visions" or see things that others can't see? _____

IF NO, skip to question 88. IF YES, continue.

85. For example? _____

86. Do these visions seem very real or life-like? _____

87. How often do you have these experiences? _____

88. Do you sometimes smell things that are unusual or that others don't smell? _____

IF NO, skip to question 90. IF YES, continue.

89. Please explain. _____

90. Do you get any strange or unusual sensations from your body? _____

IF NO, skip to question 92. IF YES, continue.

91. Tell me about this. _____

Data on "Somatic Concern" (GI)

92. How have you been feeling in terms of your health? _____

IF OTHER THAN "GOOD," skip to question 94. IF "GOOD," continue.

93. Do you consider yourself to be in top health? _____

IF YES, skip to question 95. IF NO, continue.

94. What has been troubling you? _____

95. Do you have any medical illness or disease? _____

96. Has any part of your body been troubling you? _____

IF YES, skip to question 98. IF NO, continue.

97. How is your head? Your heart? Stomach? The rest of your body? _____

98. Could you explain? _____

99. Has your head or body changed in shape or size? _____

IF NO, skip to question 102. IF YES, continue.

100. Please explain. _____

101. What is causing these changes? _____

Data on "Depression" (G6)

102. How has your mood been in the past week: mostly good, mostly bad? _____

IF "MOSTLY BAD," skip to question 104. IF "MOSTLY GOOD," continue.

103. Have there been times in the past week when you were feeling sad or unhappy? _____
IF NO, skip to question 114. IF YES, continue.

104. Is there something in particular that is making you sad? _____

105. How often do you feel sad? _____

106. Just how sad have you been feeling? _____

107. Have you been crying lately? _____

108. Has your mood in any way affected your sleep? _____

109. Has it affected your appetite? _____

110. Do you participate less in activities on account of your mood? _____

111. Have you had any thoughts of harming yourself? _____
IF NO, skip to question 114. IF YES, continue.

112. Any thoughts about ending your life? _____
IF NO, skip to question 114. IF YES, continue.

113. Have you attempted suicide? _____

114. If you were to compare yourself to the average person, how would you come out: a little better, maybe a little worse, or about the same? _____

IF "BETTER," skip to question 117.

IF "ABOUT THE SAME," skip to question 118.
IF "WORSE," continue.

115. Worse in what ways? _____

116. Just how do you feel about yourself? _____

Skip to question 120.

117. Better in what ways? _____

Skip to question 120.

118. Are you special in some ways? _____

IF NO, skip to question 120. IF YES, continue.

119. In what ways? _____

120. Would you consider yourself gifted? _____

121. Do you have talents or abilities that most people don't have? _____

IF NO, skip to question 123. IF YES, continue.

122. Please explain. _____

123. Do you have any special powers? _____

IF NO, skip to question 126. IF YES, continue.

124. What are these? _____

125. Where do these powers come from? _____

126. Do you have extrasensory perception (ESP), or can you read other people's minds? _____

127. Are you very wealthy? _____

IF NO, skip to question 129. IF YES, continue.

128. Explain please. _____

129. Can you be considered to be very bright? _____
IF NO, skip to question 131. IF YES, continue.

130. Why would you say so? _____

131. Would you describe yourself as famous? _____

132. Would some people recognize you from TV, radio, or the newspaper? _____

IF NO, skip to question 134. IF YES, continue.

133. Can you tell me about it? _____

134. Are you a religious person? _____

IF NO, skip to question 140. IF YES, continue.

135. Are you close to God? _____
IF NO, skip to question 140. IF YES, continue.

136. Did God assign you some special role or purpose? _____

137. Can you be one of God's messengers or angels? _____
IF NO, skip to question 139. IF YES, continue.

138. What special powers do you have as God's messenger (angel)? _____

139. Do you perhaps consider yourself to be God? _____

140. Do you have some special mission in life? _____

IF NO, skip to question 143. IF YES, continue.

141. What is your mission? _____

142. Who assigned you to that mission? _____

143. Did you ever do something wrong — something you feel bad or guilty about? _____
IF NO, skip to question 149. IF YES, continue.

144. Just how much does that bother you now? _____

145. Do you feel that you deserve punishment for that? _____
IF NO, skip to question 149. IF YES, continue.

146.What kind of punishment would you deserve? _____

147.Have you at times thought of punishing yourself? _____

IF NO, skip to question 149. IF YES, continue.

148.Have you ever acted on those thoughts of punishing yourself? _____

Data on "Disorientation" (GlO)

149.Can you tell me today's date (i.e., the day, month, and year)? _____

IF YES, skip to question 151. IF NO, continue.

150.Can you tell me what day of the week it is? _____

151.What is the name of the place that you are in now? _____

IF NOT HOSPITALIZED, skip to question 154. IF HOSPITALIZED, continue.

152.What ward are you on? _____

153.What is the address of where you're now staying? _____

IF ABLE TO TELL, skip to question 155. IF NOT ABLE TO TELL, continue.

154.Can you tell me your home address? _____

IF NOT HOSPITALIZED, skip to question 156. IF HOSPITALIZED, continue.

155.If someone had to reach you by phone, what number would that person call? _____

156.If someone had to reach you at home, what number would that person call? _____

157.What is the name of the doctor who is treating you? _____

IF NOT HOSPITALIZED, skip to question 159. IF HOSPITALIZED, continue.

158.Can you tell me who else is on the staff and what they do? _____

159.Do you know who is currently the president (prime minister, etc.)? _____

160.Who is our governor (premier, etc.)? _____

161.Who is the mayor (town supervisor, etc.) of this city (town, etc.)? _____

Data on "Difficulty in Abstract Thinking" (N5)

I'm going to now say a pair of words, and I'd like you to tell me in what important way they're alike. Let's start, for example, with the ~~words~~ "apple" and "banana." How are they alike — what do they have in common? **IF THE RESPONSE IS THAT "THEY'RE BOTH FRUIT", THEN SAY:** Good. Now what about ...? *(Select three other items from the Similarities list at varying levels of difficulty from Appendix A.)*

IF AN ANSWER IS GIVEN THAT IS CONCRETE, TANGENTIAL, OR IDIOSYNCRATIC (E.G., "THEY BOTH HAVE SKINS," "YOU CAN EAT THEM," "THEY'RE SMALL," OR "MONKEYS LIKE THEM"), THEN SAY: OK, but they're both fruit. Now how about ... and ~~...~~ how are these alike? *(Select three other items from the Similarities list at varying levels of difficulty from Appendix A.)*

APPENDIX A
Items for Similarities in the evaluation of "Difficulty in Abstract Thinking"

Circle the Similarities Used

1. How are a ball and an orange alike?
2. Apple and ~~banana ?~~
3. Pencil and pen?
4. Nickel and dime?

5. Table and chair?
6. Tiger and elephant?
7. Hat and shirt?
8. Bus and train?

9. Arm and ~~leg?~~
10. Rose and tulip?
11. Uncle and cousin?
12. The sun and the moon?

13. Painting and poem?
14. Hilltop and valley?
15. Air and water?
16. Peace and prosperity?

Note on Appendix A: Similarities are generally assessed by sampling four items at different levels of difficulty (i.e., one item selected from each quarter of the full set). When using the PANSS longitudinally, items should be systematically altered with successive interviews so as to provide different selections from the various levels of difficulty and thus minimize repetition.

Notes on Similarities responses:

You've probably heard the expression, "Carrying a chip on the shoulder." What does that really mean? There's a very old saying, "Don't judge a book by its cover." What is the deeper meaning of this proverb? *(Select two other proverbs from the list in Appendix B at varying levels of difficulty.)*

APPENDIX B
Items for assessing PROVERB INTERPRETATION in the evaluation of "Difficulty in Abstract Thinking"

Circle the Proverbs Used

What does the saying mean:
1. "Plain as the nose on your face"
2. "Carrying a chip on your shoulder"
3. "Two heads are better than one"
4. "Too many cooks spoil the broth"

5. "Don't judge a book by its cover"
6. One man's food is another man's poison"
7. "All that glitters is not gold"
8. "Don't cross the bridge until you come to it"

9. "What's good for the goose is good for the gander"
10. "The grass always looks greener on the other side"
11. "Don't keep all your eggs in one basket"
12. "One swallow does not make a summer"

13. "A stitch in time saves nine"
14. "A rolling stone gathers no moss"
15. "The acorn never falls far from the tree"
16. "People who live in glass houses should not throw stones at others"

Note on Appendix B: Proverb interpretation is generally assessed by sampling four items at different levels of difficulty (i.e., one item selected from each quarter of the full set). When using the PANSS longitudinally, items should be systematically altered with successive interviews so as to provide different selections from the various levels of difficulty and thus minimize repetition.

Notes on Proverb responses:

162.How long have you been in the hospital (clinic, etc.)? _____

163. Why did you come to the hospital (clinic, etc.)? _____

164. Did you need to be in a hospital (clinic, etc.)? _____

IF YES, skip to question 167. IF NO, continue.

165. Did you have a problem that needed treatment? _____

IF NO, skip to question 169. IF YES, continue.

166. Would you say that you had a psychiatric or mental problem? _____

IF NO, skip to question 169. IF YES, continue.

167. Why?....would you say that you had a psychiatric or mental problem? _____

IF NO, skip to question 169. IF YES, continue.

168. Can you tell me about it and what it consisted of? _____

169. In your own opinion, do you need to be taking medicine? _____

IF YES, skip to question 171.

IF NO and <u>unmedicated</u>, skip to question 172.
IF NO and <u>medicated</u>, continue.

170. Why then are you taking medicines? _____

Skip to question 172.

171. Why?... Does the medicine help you in any way? _____

172. Do you at this time have any psychiatric or mental problems? _____

IF YES, skip to question 174. IF NO, continue.

173. For what reason are you at the hospital (clinic, etc.)? _____

Skip to question 175.

174. Please explain _____

175. Just how serious are these problems? _____

IF UNHOSPITALIZED, skip to question 178. IF HOSPITALIZED, continue.

176. Are you ready yet for discharge from the hospital? _____

177. Do you think you'll be taking medicine for your problems after discharge? _____

178. What are your future plans? _____

179. What about your longer-range goals? _____

Well, that's about all I have to ask of you now. Are there any questions that you might like to ask of me? Thank you for your cooperation.

ANNEXE E: Simulator Sickness Questionnaire (SSQ)

Simulator Sickness Questionnaire				
	None	Slight	Moderate	Severe
1) Genearl Discomfort	○	○	○	○
2) Fatigue	○	○	○	○
3) Headache	○	○	○	○
4) Eye strain	○	○	○	○
5) Difficulty focusing	○	○	○	○
6) Salivation increasing	○	○	○	○
7) Sweating	○	○	○	○
8) Nausea	○	○	○	○
9) Difficulty concentrating	○	○	○	○
10) Fullness of the head	○	○	○	○
11) Blurred vision	○	○	○	○
12) Dizziness with eyes open	○	○	○	○
13) Dizziness with eyes closed	○	○	○	○
14) Vertigo	○	○	○	○
15) Stomach awareness	○	○	○	○
16) Burping	○	○	○	○

ANNEXE F: Working Alliance Inventory Short (WAI-S)

On the following page there are some sentences that describe some of the different ways a person might think or feel about his or her therapist. Please complete these ratings in terms of your experience with your therapist during the most recent session. As you read the sentences, mentally insert the name of your therapist in place of the _____ in the text.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

Use the above seven point scale for each item. If the statement describes the way you <u>always</u> feel (or think), circle the number '7'; if it <u>never</u> applies to you, circle the number '1'. Use the numbers in between to describe the variations between these extremes. This questionnaire is confidential; your therapist will not see your answers. Work fast; your first impressions are the ones we would like to see. Please don't forget to respond to every item.

_____ 1. _____ and I agree about the things I will need to do in therapy to help improve my situation.

_____ 2. What I am doing in therapy gives me new ways of looking at my problem.

_____ 3. I believe _____ likes me.

_____ 4. _____ does not understand what I am trying to accomplish in therapy.

_____ 5. I am confident in _____'s ability to help me.

_____ 6. _____ and I are working on mutually agreed upon goals.

_____ 7. I feel that _____ appreciates me.

_____ 8. We agree on what is important for me to work on.

_____ 9. _____ and I trust one another.

_____ 10. _____ and I have different ideas on what my problems are.

_____ 11. We have established a good understanding of the kind of changes that would be good for me.

_____ 12. I believe the way we are working with my problem is correct.

ANNEXE G: Treatment Adherence/Acceptability Scale (TAAS)

Treatment Acceptability/Adherence Scale (TAAS)

Please respond to the treatment that you just completed by indicating your agreement with each of the below statements.*

---

1. If I began this treatment, I would be able to complete it.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

2. If I participated in this treatment, I would be able to adhere to its requirements.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

R3. I would find this treatment exhausting.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

R4. It would be distressing to me to participate in this treatment.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

R5. Overall, I would find this treatment intrusive.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

6. This treatment would provide effective ways to help me cope with my fear/anxiety.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

R7. I would prefer to try another type of psychological treatment instead of this one.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

R8. I would prefer to receive medication for my fear/anxiety instead of this treatment.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

9. I would recommend this treatment to a friend with a similar problem (i.e. fear/anxiety).

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

R10. If I began this treatment, I would likely drop out.

1	2	3	4	5	6	7
Disagree strongly			Neither agree nor disagree			Agree strongly

*Instructions can be modified to reflect the point at which the respondent is completing the scale (e.g., after reading a treatment description or hearing about the treatment rationale, after completing a treatment session, or after completing a treatment component). For cases where respondents have initiated treatment, alternate wording for each item is suggested below:

1. I will be able to complete this treatment.
2. I will be able to adhere to the requirements of this treatment.
R3. I find this treatment exhausting.
R4. It will be distressing to me to participate in this treatment.
R5. Overall, I find this treatment intrusive.
6. This treatment will provide effective ways to help me cope with my fear/anxiety.
R7. I would prefer to try another type of psychological treatment instead of this one.
R8. I would prefer to receive medication for my fear/anxiety instead of this treatment.
9. I would recommend this treatment to a friend with a similar problem (i.e. fear/anxiety).
R10. I will likely drop out of this treatment.

ANNEXE H: Satisfaction with Cognitive Remediation Therapy

Satisfaction with CRT Program Survey

1. Overall, how satisfied were you with the training program?

Very unsatisfied	Unsatisfied	Neutral	Satisfied	Very satisfied
1	2	3	4	5

   a. What did you like in the training program?

2. How realistic did you find the different aspects of the training program?

	Very unrealistic	Unrealistic	Neutral	Realistic	Very realistic
	1	2	3	4	5
Virtual reality environment					
Virtual reality coach					
Virtual reality avatars					

3. How enjoyable were the different tasks in the training program?

Strongly unenjoyable	Unenjoyable	Neutral	Enjoyable	Strongly enjoyable
1	2	3	4	5

4. What module did you enjoy the most, and why?

   a. What module did you enjoy the least, and why?

5. How comfortable did you find the virtual reality equipment?

	Very uncomfortable	Uncomfortable	Neutral	Comfortable	Very comfortable
	1	2	3	4	5
Virtual reality headset					
Hand sensors					

6. How helpful did you find the therapist's presence?

Very unhelpful	Unhelpful	Neutral	Helpful	Very helpful
1	2	3	4	5

   a. In what way?

7. Please rate how much you agree with the following statements:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	1	2	3	4	5
I felt like the training program helped improve my thinking skills					
I felt like the training program helped improve my social skills					
I felt like the training program helped me in my daily life tasks					
I felt motivated to attend the visits					
I felt engaged when participating in the visits					
I would recommend this training to someone I know					

8. How appropriate did you find the duration of the program?

	Too few visits		The right amount of visits		Too many visits
	1	2	3	4	5
Total number of visits					
Having two visits per week					

9. Was there anything you disliked about the training program?

10. How confident that you were in the active training condition?

Not at all confident	Not confident	Neutral	Confident	Very confident
1	2	3	4	5

11. Any other comments or feedback?

ANNEXE I: Subjective Scale to Investigate Cognition in Schizophrenia (SSTICS)

SSTICS-Brief : Subjective Scale to Investigate Cognition in Schizophrenia Brief version

Reference: Cella M, Bodnar M, Lepage M, Malla A, Joober R, Iyer S, Wykes T, Preti A. (2020). Investigating subjective cognitive complaints in psychosis: Introducing the brief scale to Investigate cognition in schizophrenia (SSTICSBrief). Cognitive Neuropsychiatry, 25(3):190-200. doi: 10.1080/13546805.2020.1722084.

INSTRUCTIONS
On the sheet before you there is a series of questions on thinking skills common problems (e.g. memory and concentration) that you may have experienced while going about your everyday activities. We would like to find out how often you have noted such problems recently. If you find that any of the descriptions below corresponds to a problem you had, please select how often it has affected your life in the last month.
Use the scale below to rate each statement. Circle the number that best corresponds to your experience:

4 very often
3 often
2 sometimes
1 rarely
0 never

1. Have you noticed any difficulty remembering things?

2. Do you have difficulty remembering information that is freshly received and that must be used immediately, such as a telephone number, an address, a room number, a bus route number or somebody's name?

3. Do you have difficulty memorising things, such as a grocery list or a list of names?

4. Do you ever forget things, such as a date with a friend or a doctor's appointment?

5. Do you have difficulty remembering information that you read in the newspapers or hear on TV?

6. Do you have difficulty doing household chores or repairs? For example, do you ever forget how to cook things or what ingredients go into a recipe?

7. Do you have difficulty remembering the names of well-known people, such as the Prime Minister?

8. Do you have difficulty remembering national capitals, important dates in history, names of countries on other continents, or major scientific discoveries?

9. Are you absent-minded or up in the clouds? For example, you lose your train of thought in a conversation because you are distracted, or you have a hard time focussing on what you are reading.

10. Do you have difficulty being on the alert or reacting to unexpected situations? For example, a fire alarm or a car that rushes by suddenly as you are crossing the street.

11.Are you unable to do two things at once? For example, memorise an address while making coffee, or count the money in your wallet while the talking to a shopkeeper.

12. Do you have trouble focussing your attention on the same thing for more than 20 minutes? For example, a TV programme or a book reading or during a lesson in a classroom.

13. Do you have difficulty planning out your activities as easily as you used to? For example, charting an itinerary for getting someplace, making a budget for the month, preparing meals or making time for laundry.

14. Do you have difficulty finding your words, forming sentences, understanding the meaning of words, pronouncing words or naming objects?

ANNEXE J: Hinting Task

Story 1

George arrives in Angela's office after a long and hot journey down the highway. Angela immediately begins to talk about some business ideas. George interrupts Angela, saying:
"My, my! It was a long, hot journey down that highway!"

QUESTION: **What does George really mean when he says this?**

ANSWER (2 points):

- George means, "*Can I have a drink*"
- "*Can I have a few minutes to settle down after my journey before we start talking business*".

Also accepted for 2 points:

- "*Can I have some water (soda, juice, any beverage)?"*
- "*Can I have a break (rest) before we start (begin)*?"
- *"I'm (he's) not ready to talk about business yet"*
    - Answer must be clear either that George needs a drink OR that he wants to rest prior to talking.

**Common answer that is often used that is NOT accepted, "Can I have a break".

If a correct response is not given for the first hint (eg. the participant just replies something like, "He means exactly what he says."), then introduce the next part of the story/hint.

ADD: **George goes on to say:**
"I'm parched!"

QUESTION: **What does George want Angela to do?**

ANSWER: *George wants Angela to get him, or offer to get him, a drink*. This response would be given a score of 1. **Anything else would be given a score of 0. There are no other accepted answers for 1 point.** At this point answering that George wants a break would receive a score of 0, response must reference receiving a beverage.

Story 2

Melissa goes to the bathroom for a shower. Anne has just had a bath. Melissa notices the bath is dirty, so she calls upstairs to Anne:
"Couldn't you find the Ajax, Anne?"

QUESTION: **What does Melissa really mean when she says this?**

ANSWER:

- Melissa means, "*Why didn't you clean out the bath*"
- "*Go and clean out the bath now*".
- Either of these responses would be given a score of a 2 and the next story would be introduced.

Also accepted for 2 points:

- *"She (Melissa) wants her (Anne) to clean the bath (shower, tub, etc)."*
- *"Can you please go clean the bath (shower, tub, etc)?"*
- Message must be clear that Melissa is either inquiring as to why Anne did not previously clean the bath OR asking Anne to go clean it at this time.

**Common answers that are often heard that are NOT accepted are, "She's looking for the Ajax" or "She wants to know where the cleaning supplies are".

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Melissa goes on to say:**
"You're very lazy sometimes, Anne!"

QUESTION: **What does Melissa want Anne to do?**
ANSWER:

- *"Melissa wants Anne to clean out the bath (shower, tub, etc)."*

Also accepted:

- *"Clean up after herself"*
- "*She wants her to clean the bath (shower, tub, etc)."*
- These responses would be given a score of 1. **Any other response would be given a score of 0. There are no other accepted answers for 1 point.**

Story 3

Gordon goes to the supermarket with his mom. They arrive at the candy aisle. Gordon says:
"Wow! That candy looks delicious."

QUESTION: **What does Gordon really mean when he says this?**

ANSWER:

- *Gordon means, "Please buy me some candy, mom".*
- This response would be given a score of 2 and next story would be introduced.

Also accepted for 2 points:

- *"He wants his mom (her) to buy him some candy"*
- *"He wants his mom (her) to buy it for him"* – This may be accepted if you are confident the participant understands the concept. You may prompt, "buy what for him?" If the response is anything other than candy, move to the additional hint.
- **No other answers are accepted for 2 points.**

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Gordon goes on to say:**
"I'm hungry, mom."

QUESTION: **What does Gordon want his mom to do?**

ANSWER:

- *"Gordon wants his mom (her) to buy him some candy*".

Also accepted:

- "*He wants her to buy the candy".*
- *"Buy him candy"*
    - These responses would be given a score of 1. **Any other response would be given a score of 0. There are no other accepted answers for 1 point.**
    - No points are given for anything other than "candy" (i.e. it/that/sweets).

Story 4

Paul has to go to an interview and he's running late. While he is cleaning his shoes, he says to his wife, Jane:
"I want to wear that blue shirt, but it's very wrinkled."

QUESTION: **What does Paul really mean when he says this?**

ANSWER:

- *Paul means, "Will you iron my shirt for me please?"*
- This response would be given a score of 2 and next story would be introduced.

Also accepted for 2 points:

- *"He wants her (his wife, Jane, etc) to iron it for him"*
- *"He wants her (his wife, Jane, etc) to iron it"*

- *"He wants her (his wife, Jane, etc) to do it"* – You may prompt, "He wants his wife to do what?" If the response is anything other than "iron it" or "iron the shirt", move to the additional hint (no score of 2 points).

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Paul goes on to say:**
"It's in the ironing basket."

QUESTION: **What does Paul want Jane to do?**

ANSWER:

- *"Paul wants Jane to iron his shirt."*

Also accepted for 1 point:

- *"He wants her (his wife, Jane, etc) to iron it for him"*
- *"He wants her (his wife, Jane, etc) to iron it"*
- These responses would be given a score of 1. Any other response would be given a score of 0. **There are no other accepted answers for 1 point.**
- No points are given for anything other than "iron".

Story 5

Lucy is broke, but she wants to go out in the evening. She knows that David has just been paid. She says to him:
"I'm flat broke! Things are so expensive these days."

QUESTION: **What does Lucy really mean when she says this?**

ANSWER:

- Lucy means, "Will you lend me some money David?"
- "Will you take me out tonight and pay?"
- Either of these responses would be given a score of a 2 and the next story would be introduced.

Also accepted for 2 points:

- *"Can I borrow some money?"*
- *"Will you take me on a date?"*
- *"She wants David to pay for her."*
- *"She wants David to take her out."*
    - Response must indicate that Lucy ***wants David to pay*** for her or the outing, not simply go out with her

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Lucy goes on to say:**
"Oh well, I suppose I'll have to miss my night out."

QUESTION: **What does Lucy want David to do?**

ANSWER:

- *"Lucy wants David to lend her money or to offer to take her out and pay."*
    - Response must indicate that Lucy ***wants David to pay*** for her or the outing, or ***to take*** her out, not simply go out with her
- Message must clear. Either of these responses would be given a score of 1. **Any other response would be given a score of 0.**

Story 6

Donald wants to run a project at work, but Richard, his boss, has asked someone else to run it. Donald says:
"What a pity. I'm not too busy at the moment."

QUESTION: **What does Donald really mean when he says this?**

ANSWER:

- *Donald means, "Please change your mind, Richard, and give the project to me."*
- This response would be given a score of a 2 and the next story would be introduced.

Also accepted for 2 points:

- *"He wants his boss to give him the project instead"*
- *"You should have picked me"*
- *"He wants him/his boss/Richard to give him the project to run"*
- *"He wants him/his boss/Richard to give him the project"*
    - Answer must include some mention that ***the boss is making the decision*** to give him the project

**Example that is often heard that is NOT accepted, "He wants to run the project".

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Donald goes on to say:**
"That project is right up my street."

QUESTION: **What does Donald want Richard to do?**
ANSWER:

- *Donald (he) wants Richard (his boss) to change his mind and give the project to him to run.*

Also accepted:

- "Give him the project"
- "*He wants his boss to let him have the project instead."*
- Message must be clear. These responses would be given a score of 1. **Any other response would be given a score of 0.**

Story 7

Rebecca's birthday is approaching. She says to her Dad:
"I love animals, especially dogs."

QUESTION: **What does Rebecca really mean when she says this?**

ANSWER:

- *Rebecca means, "Will you buy me a dog for my birthday, Dad?"*
- This response would be given a score of a 2 and the next story would be introduced.

Also accepted for 2 points:

- "She wants a dog for her birthday"
- "She wants her dad to buy her a dog for her birthday"
- Birthday must be referenced.

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Rebecca goes on to say:**
"Will the pet shop be open on my birthday, Dad?"

QUESTION: **What does Rebecca want her dad to do?**

ANSWER:

- *Rebecca wants her dad buy her a dog for her birthday or say he'll buy her a dog for her birthday.*
- Either of these responses would be given a score of 1.
- **Any other response would be given a score of 0. There are no other accepted answers for 1 point.**

Story 8

Betty and Michael moved into their new house a week ago. Betty has been unpacking some ornaments and knickknacks. She says to Michael:

"Have you unpacked those shelves we bought, Michael?"

QUESTION: **What does Betty really mean when she says this?**

ANSWER:

- *Betty means, "Will you put those shelves up now please?"*
- This response would be given a score of a 2 and the next story would be introduced.

Also accepted for 2 points:

- *"Betty (She) wants Michael (him) to put up the shelves."*
- Answer must be clear that the shelves are being put up.

**Common answer that if often heard that is NOT accepted is, "She wants him to unpack the shelves".

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Betty goes on to say:**
"If you want something done you have to do it yourself!"

QUESTION: **What does Betty want Michael to do?**

ANSWER:

- *Betty (she) wants Michael (him) to put the shelves up.*
- This response would be given a score of 1. Any other response would be given a score of 0. **There are no other accepted answers for 1 point.**

Story 9

Jessica and Max are playing with a train set. Jessica has the blue train, and Max has the red one. Jessica says to Max:

“I don’t like this train.”

QUESTION: **What does Jessica really mean when she says this?**

ANSWER:

- *Jessica means, “I want your train and can have mine.”*
- This response would be given a score of a 2 and the next story would be introduced.

Also accepted for 2 points:

- *“She wants to swap trains with him”*
- *“She want his train and he can have hers”*
- Answer must be clear that they are trading or swapping trains. \

**Common answers that are NOT accepted, “She wants the red train”, “She wants his train”, “She doesn’t want her train anymore”.

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Jessica goes on to say:**
“Red is my favorite color.”

QUESTION: **What does Jessica want Max to do?**

ANSWER:

- “*Jessica wants to swap trains with Max”*
- *“She wants to swap (trade) trains with him”.*
- These responses would be given a score of 1. Any other response would be given a score of 0. **There are no other accepted answers for 1 point.**

Story 10

Patsy is getting off the train with three heavy suitcases. John is standing behind her. Patsy says to John:
“Gosh! These suitcases are a nuisance.”

QUESTION**: What did Patsy really mean when she said this?**

ANSWER:

- *Patsy means, “Would you help me with my luggage please?”*

- This response would be given a score of a 2 and the next item would be introduced.

Also accepted for 2 points:

- "Can you carry them/the bags for me?"
- "She wants him to help her with her bags"
- Indication that she wants help (does not explicitly need to say "help" and some reference to luggage (suitcases, bags, etc) must be used.

If the participant fails to give the correct answer at this stage then, introduce the next part of the story/hint.

ADD: **Patsy goes on to say:**
"I don't know if I can manage all three."

QUESTION: **What does Patsy want John to do?**

ANSWER:

- "*Patsy (she) wants John (him) to help her with the cases (bags, luggage, etc).*
- *"Carry the suitcases/luggage"*

This response would be given a score of 1. **Any other response would be given a score of 0. There are no other accepted answers fo**

ANNEXE K: Emotion Regulation Questionnaire (ERQ)

Emotion Regulation Questionnaire (ERQ)
Gross & John

The Emotion Regulation Questionnaire is designed to assess individual differences in the habitual use of two emotion regulation strategies: cognitive reappraisal and expressive suppression.

Citation

Gross, J.J., & John, O.P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. Journal of Personality and Social Psychology, 85, 348-362.

Instructions and Items

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

1----------2----------3----------4----------5----------6----------7
strongly disagree — **neutral** — **strongly agree**

1. ____ When I want to feel more *positive* emotion (such as joy or amusement), I *change what I'm thinking about*.

2. ____ I keep my emotions to myself.

3. ____ When I want to feel less *negative* emotion (such as sadness or anger), I *change what I'm thinking about*.

4. ____ When I am feeling *positive* emotions, I am careful not to express them.

5. ____ When I'm faced with a stressful situation, I make myself *think about it* in a way that helps me stay calm.

6. ____ I control my emotions by *not expressing them*.

7. ____ When I want to feel more *positive* emotion, I *change the way I'm thinking* about the situation.

8. ____ I control my emotions by *changing the way I think* about the situation I'm in.

9. ____ When I am feeling *negative* emotions, I make sure not to express them.

10. ____ When I want to feel less *negative* emotion, I *change the way I'm thinking* about the situation.

Note
Do not change item order, as items 1 and 3 at the beginning of the questionnaire define the terms "positive emotion" and "negative emotion".

Scoring (no reversals)
Reappraisal Items: 1, 3, 5, 7, 8, 10; Suppression Items: 2, 4, 6, 9.

ANNEXE L: Ambiguous Intentionality Hostility Questionnaire (AIHQ)

AIHQ

SUBJECT NAME/ID#_____ DATE_____

PLEASE READ EACH OF THE SITUATIONS LISTED BELOW AND IMAGINE THE SITUATION HAPPENING TO YOU. FOR EACH SITUATION, WRITE DOWN A BRIEF REASON FOR IT. THEN, RATE WHETHER YOU THINK THE PERSON ACTED THAT WAY TOWARD YOU ON PURPOSE. YOU WILL THEN BE ASKED TO RATE HOW ANGRY THAT SITUATION MAKES YOU FEEL AND HOW MUCH YOU BLAME THE OTHER PERSON. FINALLY, PLEASE WRITE DOWN WHAT YOU WOULD DO ABOUT THAT SITUATION. A RESPONSE OF "I DON'T KNOW" IS NOT ACCEPTABLE. YOU NEED TO DESCRIBE SOME TYPE OF BEHAVIORAL RESPONSE.

1. 1. Someone jumps in front of you on the grocery line and says, "I'm in a rush."

A. What do you think was the real reason why someone jumped in line in front of you?

_____

B. Did that person jump in front of you on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame that person for jumping in front of you on line?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

2. A friend of yours slips on the ice, knocking you onto the ground.

A. What do you think was the real reason why your friend knocked you to the ground?

_____

B. Do you think your friend knocked you onto the ground on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame your friend for knocking you onto the ground?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

3. You've been at a new job for three weeks. One day, you see one of your new co-workers on the street. You start to walk up to this person and start to say hello, but she/he passes by you without saying hello.

A. What do you think was the real reason why your coworker passed by you without saying hello?

_____

B. Do you think your co-worker did this to you on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the co-worker for passing by you?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

4, While walking outside during the rain, a car swerves to avoid hitting a cat, and drives into a puddle, splashing water onto you.

A. What do you think was the real reason why the car splashed water onto you?

_____

B. Do you think the driver of the car splashed water onto you on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the person in the car for splashing water onto you?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

5. You have an appointment with an important person. When you arrive at your appointment, the secretary informs you that the person is not in; they took the day off.

A. What do you think was the real reason why the person didn't keep your appointment?

B. Do you think the person did this to you on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the person for not keeping your appointment?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

6. You are on a bus sitting in an aisle seat. A person gets on the bus at the next stop, begins walking as the bus moves, and steps on your foot.

A. What do you think was the real reason why the person stepped on your foot?

_____

B. Do you think the person did this to you on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the person for stepping on your foot?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

7. Your neighbors are playing loud music. You knock on the door and ask them to turn it down. Fifteen minutes later, the music is loud again.

A. What do you think was the real reason why your neighbors made the music loud again?

_____

B. Do you think your neighbors raised the music on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame them for raising the music again?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

8. You walk past a bunch of teenagers at a mall and your hear them start to laugh.

A. What do think was the real reason why the teenagers started to laugh after you walked past them?

_____

B. Do you think the teenagers did this to you on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the teenagers for laughing as you walked past them?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

9. While driving, the person in the car behind you honks their horn and then cuts you off.

A. What do you think was the real reason why the person cut you off while driving?

_____

B. Do you think the person cut you off on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the driver of the car for cutting you off on the road?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

10. You are supposed to meet a new friend for lunch at a restaurant but she/he never shows up.

A. What do you think was the real reason why your new friend didn't show up at the restaurant?

_____

B. Do you think your new friend did this to you on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame your new friend for not showing up at the restaurant?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

11. You've been looking for a parking spot for awhile, when you see one up ahead. You put your signal on, proceed toward the spot, but someone passes your car and takes the parking space.

A. What do you think was the real reason why the person in the other car took your parking space?

_____

B. Do you think the person in the other car took your parking space on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the person in the other car for taking your parking space?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

12. You're dancing at a club and someone bumps into you from behind.

A. What do you think was the real reason why the person in the club bumped into you from behind?

_____

B. Do you think the person bumped into you on purpose?

1	2	3	4	5	6
Definitely	Probably	Maybe	Maybe	Probably	Definitely

No	No	No	Yes	Yes	Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the person for bumping into you at the club?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

13. You call a friend and leave a message on their answering machine, asking them to call you back. One week passes and they have not called you back.

A. What do you think was the real reason why your friend didn't call you back?

_____

B. Do you think your friend didn't call you back on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame your friend for not calling you back?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

14. You're at a bar watching a football game and having a drink. Suddenly, the home team scores, people begin to cheer, and someone hits your arm, spilling the drink onto your clothes.

A. What do you think was the real reason why the other person hit your arm?

_____

B. Did the other person hit your arm on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the other person for hitting your arm?

1	2	3	4	5
Not at				Very

All Much

E. What would you do about it?

_____

15. A day before meeting someone for a date, she/he calls to cancel. This is the third straight time they've done that.

A. What do you think was the real reason why the other person cancelled the date with you?

_____

B. Did the other person cancel the date on purpose?

1	2	3	4	5	6
Definitely No	Probably No	Maybe No	Maybe Yes	Probably Yes	Definitely Yes

C. How angry would this make you feel?

1	2	3	4	5
Not at all Angry				Very Angry

D. How much would you blame the other person for canceling the date?

1	2	3	4	5
Not at All				Very Much

E. What would you do about it?

_____

ANNEXE M: Global Assessment of Functioning (GAF)

1-3: 5-6 of the criteria in Group A
4-7: 3-4 of the criteria in Group A
8-10: 1-2 of the criteria in Group A

Group A Criteria:

- Serious suicidal act with clear expectation of death (e.g., stabbing, shooting, hanging, or serious overdose with no one present).
  → Have you ever attempted suicide?
  → IF YES: Did you intend to die because of a suicidal act?
  → IF NO: Have you ever had frank suicidal ideation with preparation?

- Frequent severe violence or self-mutilation.
  → Did you ever hit anyone or anything?
  → Have you ever self-mutilating?
  → How often?

- Extreme manic excitement, or extreme agitation and impulsivity (e.g., wild screaming, ripping the stuffing out of a bed mattress).
  → Have you ever had a period when you were feeling "up" or "high" or impulsive?
  → For how long would you say that you felt that way?

- Persistent inability to maintain minimal personal hygiene.
  → Can you tell me a little about your personal hygiene? For example, how often do you shower and brush your teeth? How often do you wash your clothes?

- Urgent/emergency admission to present psychiatric hospital.
  → Have you ever been urgently admitted to your current psychiatric hospital?

- In acute, severe danger due to medical problems (e.g., severe anorexia or bulimia with heart or kidney problems)
  → Have you ever been in severe danger due to a medical problem?

11-13: 5-6 of the criteria in Group B
14-17 : 3-4 of the criteria in Group B
18-20: 1-2 of the criteria in Group B

Group B Criteria:

- Suicide attempts without clear expectation of death
- Some severe violence or self-mutilating behaviors
- Severe manic excitement, or severe agitation and impulsivity

- Occasionally fails to maintain minimum personal hygiene (e.g., diarrhea due to laxatives, or smearing feces)
- Urgent/emergency admission to the present psychiatric hospital
- In physical danger due to medical problems (e.g., severe anorexia or bulimia and some spontaneous vomiting or extensive laxative/diuretic/diet pill use, but without serious heart or kidney problems or severe dehydration and disorientation)

21: 1 of the criteria in Group C

Group C Criteria:

- EITHER Suicidal Preoccupation or frank suicidal ideation with preparation
  → Have you ever had frank suicidal ideation with preparation?)

- OR behavior considerably influenced by delusions or hallucinations.
  → Are your behaviors influenced by delusions or hallucinations?

- OR serious impairment in communication (sometimes incoherent, acts grossly inappropriately, OR profound stuporous depression)
  → Do people ever tell you that they can't understand you?
  ** Or can I just score this by talking with the participant?

20-23: 9 of the criteria in Group D
24-27: 8 of the criteria in Group D
28-30: 7 of the criteria in Group D
31-33: 6 of the criteria in Group D
34-37: 5 of the criteria in Group D
38-40: 4 of the criteria in Group D
41-43: 3 of the criteria in Group D
44-47: 2 of the criteria in Group D
48-50: 1 of the criteria in Group D

Group D Criteria:

- Serious impairment with work, school or housework if a housewife or househusband (e.g., unable to keep job or stay in school, or failing school, or unable to care for family and house)
  → How is it going at work (or school or at home)?

- Frequent problems with the law (e.g., frequent shoplifting, arrests) or occasional combative behavior.
  → Have you ever had problems with the law or gotten into trouble with people in positions of authority?
  → How many times it happened?

- Serious impairment in relationships with friends (e.g., very few or now friends, or no current friends).
  → What do you usually do with your free time?
  → Can you tell me about your social interaction? Do you have some friends? How many? Who tends to initiate social contact, you or others?

- Serious impairment in judgment (including inability to make decisions, confusion, disorientation).
  → Do you have difficulty making decision in your day-to-day life?

- Serious impairment in thinking (including constant preoccupation w/thoughts, distorted body image, paranoia)
  →
- Serious impairment in mood (including constant depressed mood plus helplessness and hopelessness, or agitation, or manic mood).
  → Were you ever depressed or down? Do you find yourself crying a lot?
  → Do you feel sad/bad/worthless/hopeless? Do you get angry often?
  → For how long do you feel that way?

- Serious impairment due to anxiety (panic attacks, overwhelming anxiety).
  → Do you feel anxious? Do these anxieties disrupt your ability to work, function socially or in other important areas of your life?
  → How often do you feel that way?

- Other symptoms: some hallucinations, delusions, or severe obsessional rituals.
  → PANSS?
- Passive suicidal ideation or mildly self-injurious behaviors (e.g., scratching wrists) that do not require medical attention.

51-53: BOTH moderate symptoms AND moderate difficulty in social, work, and school functioning
54-57: Moderate difficulty in more than 1 area of social, work or school functioning
58-60: EITHER moderate depressed mood, symptoms OR moderate difficulty in social, work, or school functioning

Group E Criteria:

- Moderate symptoms (e.g., frequent, moderate depressed mood and insomnia and/or moderate ruminating and obsessing; or occasional anxiety attacks; or flat affect and circumstantial speech; or eating problems and below minimum safe weight without depression).

61-63: BOTH mild persistent symptoms AND some difficulty in social, work, and school functioning

64-67: Mild persistent difficulty in more than one area of social, work or school functioning
68-70: EITHER mild persistent symptoms OR mild difficulty in social, work, or school functioning

Group F Criteria:

- Mild symptoms are present that are NOT just expectable reactions to psychosocial stressors (e.g., mild or lessened depression and/or mild insomnia)
- Some persistent difficulty in social, work or school functioning (e.g., occasional truancy, theft within the family, or repeated falling behind in school or work)
- But has some meaningful interpersonal relationships

71-73: BOTH mild symptoms AND slight impairment in social, work & school functioning
74-77: Mild impairment in more than one area of social, work or school functioning
78-80: EITHER mild symptom(s) OR mild impairment in social, work or school functioning

Group G Criteria:

- Mild symptoms are present, but they are transient and expectable reactions to psychosocial stressors (e.g., difficulty concentrating after family argument).
- Slight impairment in social, work, or school functioning (e.g., temporarily falling behind in school or work).

81-83: Minimal symptoms and some everyday problems
84-87: Minimal symptoms and no everyday problems
88-90: No psychological symptoms and no problems of living or functioning

Group H Criteria:

- Minimal or absent symptoms (e.g., mild anxiety before an examination)
- Good functioning in all areas and satisfied with life
- Interested and involved in a wide range of activities
- Socially effective

ANNEXE N: Role Functioning Scale (RFS)

Role Functioning Scale (RFS)

Rate the client primarily in the most appropriate expected role (i.e. homemaker, student, wage earner).

Working Productivity

Questions:

- ➔ Can you tell me about your situation at work, at school, or at home?
- ➔ Are you able to accomplish the various tasks you have to do at work, at school or at home? Has it always been like that?
- ➔ Are you productive in accomplishing these tasks?
- ➔ Do you need assistance to accomplish these tasks?

1. Productivity severely limited; often unable to work or adapt to school or homemaking; virtually no skills or attempts to be productive.
2. Occasional attempts at productivity unsuccessfully; productive only with constant supervision in sheltered work, home or special classes.
3. Limited productivity; often with restricted skills/abilities for homemaking, school, independent employment (e.g. requires highly structured routine.)
4. Marginal productivity (e.g. productive in sheltered work or minimally productive in independent work; fluctuates at home, in school; frequent job changes.)
5. Moderately functional in independent employment, at home or in school. (Consider very spotty work history or fluctuations in home, in school with extended periods of success).
6. Adequate functioning in independent employment, home or school; often not applying all available skills/abilities.
7. Optimally performs homemaking, school tasks or employment-related functions with ease and efficiency.

Independent Living, Self Care.

(Management of household, eating, sleeping, hygiene care)

Questions :

- ➔ Do you live alone or with other person?
- ➔ Do you take care of household chores on your own?
- ➔ Do you cook for yourself?
- ➔ Do you get help at home to do the various tasks?
- ➔ How are your life habits? For example, do you sleep well, shower enough, wash your clothes?
- ➔ Do you often use mental health care services?

1. Lacking self-care skills approaching life endangering threat; often involves multiple and lengthy hospital services; not physically able to participate in running a household.

2. Marked limitations in self- care/independent living; often involving constant supervision in or out of a protective environment (e.g. frequent utilization of crisis services).
3. Limited self-care/independent living skills; often relying on mental/physical health care; limited participation in running a household.
4. Marginally self-sufficient; often uses REGULAR assistance to maintain self-care/independent functioning; minimally participates in running households.
5. Moderately self-sufficient; i.e. living independently with ROUTINE assistance (e.g. home visits by nurses, other helping persons, in private or self-help residences).
6. Adequate independent living & self-care with MINIMAL support (e.g. some transportation, shopping assistance with neighbors, friends, other helping persons).
7. Optimal care of health/hygiene; independently manages to meet personal needs and household tasks.

Immediate Social Network Relationships
(Close friends, Spouse, Family) *(We will probably have the information from the PANSS)*

Questions:

- ➔ Tell me about your social life.
- ➔ Do you have friends?
- ➔ Are they casual or close friends?
    - ◆ If only casual-are they school or work friends only? If close-how long have you been close friends?
- ➔ Do you spend time with family members (at home)?
- ➔ How often do you communicate with them?
- ➔ Do you ever avoid contact with family members?

1. Severely deviant behaviors within immediate social networks (i.e. often with imminent physical aggression or abuse to others or severely withdrawn from close friends, spouse, family; often rejected by immediate social network).
2. Marked limitations in immediate interpersonal relationships (e.g. excessive dependency or destructive communication or behaviors).
3. Limited interpersonally; often no significant participation/ communication with immediate social network.
4. Marginal functioning with immediate social network (i.e. relationships are often minimal and fluctuate in quality).
5. Moderately affective continuing and close relationship with at least one other person.
6. Adequate personal relationship with one or more immediate members of a social network (e.g. friend or family).
7. Positive relationships with spouse or family and friends; assertively contributes to these relationships.

Extended Social Network Relationships
(Neighborhood, community church, clubs, agencies, recreational activities).

Questions:

- ➔ Could you tell me about your interactions within your neighborhood, community church, clubs, agencies, and any recreational activities you engage in?
- ➔ Do you interact with your neighborhood, or do you participate in any recreational activities?
- ➔ Do you enjoy interacting in community or engaging in recreational activities?
- ➔ How often do you interact with your neighborhood or participate in recreational activities?

1. Severely deviant behaviors within extended social networks (i.e. overtly disruptive, often leading to rejection by extended social networks).
2. Often totally isolated from extended social networks, refusing community involvement or belligerent to helpers, neighbors, etc.
3. Limited range of successful and appropriate interactions in extended social networks (i.e. often restricts community involvement to minimal survival level interactions).
4. Marginally effective interactions; often in a structured environment; may receive multiple public system support in accord with multiple needs.
5. Moderately affective and independent in community interactions; may receive some public support in accord with need.
6. Adequately interacts in neighborhood or with at least one community or other organization or recreational activity.
7. Positively interacts in community; church or clubs, recreational activities, hobbies or personal interests, often with other participants.

ANNEXE O: Approbation éthique

UQO

CERTIFICAT D'APPROBATION ÉTHIQUE

La présente atteste que le projet de recherche décrit ci-dessous a fait l'objet d'une évaluation en matière d'éthique de la recherche avec des êtres humains et qu'il satisfait aux exigences de notre politique en cette matière.

Projet # : 2024-2938

Titre du projet de recherche : Investigation de la faisabilité, de l'acceptabilité et de l'efficacité initiale d'un programme de remédiation cognitive en réalité virtuelle pour des individus ayant un trouble psychotique

Chercheure principale :
Marika Goyette
Étudiante, Université du Québec en Outaouais

Directrice de recherche:
Synthia Guimond
Professeure, Université du Québec en Outaouais

Date d'approbation du projet : 05 février 2024
Date d'entrée en vigueur du certificat : 05 février 2024
Date d'échéance du certificat : 05 février 2025

Caroline Tardif
Attachée d'administration, CÉR
pour André Durivage, Président du CÉR

Signé le 2024-02-05 à 13:30

Le 05 février 2024

À l'attention de :
Marika Goyette
Étudiante, Université du Québec en Outaouais

Objet : Approbation éthique de votre projet de recherche

Projet #: 2024-2938
Titre du projet de recherche : Investigation de la faisabilité, de l'acceptabilité et de l'efficacité initiale d'un programme de remédiation cognitive en réalité virtuelle pour des individus ayant un trouble psychotique

---

Votre projet de recherche a fait l'objet d'une évaluation en matière d'éthique de la recherche avec des êtres humains par le CER de l'UQO. Suivant l'examen de la documentation reçue, nous constatons que votre projet de recherche rencontre les normes éthiques établies par l'UQO.

Un certificat d'approbation éthique qui atteste de la conformité de votre projet de recherche à la *Politique d'éthique de la recherche avec des êtres humains* de l'UQO est par conséquent émis en date du 05 février 2024. Nous désirons vous rappeler que pour assurer la validité de votre certificat d'éthique pendant toute la durée de votre projet, vous avez la responsabilité de produire, chaque année, un rapport de suivi continu à l'aide du formulaire *F9 - Suivi continu*. Le prochain suivi devra être fait au plus tard le :

05 février 2025.

Un rappel automatique vous sera envoyé par courriel quelques semaines avant l'échéance de votre certificat.

Si des modifications sont apportées à votre projet, vous devrez remplir le formulaire *F8 - Modification de projet* et obtenir l'approbation du CER avant de mettre en œuvre ces modifications. Finalement, lorsque votre projet sera terminé, vous devrez remplir le formulaire *F10 - Rapport final.*

Notez qu'en vertu de la *Politique d'éthique de la recherche avec des êtres humains*, il est de la responsabilité des chercheurs d'assurer que leurs projets de recherche conservent une approbation éthique pour toute la durée des travaux de recherche et d'informer le CER de la fin de ceux-ci.

Nous vous souhaitons bon succès dans la réalisation de votre recherche.

Statuts pour le projet VR_Phase 2 - Marika Goyette

Information générale

Identifiant Nagano (acronyme)	VR_Phase 2 - Marika Goyette
Numéros	2024-2938
Type de projet	F1B - Demande de certificat d'éthique pour un projet de recherche qui s'insère dans un projet d'un professeur approuvé par le CER de l'UQO
Processus accéléré	Oui
Si sous-étude, étude principale	Aucune étude principale
Champ d'application	Département de psychoéducation et de psychologie
Bureau	Comité d'éthique de la recherche de l'Université du Québec en Outaouais
Lieu d'évaluation éthique	Évaluation locale
Statut	Autorisé pour la recherche
Utilisateur principal	Goyette, Marika
Date d'approbation du CÉR évaluateur	2024-02-05
Date de renouvellement	2026-02-05

Rencontres

Nom	Décision	Date
Rencontre Comité plénier du 2024-02-08	Approbation	2024-02-08

Statuts du projet CÉR

Statut	Date de création	Utilisateur
Approbation	2024-02-05 11:10	Durivage, André
À l'étude	2024-01-25 11:36	Tardif, Caroline
Dossier complet	2024-01-25 11:36	Tardif, Caroline
Déposé	2024-01-24 16:57	Guimond, Synthia
En préparation	2023-05-30 08:41	Goyette, Marika

Statuts des formulaires

1b - Formulaire de demande de certificat d'éthique pour un projet de recherche qui s'insère dans un projet d'un professeur

Formulaire	Créé le	Déposé le	Approuvé / traité	Déposé par
F1b-11394	2023-05-30 08:41	2024-01-24 16:57	2024-02-05 11:10	Guimond, Synthia

9 - Formulaire de demande de renouvellement de l'approbation éthique

Formulaire	Créé le	Déposé le	Approuvé / traité	Déposé par
F9-15423	2025-01-06 08:52	2025-01-07 10:30	2025-01-07 14:45	Guimond, Synthia

The Royal's
Institute of Mental Health Research
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RESEARCH ETHICS BOARD - APPROVAL

Date: 3 May 2023

Investigator Name: Synthia Guimond

REB Number: **2023001**

Study Title: ***Examining the Efficacy of a Virtual Reality Cognitive Remediation Program for People Living with Psychosis***

Submission Type: Initial Application

Review Type: ☒ Full Board Review ☐ Delegated Review

Date of Approval: 3 May 2023

Approval Expiry Date: **3 May 2024**

Dear Synthia Guimond,

Thank you for submitting the above noted study to the Royal Ottawa Health Care Group (ROHCG) REB for review. The study has been reviewed by the REB and approval has been granted. This study is approved until the expiration date noted above.

The following documents are approved:

Document Name/Title	Version	Document Version Date
Protocol	1	1 March 2023
Informed Consent Form – Main	1	28 April 2023
Informed Consent Form – COVID-19	1	6 October 2020
Informed Consent Form – Unspecified Research	1	28 April 2023
Consent to Contact – Healthcare Provider	1	30 November 2022
Consent to Contact – Patient	1	30 November 2022
Screening Form	1	1 March 2023
Extended Screening Form	1	4 June 2022
Cybersickness Resource	1	6 March 2023
Assessment Timing	1	17 March 2023
Social Media Script	1	13 January 2023
Poster – Tear-Off	1	23 January 2023
Poster	1	23 January 2023

No changes to, or deviations from, the approved documents should be initiated prior to submitting an appropriate amendment and obtaining written approval from the Research Ethics Board, except when necessary to eliminate immediate hazard(s) to study participants.

An Annual Progress Report must be submitted a minimum of 30 days prior to the date of study expiration if the study will continue beyond the expiration date.

[redacted]

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If the study is completed by the expiry date noted above, a Study Closure/Termination report must be submitted to the REB.

Sin[redacted]ard,

Alexis Dorland, Interim REB Coordinator
Signing for:
Ann-Marie O'Brien
Chair, ROHCG REB

Research Ethics Board Attestation

REB members who are involved in a research project under review recuse themselves from the meeting and do not take part in the review, discussion or decision related to their respective projects.

The Royal Ottawa Health Care Group REB complies with the requirements of the Tri-Council Policy Statement (TCPS2): Ethical Conduct for Research Involving Humans; International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use Guideline for Good Clinical Practice (ICH-GCP0; Part C, Division 5 of the food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Device Regulations and the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations.

You must retain a copy of this letter for your study file

ROHCG REB [redacted]