Title

Treatment engagement in first-episode schizophrenia: Associations between intrinsic motivation and attendance during cognitive training and an aerobic exercise program.

Authors

Le, Thanh
Ventura, Joseph
Ruiz-Yu, Bernalyn
et al.

Publication Date

2023

DOI

10.1016/j.schres.2022.12.018

Peer reviewed

HHS Public Access

Author manuscript

Schizophr Res. Author manuscript; available in PMC 2024 January 01.

Published in final edited form as:

Schizophr Res. 2023 January ; 251: 59–65. doi:10.1016/j.schres.2022.12.018.

Treatment engagement in first-episode schizophrenia: Associations between intrinsic motivation and attendance during cognitive training and an aerobic exercise program

Thanh P. Le[a,*], **Joseph Ventura**[a], **Bernalyn Ruiz-Yu**[a], **Sarah C. McEwen**[b], **Kenneth L. Subotnik**[a], **Keith H. Nuechterlein**[a,c]

[a]Department of Psychiatry and Biobehavioral Sciences, Semel Institute for Neuroscience and Human Behavior, University of California, Los Angeles, CA, USA

[b]atai Life Sciences, Berlin, Germany

[c]Department of Psychology, University of California, Los Angeles, CA, USA

Abstract

Systematic cognitive training and aerobic exercise programs have emerged as promising interventions to improve cognitive deficits in first-episode schizophrenia, with successful outcomes closely linked with greater treatment engagement (e.g., higher attendance and homework completion rates). Unfortunately, treatment disengagement from these services remains a persistent issue. Intrinsic motivation, or the willingness to exert effort because a task is inherently interesting or meaningful, has emerged as a promising malleable personal factor to enhance treatment engagement. This study investigated whether early task-specific intrinsic motivation and its domains (e.g., interest, perceived competence, and value) predicted treatment engagement within the context of intensive cognitive training and aerobic exercise interventions over a 6-month period. Thirty-nine participants with first-episode schizophrenia were administered baseline measures of task-specific intrinsic motivation inventories, one for cognitive training and one for exercise, and completed a 6-month randomized clinical trial comparing a neuroplasticity-based cognitive training plus aerobic exercise program against the same cognitive training alone. Results indicated that higher baseline scores of intrinsic motivation for cognitive training,

*Corresponding author at: University of California, Los Angeles, Department of Psychiatry and Biobehavioral Sciences and the Semel Institute for Neuroscience and Human Behavior, 300 UCLA Medical Plaza, Room 2240, Los Angeles, CA 90095, USA. thanhle@mednet.ucla.edu (T.P. Le).

CRediT authorship contribution statement

TPL performed the literature search, conducted data analyses, and wrote the bulk of the manuscript. KHN, JV, SCM, and KLS designed the randomized clinical trial and collected the data. JV, BR, KLS, and KHN aided with data interpretation. All authors helped interpret the findings and provided conceptual material to the planning and presentation of this project. All authors contributed to the writing of the manuscript.

Conflicts of interest

KHN reports medication and supplemental research grant support from Janssen Scientific Affairs, LLC., and has served as a consultant to Astellas, Genentech, Janssen, Medincell, Otsuka, Recognify, Takeda, and Teva. He is an officer in the nonprofit company, MATRICS Assessment, Inc., which publishes the MCCB, but receives no financial compensation. JV has received funding from Brain Plasticity, Inc., Genentech, Inc., and Janssen Scientific Affairs, LLC, and has served as a consultant to Boehringer-Ingelheim, GmbH, and Brain Plasticity, Inc. KLS has received lecture honoraria from Janssen and research grant support from Alkermes. Other authors report no potential conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.schres.2022.12.018.

specifically early perceptions of task interest and value, were predictive of greater cognitive training and exercise group attendance. Scores for exercise-specific intrinsic motivation were generally unrelated to indices of exercise participation, with the exception that the gain over time in perceived choice for exercise was linked with greater exercise homework completion and a similar directional tendency for greater in-clinic exercise attendance. This study provides support for monitoring and enhancing motivation early during service delivery to maximize engagement and the likelihood of successful treatment outcomes.

Keywords

Cognitive remediation; Exercise intervention; Motivation; Treatment adherence; First episode psychosis; Treatment dropout

1. Introduction

Cognitive deficits are a core feature of schizophrenia (Green et al., 2000), resistant to antipsychotic medication, evident in the initial phases of the illness (McCleery et al., 2014), and impair individuals' abilities to effectively function within key social and vocational domains (Le et al., 2018; Nuechterlein et al., 2011). Systematic cognitive training (CT), or cognitive remediation, has emerged as a promising intervention to reverse these cognitive limitations, with multiple meta-analyses (Revell et al., 2015; Wykes et al., 2011) showing small to medium effect sizes on overall cognitive functioning (0.20 to 0.45) across the phases of illnesses in schizophrenia, including first-episode. More recently, the effect of aerobic exercise programs on cognitive deficits in schizophrenia has been examined. Kimhy et al. (2015) demonstrated cognitive gains via an aerobic exercise program in schizophrenia in a 3-month randomized controlled trial (RCT) with increases in brain-derived neurotrophic factor as mediating factor. Moreover, we recently reported (2022) recently that aerobic exercise significantly enhanced the impact of cognitive training (compared to cognitive training alone) on cognition and functional outcome in first-episode schizophrenia. More specifically, a synergistic effect was observed such that the addition of an aerobic exercise program to systematic cognitive training led to faster gains in cognition and larger improvements in work/school functioning relative to the same cognitive training alone (6-month RCT) in individuals with first-episode schizophrenia. Interestingly, the amount of improvement in cognitive performance and everyday functioning was strongly associated with greater exercise treatment engagement (i.e., group session attendance and homework completion). Given the importance of identifying modifiable factors that can be targeted to enhance treatment engagement, the present study examined links between intrinsic motivation and treatment engagement in cognitive training and an exercise program in patients who recently experienced a first-episode of schizophrenia.

Coordinated and comprehensive early intervention encompassing psychotherapeutic, medication, and supportive components, provided in the early course of psychosis can reduce the short-term and potentially long-term dysfunction associated with schizophrenia-spectrum disorders (Heinssen et al., 2014). Despite the documented effectiveness of these programs, treatment disengagement (e.g., drop-out, poor individual and group therapy

attendance, and medication adherence) remains a vexing issue (Cowan et al., 2020; Doyle et al., 2014). The substantial minority (25–30 %) of those who fail to meaningfully engage in treatment are at elevated risk for re-hospitalization, chronic disability, and, pertinent to the current study, worse treatment outcomes (Kreyenbuhl et al., 2009). Our recent findings (2022) that treatment engagement, or amount of exercise completed, was a critical factor in cognitive gains for first-episode patients extends this observation. Strong correlations were found between six-month cognitive gains and proportion of in-clinic exercise completed ($r = 0.56$) and the number of exercise homework sessions completed ($r = 0.61$). Moreover, improvements in work/school functioning were also associated with attendance at in-clinic exercise and cognitive training sessions (r's > 0.45), supporting the notion that intervention participation facilitates cognitive gains and associated generalization to everyday functioning. A recent study (Best et al., 2020) observed similar findings such that the number of cognitive training sessions attended and minutes of homework completed significantly predicted cognitive gains. Thus, increased understanding of the determinants of treatment disengagement is needed to limit the impairment that usually follows a first-episode of schizophrenia.

Previous research has generally focused on demographic and historical predictors of treatment engagement in early psychosis, such as forensic and substance use history and socioeconomic status (Doyle et al., 2014; Stowkowy et al., 2012). However, these characteristics are largely immutable, so they are not likely treatment targets for improving treatment engagement. Intrinsic motivation, or the willingness to exert effort because a task is inherently interesting or meaningful (Ryan and Deci, 2000), has emerged as a promising malleable treatment target to increase treatment engagement (Brett et al., 2018). Intrinsic motivation is a key concept within Self-Determination Theory (SDT; Ryan and Deci, 1985), which is a leading framework of motivation that has accumulated a considerable amount of evidence in recent years as a viable approach to improving motivation toward treatment engagement. While external incentives are useful for initial engagement, intrinsically motivated behaviors that are experienced as internally enjoyable, valuable, and autonomous are specifically linked with continued engagement within the context of cognitive training in mid- and late-stage schizophrenia. For example, Choi and Medalia (2010) found that higher baseline scores of intrinsic motivation were associated with greater attendance rates of a four-week computer-assisted arithmetic training program as well as improved arithmetic skill at end-treatment. These findings were extended in another 4-week arithmetic training program where a motivational enhancement intervention was associated with large improvements in intrinsic motivation for cognitive training as well as the number of training sessions in patients with schizophrenia (Fiszdon et al., 2016). Similarly, Bryce et al. (2018) found that early task value predicted cognitive training attendance to above and beyond baseline cognitive and psychiatric symptoms and that changes in task value were also associated with cognitive gains.

There has been considerably less research on the associations between intrinsic motivation and exercise in schizophrenia. This is surprising given that individuals with first-episode schizophrenia often have poor metabolic physical health (Whitson et al., 2021) and engage in fewer physical activities compared to same-aged controls (Rosenbaum et al., 2016). However, several studies of SDT-based interventions aimed at increasing exercise behavior

have shown consistent support for positive relationships between more autonomous forms of motivation and long-term exercise participation across samples and settings (Teixeira et al., 2012). While the literature provides good evidence for the value of intrinsic motivation in understanding how to enhance cognitive training participation and physical activity broadly, it remains unknown if the linkage between intrinsic motivation and cognitive training engagement extends to individuals with first-episode schizophrenia and if it generalizes to engagement in intensive exercise program.

With increased calls for patient-centered interventions (Cohen et al., 2019; Thonon et al., 2020), there has been more emphasis on identifying individual variables that predict treatment response. While intrinsic motivation, which is separate from the more general negative symptom domain of amotivation (e.g., broader reduction in behaviors and including both internal and external processes), is impaired in individuals with first-episode schizophrenia (Breitborde et al., 2012; Luther et al., 2015), there is emerging evidence that it may be improved with participation in early intervention services (Alvarez-Jimenez et al., 2021; Breitborde et al., 2021). The current study, which is a secondary analyses of a completed RCT (Nuechterlein et al., 2022), investigated whether early task-specific intrinsic motivation and its domains (e.g., interest, perceived competence, and value) were linked with treatment engagement in cognitive training and an aerobic exercise program. This study extends previous work by investigating these associations within the context of a more intensive, longer duration, and systematic cognitive training protocol than seen in previous studies (Choi et al., 2010a; Fiszdon et al., 2016) and also by including an aerobic exercise program for patients experiencing first-episode schizophrenia. It was hypothesized that higher baseline intrinsic motivation would predict greater cognitive training session attendance and exercise participation. This study also explored if changes in task-specific intrinsic motivation were linked with treatment engagement indices.

2. Methods

2.1. Participants

Please see Nuechterlein et al. (2022) for detailed information about the parent study, including full sample demographics, assessments, primary outcomes, and a description of the experimental and control conditions. Briefly, data for the current report were drawn from an RCT examining the efficacy of a 6-month neuroplasticity-based cognitive training plus aerobic exercise program compared to the same systematic cognitive training alone. The primary treatment targets were overall cognitive deficit level and social and role functioning (ClinicalTrials.gov Identifier: NCT02267070).

Participants were first-episode patients ($N = 39$) recently diagnosed with schizophrenia-spectrum disorders. The inclusion and exclusion criteria were (1) a first episode of a psychotic illness that began within the past two years, based a clinical interview (SCID; First et al., 1997), medical records, treatment providers, and family members; (2) a diagnosis by DSM-IV of schizophrenia, schizoaffective disorder, mainly depressed type, or schizophreniform disorder; (3) 18 to 45 years old; (4) no evidence of significant head injury or neurological disorder or; (5) no evidence of moderate or severe alcohol or substance use disorder within the six months before the first-episode, (6) premorbid IQ

not <70; (7) satisfactory fluency in the English language to avoid invalidating measures of verbal cognitive abilities; and (8) residence likely to be within commuting distance of the UCLA Aftercare Research Program. The initial antipsychotic medication prescribed was oral risperidone unless prior treatment indicated that risperidone was ineffective or produced intolerable side effects. Antipsychotic dosage was individually optimized. Adjunctive medications (e.g., antidepressants, antiparkinsonian medications) were used when required.

2.2. Procedures

All patients were enrolled in the UCLA Aftercare Research Program, an outpatient clinic that provides coordinated treatment including antipsychotic medication, individual case management, psycho-education, family education, and group and individual therapy focused on recovery and practical life skills. Patients were participants in a 6-month RCT of Cognitive Training & Exercise (CT&E) vs. Cognitive Training (CT) alone (for theoretical rationale and detailed design information, see Nuechterlein et al., 2016 and Nuechterlein et al., 2022). The randomized treatment conditions lasted 6 months. The major assessment battery, including clinical symptoms (Brief Psychiatric Rating Scale; Ventura et al., 1993) and neurocognition (MATRIC Consensus Cognitive Battery; Nuechterlein and Green, 2006), was conducted at baseline and repeated after 3 months and at the end of the 6-month randomized treatment period.

2.2.1. Cognitive training—Both the CT and CT&E groups were provided the same cognitive training program, with the first 12 weeks focused on neurocognitive training and the second 12 weeks focused on social cognitive training. Patients completed 2 h/day of computerized cognitive training 2 days/week (maximum 96 possible cognitive training sessions/participant). CT sessions were reinforced by providing $2 per session. Between 4 and 6 patients completed the CT sessions in a clinic room with separate computers and one cognitive coach.

2.2.2. Neurocognitive training—The Posit Science Brain HQ modules focused on improving the neurocognitive processes of auditory discrimination, speed of processing, working memory, verbal memory, and verbal reasoning. BrainHQ's auditory exercises started with basic processes involving auditory discrimination and progressed to more complex processes involving memory processing and reasoning (see Nuechterlein et al., 2022 for a description of the modules). Difficulty levels continuously adapted according to the skill level of each participant to encourage engagement.

2.2.3. Social cognitive training—The Posit Science SocialVille modules focused on impairments in facial recognition, social perception, processing of emotion, self-referential style, and interpretation of social information. Participants began with simple face and emotion identification tasks and gradually progressed to more difficult emotion discrimination and social cue interpretation tasks. Difficulty levels continuously adjusted according to the skill level of each participant for maximum engagement and reward. Engaging sound effects, dynamic visual stimuli, and a social reward system also encouraged continued participation.

2.2.4. Exercise—In addition to the cognitive training sessions, participants randomized to the CT&E condition participated in a 24-week progressive aerobic exercise program. The in-clinic group exercise sessions occurred two sessions/week (occurred on the same day as cognitive training sessions at Aftercare; maximum 48 possible in-clinic exercise sessions/participant). The in-clinic training consisted of moderate-intensity aerobic exercises (1-minute intervals) with moderate to high-intensity strength and callisthenic conditioning (1-minute intervals) for 45 min. Participants completed three rounds of five different sets of aerobic and strength exercises with a certified personal trainer.

The at-home exercise homework program consisted of two 30-minute sessions per week (maximum 48 possible at-home exercise homework/participant). The home-based exercise was designed around the individual participant's interests and current fitness level and ranged from completing an exercise DVD, to hiking, or taking Zumba classes.

Overall, the combined exercise dosage goal was 150 min/week of moderate aerobic activity, and the conditioning program was designed by a certified personal trainer (co-author SM). Each participant earned $2 for each session completed in the clinic and $5 for every homework session completed.

2.3. Measures

2.3.1. Cognitive training engagement—Engagement for cognitive training was calculated as the proportion of attendance (i.e., the raw number of sessions attended/possible number of sessions attended) over the 6 months. Proportion was used because participants varied on the possible number of attendance due to excused absences (e.g., sick day, other emergencies, overlap with battery testing day, etc.) or early drop out from the parent study. The range of cognitive training proportion was 42 %–100 %. Attendance was taken at the beginning of the cognitive training session by the research staff.

2.3.2. Exercise engagement—For participants randomized to the CT&E condition, in-clinic group exercise occurred on the same days at Cognitive Training sessions. Engagement for in-clinic exercise was also calculated as the proportion of attendance over the 6-month treatment period. The range of in-clinic group exercise proportion was 41 %–100 %. Attendance was taken at the beginning of the in-clinic exercise session by the research staff.

Engagement for at-home exercise homework was calculated as the proportion of homework completion. Participants were given a Fitbit Charge HR to capture heart rate and movement data and were taught to sync their Fitbit with their mobile phone to remotely collect their exercise homework. Participants self-reported adherence to the at-home exercise sessions (2 per week) to research staff every week. The research staff would then verify the participant's self-report by examining their Fitbit data. The range of exercise homework completion proportion was 0 %–81 %.

2.3.3. Intrinsic motivation—The Intrinsic Motivation Inventory for Schizophrenia Research (IMI; Choi et al., 2010b) was used for task-specific intrinsic motivation. The IMI demonstrated adequate psychometric properties (Cronbach's alpha = 0.88). The 21-item

IMI assesses three domains pertinent to motivation: value/utility (e.g., “I think doing this activity could help me”), perceived choice (e.g., “I believe I had some choice about doing this activity”), and interest/enjoyment (e.g., “I enjoyed doing this activity very much”). Individual items are rated on a Likert-type scale from 1 (Not at all true) to 7 (Very true). Higher scores indicate greater task-specific intrinsic motivation. Average total score and average domain scores (i.e., the average response to each question) were used for analyses. Importantly, two different task-specific IMIs were administered: one for cognitive training and one for exercise. The cognitive training-specific IMI was administered at the end of the second session and again in their last week of participation as a measure of intrinsic motivation to complete the cognitive training program. The exercise-specific IMI was administered at the end of the first in-clinic exercise session and again in their last week of participation as a measure of intrinsic motivation to complete in-clinic and at-home exercises.

2.4. Statistical analyses

Analyses were conducted in three steps. First, this study examined potential demographic associations with study variables that might inform subsequent analyses. Second, this study sought to determine the degree to which treatment engagement indices were related to baseline, or early, scores of intrinsic motivation using correlational analyses. Of note, cognitive training attendance proportion and cognitive training intrinsic motivation were collapsed between the two treatment conditions (CT&E, CT) to maximize statistical power [cognitive training attendance did not significantly differ between the two conditions; $t(44) = -0.61$, $p = .55$]. Partial Pearson correlations were used to control for group membership in these analyses. For analyses including exercise engagement indices and exercise-specific intrinsic motivation, Spearman correlations were used to account for small sample sizes ($n \leq 20$) and non-normal distribution for attendance proportion indices. Third, in exploratory analyses, treatment engagement indices were also correlated with intrinsic motivation change scores (6 months – base-line). All tests were two-tailed. The various intrinsic motivation summary scores were normally distributed (skew < 1.0); one participant was excluded due to being an extreme multivariate outlier (Cook’s distance > 1.0). All available treatment engagement data were examined regardless to the number of treatment sessions that the patients completed to increase statistical power and to be consistent with the parent study’s intent-to-treat analyses.

3. Results

3.1. Descriptive and demographic data

Table 1 presents descriptive statistics. As reported in Nuechterlein et al., 2022, demographic and clinical characteristics did not significantly differ between treatment conditions (CT&E vs. CT alone). Demographic characteristics (e.g., gender, race, ethnicity, education) were generally unrelated with treatment engagement and intrinsic motivation measures, with the exception that age was significantly associated with cognitive training attendance ($r = 0.37$, $p < .05$). Results were not substantially changed when accounting for age. As seen in Table 1, there was a relatively high attendance for cognitive training and in-clinic exercise group sessions (both >84 %). Homework completion in contrast demonstrated

much smaller adherence rates with results indicating that most participants completed less than half of the exercise homework assignments. Please see Supplementary Materials to view the results for potential change in intrinsic motivation for cognitive training and exercise using a generalized linear mixed model (GLMM). Briefly, the results indicate that intrinsic motivation for cognitive training and exercise was largely stable over time.

3.2. Associations between treatment engagement measures and intrinsic motivation

Table 2 presents results for the primary analyses. Baseline scores of IMI interest for cognitive training predicted cognitive training attendance for the next 6 months ($r = 0.33$, $p < .05$). Moreover, baseline scores for the IMI value of cognitive training were significantly predictive the cognitive training attendance ($r = 0.45$, $p < .01$). Baseline scores of IMI perceived choice for cognitive training were not linked with cognitive training attendance ($r = 0.04$, $p = .83$). Similarly, baseline scores of exercise-specific IMI (across domains and total scores) were not associated with cognitive training attendance (absolute r's < 0.30).

For in-clinic exercise engagement, none of the baseline scores of exercise-specific IMI (e.g., total score, interest, perceived choice, and value) were associated with group exercise attendance (absolute r's < 0.17). Correlations between baselines exercise-specific IMI scores and exercise homework completion were also not significant (absolute r's < 0.25). Interestingly, baseline score for IMI Total score ($r = 0.51$, $p < .05$), IMI interest ($r = 0.55$, $p < .05$) and IMI value ($r = 0.51$, $p < .05$) for cognitive training were significantly predictive of proportion of in-clinic exercise attendance. As noted in Nuechterlein et al., 2022, none of the baseline scores of intrinsic motivation were significantly linked with cognitive gains or role functioning improvement in the parent study.

3.3. Exploratory analyses

Change scores for IMI for cognitive training (e.g., total, interest, perceived choice, value) were not associated with cognitive training attendance proportion (absolute r's < 0.26). However, the gain in IMI perceived choice for exercise was significantly associated with homework completion ($r = 0.73$, $p < .01$) and showed a similar tendency for in-clinic group exercise attendance ($r = 0.49$, $p = .06$). No other IMI for exercise change scores (e.g., total, interest, value) were associated with in-clinic exercise attendance or homework completion (r's < 0.38).

4. Discussion

The current study investigated relations between intrinsic motivation for cognitive training and an aerobic exercise program in individuals with first-episode schizophrenia. Higher baseline scores of intrinsic motivation for cognitive training, specifically early perceptions of task interest and value, predicted greater cognitive training attendance. Surprisingly, scores for intrinsic motivation for exercise were generally unrelated to indices of exercise participation. The exception was a significant relationship between the gain over time in perceived choice for exercise and greater exercise homework completion and a similar directional tendency for greater in-clinic exercise attendance. Furthermore, baseline intrinsic motivation for cognitive training was significantly predictive of in-clinic exercise attendance.

There are clear treatment implications from this study given that cognitive training is more effective in the early course of schizophrenia relative to mid-stage (Bowie et al., 2014) and the increased calls for cognitive remediation to be standard clinical practice in schizophrenia (Bowie, 2019; Lewandowski, 2021). With increasing evidence that exercise interventions for schizophrenia are also beneficial (Browne et al., 2021a; Firth et al., 2017; Nuechterlein et al., 2022), understanding factors in exercise program engagement also become clinically important.

The study's primary findings that early perceptions of cognitive training interest and value were predictive of cognitive training attendance in first-episode schizophrenia are consistent with previous findings with individuals in the middle stage of schizophrenia (Choi and Medalia, 2010). Of note, Nuechterlein et al. (2022; the parent study) observed that successful outcomes from their intensive cognitive training plus exercise protocol were linked with greater group attendance and exercise homework completion. Initial disconnection from treatment, particularly if characterized by low perceived treatment worth and pleasure, may reduce the likelihood of a patient to attend a meaningful amount of sessions (Choi and Medalia, 2005). Early assessment of intrinsic motivation in first-episode schizophrenia therefore may provide crucial insight into initial engagement and an opportunity for tailored discussions on how a patient's cognitive difficulties impede their everyday functioning but are remediable through cognitive training and aerobic exercise. Brief motivational interviewing before cognitive training has also been found to increase intrinsic motivation attributed to cognitive learning and subsequent session attendance in schizophrenia (Fiszdon et al., 2016).

Early intrinsic motivation was largely unrelated to exercise treatment engagement indices, with two exceptions. First, early intrinsic motivation (e.g., task value and interest) attributed to cognitive training, was associated with in-clinic exercise participation. This clear positive association may have been because cognitive training and group exercise sessions occurred in the clinic on the same day, such that attendance at one was associated with attendance at the other. However, it could be that the intrinsic motivation measure used in the study (i.e., IMI) taps a general state of intrinsic motivation for interventions, and thus early perceived task value and interest may be relevant to participation in both exercises and cognitive training. Second, a greater increase in perceived choice over time for exercise was strongly associated with higher exercise homework completion rates. While this exploratory result should be interpreted with caution, this individual difference finding provides promising evidence that increasing the sense of autonomy in exercise programs may lead to improved participation. For example, with the aid of a certified personal trainer, each patient in the current study was encouraged to choose home-based exercises designed around their specific interests, current fitness levels, and personal schedule. Further research on ways to improve motivation for physical activity is warranted, especially considering that the exercise homework completion rate in this study was low (40 %). An emerging approach is the use of SDT-based interventions to increase physical activity in individuals with schizophrenia. For example, exercise interventions can enhance perceptions of autonomy through selecting personalized home-based activities, relatedness through participation in exercise groups, and competence through activity tracking with commercially available fitness trackers (Browne et al., 2021a, 2021b). Regarding the lack of associations between

baseline scores of IMI for exercise and exercise participation, there are many potential barriers (i.e., institutional, societal, environmental) that stymie physical activity, particularly in underserved populations, despite aspirations to exercise (Bantham et al., 2021).

Several limitations are noteworthy. First, the study involved a relatively small sample, which reduces power and limits the ability to investigate potential moderator or mediator variables (e.g., demographic, pre-morbid IQ, or other clinical variables) in primary analyses. With that said, study findings with this sample of first-episode schizophrenia are consistent with findings from studies involving middle-stage schizophrenia patients. Second, the study used the IMI (Choi et al., 2010b) to assess intrinsic motivation for exercise; this measure has mainly been used within the context of cognitive training and may not index motivation for exercise as effectively. This may help explain the null results between baseline scores of IMI for exercise and exercise participation. Future research would benefit from using additional measures of motivation for exercise such as the Behavioral Regulation in Exercise Questionnaire-2 (Markland and Tobin, 2004). Finally, the measures of treatment engagement examined in the current study focused on the proportion of session attendance and homework compliance rate. Future studies could expand the scope to examine performance-based measures of training efficiency such as the number of cognitive learning modules completed per training day or actigraphy-based measures of physical activity throughout the week using easily accessible, consumer-grade technology (Cohen et al., 2020).

This study provides support for the role of intrinsic motivation toward treatment engagement after a first schizophrenia episode in the context of intensive cognitive training and aerobic exercise interventions over a substantial duration. Thus, it suggests that evaluating motivation early during service delivery is very useful. These findings must be replicated in future trials across diverse clinical settings (i.e., community-based coordinated care, telehealth), with larger samples, and with consideration of other variables that may contribute to these results. A greater understanding of the contribution of initial motivation for treatment may assist in developing methods to optimize the benefits and accessibility of crucial intervention services for first-episode schizophrenia.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgment

The authors would like to thank the study participants and the dedicated UCLA Aftercare Research Program staff members.

Financial support

This research was supported by the NIMH (KHN, R34 MH102529, P50 MH066286, and R01 MH110544; ClinicalTrials.gov Identifier: NCT02267070) and supplemental funding and medication by Janssen Scientific Affairs, L.L.C. (KHN, investigator-initiated study R092670SCH4005). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Mental Health, the National Institutes of Health, or Janssen Scientific Affairs, L.L.C. TPL is supported by an institutional training grant from the National Institutes of Health (NIH; T32MH122395-01).

References

Alvarez-Jimenez M, Koval P, Schmaal L, Bendall S, O'Sullivan S, Cagliarini D, D'Alfonso S, Rice S, Valentine L, Penn DL, Miles C, Russon P, Phillips J, McEnery C, Lederman R, Killackey E, Mihalopoulos C, Gonzalez-Blanch C, Gilbertson T, Lal S, Cotton SM, Herrman H, McGorry PD, Gleeson JFM, 2021. The horyzons project: a randomized controlled trial of a novel online social therapy to maintain treatment effects from specialist first-episode psychosis services. World Psychiatry 20, 233–243. 10.1002/WPS.20858. [PubMed: 34002511]

Bantham A, Taverno Ross SE, Sebastião E, Hall G, 2021. Overcoming barriers to physical activity in underserved populations. Prog. Cardiovasc. Dis 64, 64–71. 10.1016/J.PCAD.2020.11.002. [PubMed: 33159937]

Best MW, Milanovic M, Tran T, Leung P, Jackowich R, Gauvin S, Leibovitz T, Bowie CR, 2020. Motivation and engagement during cognitive training for schizophrenia spectrum disorders. Schizophr. Res. Cogn 19, 100151 10.1016/j.scog.2019.100151. [PubMed: 31828022]

Bowie CR, 2019. Cognitive remediation for severe mental illness: state of the field and future directions. World Psychiatry 18, 274. 10.1002/WPS.20660. [PubMed: 31496075]

Bowie CR, Grossman M, Gupta M, Oyewumi LK, Harvey PD, 2014. Cognitive remediation in schizophrenia: efficacy and effectiveness in patients with early versus long-term course of illness. Early Interv. Psychiatry 8, 32–38. 10.1111/EIP.12029. [PubMed: 23343011]

Breitborde NJK, Kleinlein P, Srihari VH, 2012. Self-determination and first-episode psychosis: associations with symptomatology, social and vocational functioning, and quality of life. Schizophr. Res 137, 132–136. 10.1016/J.SCHRES.2012.02.026. [PubMed: 22445463]

Breitborde NJK, Pine JG, Moe AM, 2021. Uncontrolled trial of specialized, multi-component care for individuals with first-episode psychosis: effects on motivation orientations. Early Interv. Psychiatry 15, 41–46. 10.1111/EIP.12907. [PubMed: 31889415]

Brett BL, McGovern JE, Choi J, Fiszdon JM, 2018. Improving treatment motivation in individuals with psychosis: predictors of response to motivational enhancement. Psychiatry Res. 266, 36–39. 10.1016/j.psychres.2018.05.038. [PubMed: 29803184]

Browne J, Battaglini C, Jarskog LF, Sheeran P, Abrantes AM, McDermott J, Elliott T, Gonzalez O, Penn DL, 2021a. Targeting physical health in schizophrenia: results from the physical activity can enhance life (PACE-Life) 24-week open trial. Ment. Health Phys. Act 20 10.1016/J.MHPA.2021.100393.

Browne J, Cather C, Zvonar V, Thayer K, Skiest H, Arntz D, Kritikos K, Schnitzer K, Brown H, Evins AE, Donovan A, 2021b. Developing a sound body: open trial results of a group healthy lifestyle intervention for young adults with psychosis. Community Ment. Health J 57, 864–871. 10.1007/S10597-020-00655-Y. [PubMed: 32524260]

Bryce SD, Lee SJ, Ponsford JL, Lawrence RJ, Tan EJ, Rossell SL, 2018. The impact of intrinsic motivation on session attendance and reliable cognitive improvement in cognitive remediation in schizophrenia. Schizophenia Res. 202, 354–360. 10.1016/J.SCHRES.2018.06.028.

Choi J, Medalia A, 2010. Intrinsic motivation and learning in a schizophrenia spectrum sample. Schizophr. Res 118, 12–19. 10.1016/J.SCHRES.2009.08.001. [PubMed: 19716270]

Choi J, Medalia A, 2005. Factors associated with a positive response to cognitive remediation in a community psychiatric sample. Psychiatr. Serv 56, 602–604. 10.1176/APPI.PS.56.5.602. [PubMed: 15872171]

Choi J, Fiszdon JM, Medalia A, 2010a. Expectancy-value theory in persistence of learning effects in schizophrenia: role of task value and perceived competency. Schizophr. Bull 36, 957–965. 10.1093/SCHBUL/SBQ078. [PubMed: 20634277]

Choi J, Mogami T, Medalia A, 2010b. Intrinsic motivation inventory: an adapted measure for schizophrenia research. Schizophr. Bull 36, 966–976. 10.1093/SCHBUL/SBP030. [PubMed: 19386577]

Cohen AS, Cox CR, Masucci MD, Le TP, Cowan T, Coghill LM, Holmlund TB, Elvevåg B, 2020. Digital phenotyping using multimodal data. Curr. Behav. Neurosci. Reports 74 (7), 212–220. 10.1007/S40473-020-00215-4, 2020.

Cohen AS, Schwartz E, Le TP, Fedechko T, Kirkpatrick B, Strauss GP, 2019. Using biobehavioral technologies to effectively advance research on negative symptoms. World Psychiatry 18, 103. 10.1002/wps.20593. [PubMed: 30600611]

Cowan T, Pope MA, MacDonald K, Malla A, Ferrari M, Iyer SN, 2020. Engagement in specialized early intervention services for psychosis as an interplay between personal agency and critical structures: a qualitative study. Int. J. Nurs. Stud. 108 10.1016/J.IJNURSTU.2020.103583.

Doyle R, Turner N, Fanning F, Brennan D, Renwick L, Lawlor E, Clarke M, 2014. First-episode psychosis and disengagement from treatment: a systematic review. Psychiatr. Serv 65, 603–611. 10.1176/APPI.PS.201200570. [PubMed: 24535333]

First MB, Spitzer RL, Gibbon M, Williams JBW, 1997. Structured Clinical Interview for DSM-IV Axis I Disorders, Clinician Version (SCID-CV), for DSMIV.

Firth J, Stubbs B, Rosenbaum S, Vancampfort D, Malchow B, Schuch F, Elliott R, Nuechterlein KH, Yung AR, 2017. Aerobic exercise improves cognitive functioning in people with schizophrenia: a systematic review and meta-analysis. Schizophr. Bull 43, 546–556. 10.1093/SCHBUL/SBW115. [PubMed: 27521348]

Fiszdon JM, Kurtz MM, Choi J, Bell MD, Martino S, 2016. Motivational interviewing to increase cognitive rehabilitation adherence in schizophrenia. Schizophr. Bull 42, 327–334. 10.1093/SCHBUL/SBV143. [PubMed: 26420905]

Green MF, Kern RS, Braff DL, Mintz J, 2000. Neurocognitive deficits and functional outcome in schizophrenia: are we measuring the “Right Stuff”? Schizophr. Bull 26, 119–136. 10.1093/oxfordjournals.schbul.a033430. [PubMed: 10755673]

Heinssen RK, Goldstein AB, Azrin ST, 2014. Evidence-Based Treatments for First Episode Psychosis: Components of Coordinated Specialty Care. NIMH White Pap.

Kimhy D, Vakhrusheva J, Bartels MN, Armstrong HF, Ballon JS, Khan S, Chang RW, Hansen MC, Ayanruoh L, Lister A, Castrén E, Smith EE, Sloan RP, 2015. The impact of aerobic exercise on brain-derived neurotrophic factor and neurocognition in individuals with schizophrenia: a single-blind, randomized clinical trial. Schizophr. Bull 41, 859–868. 10.1093/SCHBUL/SBV022. [PubMed: 25805886]

Kreyenbuhl J, Nossel IR, Dixon LB, 2009. Disengagement from mental health treatment among individuals with schizophrenia and strategies for facilitating connections to care: a review of the literature. Schizophr. Bull 35, 696–703. 10.1093/SCHBUL/SBP046. [PubMed: 19491314]

Le TP, Holden JL, Link PC, Granholm EL, 2018. Neurocognitive and theory of mind deficits and poor social competence in schizophrenia: the moderating role of social disinterest attitudes. Psychiatry Res. 270 10.1016/j.psychres.2018.10.011.

Lewandowski KE, 2021. Feasibility and tolerability of a cognitive remediation clinical service in first episode coordinated specialty care. Early Interv. Psychiatry 15, 391–396. 10.1111/EIP.12978. [PubMed: 32512644]

Luther L, Lysaker PH, Firmin RL, Breier A, Vohs JL, 2015. Intrinsic motivation and amotivation in first episode and prolonged psychosis. Schizophr. Res 169, 418–422. 10.1016/J.SCHRES.2015.08.040. [PubMed: 26386901]

Markland D, Tobin V, 2004. A modification to the behavioural regulation in exercise questionnaire to include an assessment of amotivation. J. Sport Exerc. Psychol 26, 191–196. 10.1123/JSEP.26.2.191.

McCleery A, Ventura J, Kern RS, Subotnik KL, Gretchen-Doorly D, Green MF, Hellemann GS, Nuechterlein KH, 2014. Cognitive functioning in first-episode schizophrenia: MATRICS consensus cognitive battery (MCCB) profile of impairment. Schizophr. Res 157, 33–39. 10.1016/J.SCHRES.2014.04.039. [PubMed: 24888526]

Nuechterlein KH, Green MF, 2006. MATRICS Consensus Cognitive Battery Manual. MATRICS Assessment Inc, Los Angeles, CA.

Nuechterlein KH, McEwen SC, Ventura J, Subotnik KL, Turner LR, Boucher M, Casaus LR, Distler MG, Hayata JN, 2022. Aerobic exercise enhances cognitive training effects in first-episode schizophrenia: randomized clinical trial demonstrates cognitive and functional gains. Psychol. Med 1–11 10.1017/S0033291722001696.

Nuechterlein KH, Subotnik KL, Green MF, Ventura J, Asarnow RF, Gitlin MJ, Yee CM, Gretchen-Doorly D, Mintz J, 2011. Neurocognitive predictors of work outcome in recent-onset schizophrenia. Schizophr. Bull 37 (Suppl), 2. 10.1093/SCHBUL/SBR084.

Nuechterlein KH, Ventura J, McEwen SC, Gretchen-Doorly D, Vinogradov S, Subotnik KL, 2016. Enhancing cognitive training through aerobic exercise after a first schizophrenia episode: theoretical conception and pilot study. Schizophr. Bull 42, S44–S52. 10.1093/schbul/sbw007. [PubMed: 27460618]

Revell ER, Neill JC, Harte M, Khan Z, Drake RJ, 2015. A systematic review and meta-analysis of cognitive remediation in early schizophrenia. Schizophr. Res 168, 213–222. 10.1016/J.SCHRES.2015.08.017. [PubMed: 26305063]

Rosenbaum S, Lederman O, Stubbs B, Vancampfort D, Stanton R, Ward PB, 2016. How can we increase physical activity and exercise among youth experiencing first-episode psychosis? A systematic review of intervention variables. Early Interv. Psychiatry 10, 435–440. 10.1111/EIP.12238. [PubMed: 25808450]

Ryan RM, Deci EL, 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am. Psychol 55, 68–78. 10.1037//0003-066X.55.1.68. [PubMed: 11392867]

Ryan RM, Deci EL, 1985. Self-determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-being Self-determination Theory.

Stowkowy J, Addington D, Liu L, Hollowell B, Addington J, 2012. Predictors of disengagement from treatment in an early psychosis program. Schizophr. Res 136, 7–12. 10.1016/J.SCHRES.2012.01.027. [PubMed: 22336955]

Teixeira PJ, Palmeira AL, Vansteenkiste M, 2012. The role of self-determination theory and motivational interviewing in behavioral nutrition, physical activity, and health: an introduction to the IJBNPA special series. Int. J. Behav. Nutr. Phys. Act 9, 17. 10.1186/1479-5868-9-17. [PubMed: 22385644]

Thonon B, Van Aubel E, Lafit G, Della Libera C, Larøi F, 2020. Idiographic analyses of motivation and related processes in participants with schizophrenia following a therapeutic intervention for negative symptoms. BMC Psychiatry 20. 10.1186/s12888-020-02824-5.

Ventura J, Lukoff D, Nuechterlein KH, Liberman RP, Green MF, Shaner A, 1993. Brief psychiatric rating scale expanded version 4.0: scales anchor points and administration manuale. Int. J. Methods Psychiatr. Res 3, 227–243.

Whitson S, O'Donoghue B, Hester R, Baldwin L, Harrigan S, Francey S, Graham J, Nelson B, Ratheesh A, Alvarez-Jimenez M, Fornito A, Pantelis C, Yuen HP, Thompson A, Kerr M, Berk M, Wood SJ, McGorry P, Allott K, 2021. Cognitive ability and metabolic physical health in first-episode psychosis. Schizophr. Res. Cogn 24 10.1016/J.SCOG.2021.100194.

Wykes T, Huddy V, Cellard C, McGurk SR, Czobor P, 2011. A meta-analysis of cognitive remediation for schizophrenia: methodology and effect sizes. Am. J. Psychiatry 168, 472–485. 10.1176/APPI.AJP.2010.10060855. [PubMed: 21406461]

Table 1

Descriptive and demographic data ($N = 39$).

Variable	*M* (*SD*) or %
Demographics	
Age	22.4 (4.0)
Gender (% identified male)	68 %
Race	
White	29 %
Black	32 %
Asian American	10 %
Other	29 %
Ethnicity	
Hispanic	36 %
Education	12.8 (1.5)
Parental education	13.6 (4.0)
Time since psychosis onset (in months)	8.4 (8.0)
Schizophrenia diagnosis	68 %
MCCB total score	25.5 (14.2)
BPRS symptoms[a]	
Reality distortion	4.8 (1.6)
Negative symptoms	3.3 (1.3)
Disorganization	2.4 (1.0)
Depression	2.3 (1.2)
Attendance measures	
Cognitive training attendance proportion[b]	0.85 (0.16)
Exercise attendance proportion[c]	0.87 (0.17)
Homework completion proportion[c]	0.41 (0.22)

MCCB = MATRICS Consensus Cognitive Battery.

[a]Baseline Brief Psychiatric Rating Scale scores.

[b]Value for both intervention types collapsed.

[c]Values for patients randomized to the Cognitive and Exercise condition.

Table 2

Correlations between intrinsic motivation and treatment engagement (n = 19–39).

	Cognitive training attendance	Exercise attendance	Homework completion
IMI cognitive training			
Baseline interest/enjoyment	0.33*	0.55*	0.06
Baseline perceived choice	0.04	0.30	0.14
Baseline value/usefulness	0.45**	0.51*	0.06
Baseline total	0.33*	0.51*	0.08
IMI exercise			
Baseline interest/enjoyment	−0.22	−0.17	0.10
Baseline perceived choice	−0.29	−0.11	−0.03
Baseline value/usefulness	0.08	0.04	0.24
Baseline total	0.19	−0.09	0.16

Note. IMI Intrinsic Motivation Inventory for Schizophrenia Research.

* $p < .05$.

** $p < .01$.