

Single versus dual pathways to functional outcomes in schizophrenia: Role of negative symptoms and cognitive function

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ABSTRACT

Background: The functional outcomes for many patients with schizophrenia remain poor, and the specific determinants for and pathways to functional outcomes are not well understood to date. It is unknown whether major determinants of outcomes are achieved via a motivated single pathway or by the motivation and capacity defined in dual pathways. This study investigated whether different aspects of functional outcomes, such as residential, social, and vocational outcomes, are the main determinants of the experience factors for negative symptoms or whether the experience factors and cognitive function are the determinants.

Method: We enrolled 107 patients with schizophrenia. The Social Functioning Scale domains were used to examine whether a single or dual pathway is appropriate for each domain based on the model fit using structural equation modeling.

Results: The model goodness of fit criterion showed a dual pathway for residential and vocational outcomes. In contrast, social and recreational outcomes showed a single pathway.

Conclusion: The major determinants were clearly different for each outcome. Therefore, we emphasize the importance of using different treatment strategies for each outcome. Irrespective of the factors approached, social and recreational outcomes should ultimately focus on motivation. The findings also suggest that interventions should be combined for vulnerable cognitive functions and motivational interventions for residential and vocational outcomes.

1. Introduction

Schizophrenia is a severe mental disorder with onset during young adulthood and a global incidence of 19.7 million cases in 2017 (Cooper, 2018). The post-onset recovery rate is approximately 14%, and routine clinical care addressing severe social dysfunction has not improved over the past 70 years (Cooper, 2018; Jääskeläinen et al., 2013). Research has identified a number of clinical factors as potential barriers for individuals with schizophrenia in maximizing their social potential (Patel et al., 2014). Among these barriers, cognition and negative symptoms have emerged as key predictors of functional outcomes in individuals with chronic schizophrenia (Green, 2016; Harvey et al., 2006; Levine and Leucht, 2013). In terms of negative symptoms, motivational deficits in particular have been linked to poorer functional outcomes (Strauss et al., 2013; Galderisi et al., 2014). The current goal is not to determine the influence of each determinant, such as cognition and negative symptoms, on the functional outcome; rather, recent studies have sought to understand the relative impact of determinants, including

cognitive and negative symptoms, on functional outcomes (Green et al., 2012; Quinlan et al., 2014; Strassnig et al., 2018a, 2018b).

For example, negative symptoms appear to be consistently associated with social and vocational outcomes, with additional cognitive function contributions to these outcomes (Strassnig et al., 2018a; Harvey et al., 2017). Other studies have shown that impairment strongly correlated with cognitive function and ability is a better predictor of residential outcomes than social outcomes (Strassnig et al., 2018a; Harvey et al., 2017). However, these results are inconsistent. Some studies have clearly shown that negative symptoms are predictors of residential outcomes (Strassnig et al., 2018b; Strauss et al., 2013). Similarly, other studies have reported that vocational outcomes are not associated with negative symptoms (Kalin et al., 2015). As mentioned above, the relative impact of determinants on the functional outcome remains inconclusive.

In addition, an important unsolved problem in this patient population is whether measures of performance (e.g., cognition) and motivation (e.g., negative symptoms) are part of a single pathway to

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functional outcome or are independent pathways. The concept of two independent paths to functional outcomes distinguishes between what the individual *can do* (defined as *cognitive function*) and what the individual *wants to do* (defined as *motivation*). Current studies have shown opposite results regarding whether cognitive and motivational variables form a single pathway or form multiple pathways. For example, a study by [Quinlan et al. \(2014\)](#) showed that cognition and motivation make major contributions to functional outcomes and that each factor independently has a direct effect, which is termed the *dual pathway model*. In contrast, studies by [Green et al. \(2012\)](#) and [Rassovsky et al. \(2011\)](#) reported that the involvement of cognitive function in functional outcome is indirect, and ultimately motivation becomes the main determinant, termed the *single pathway model*. As just described, the important questions regarding whether cognition or motivation is the main determinant remain unsolved. However, these conflicting findings for the primacy of a dual or single pathway may be attributed to the fact that the functional outcome is analyzed using a global score without considering the fact that the residential, social, and vocational outcomes are not highly correlated ([Harvey, 2013](#)).

Therefore, this study was designed to conduct analysis using the Social Functioning Scale (SFS) domains that evaluate residential, social, and vocational outcomes, for which models were generated to examine whether the single pathway model was valid compared with a dual pathway model in which cognitive function and motivation both make major contributions. The hypothesis was that the main determinants are different for each functional outcome and that motivation is the main determinant of functional outcomes. In the single pathway model, motivation is the most proximal determinant, and cognitive function was included as an influence in this pathway ([Green et al., 2012](#); [Rassovsky et al., 2011](#)). In the dual pathway model, cognitive function and motivation were the most proximate determinants. Because motivation is strongly associated with experience factor among the two factors of negative symptoms (experience factor and expression factor) ([Blanchard and Cohen, 2006](#); [Blanchard et al., 2011](#)), motivation was evaluated by the experience factor in the Brief Negative Symptom Scale (BNSS). In addition, among the factors of negative symptoms, the expression factor decreases motivation and indirectly affects the functional outcome; thus, the expression factor was incorporated as a factor that indirectly affects each model ([Okada et al., 2020](#); [Schlosser et al., 2015](#)).

As the identification of key mediators of each functional outcome can be a rational target for intervention, further strengthening the therapeutic mechanism, including the combination of treatments and the theoretical framework, given the highly complex nature of functional outcomes, the identification of these key mediators is of great importance because they may suggest specific therapeutic targets.

2. Materials and methods

2.1. Participants

This study was approved by the Institutional Review Board of the International University of Health and Welfare. All participants provided written informed consent after reading a complete description of the study. To secure a sufficient sample size, candidates were recruited to reach a total of 100 patients with schizophrenia.

In total, 107 patients were recruited from the outpatient treatment clinics of the Nasukougen Hospital in Japan. Inclusion criteria were the diagnosis of schizophrenia or schizoaffective disorder based on the *International Statistical Classification of Diseases and Related Health Problems—version 10* (ICD-10). Exclusion criteria were: 1) substance use disorder; and 2) history of neurologic disorders, such as seizure disorder, stroke, head injury, brain surgery, or general learning disability.

All study participants were stable patients with schizophrenia, had not been hospitalized in or readmitted to a psychiatric hospital in the past 6 months, and had not used emergency medical services in the past

year. Outpatient status was defined as living outside of any institutional setting, including a nursing home.

2.2. Procedure

After study eligibility was determined by an intake evaluation, the participants underwent a series of structured clinical assessments and measures of symptoms and functioning. Except for functional outcomes, all symptoms were evaluated by the author and the attending physician, and cognitive function was evaluated by the author and the responsible nurse and health care worker.

2.3. Measures

Positive symptom severity was assessed using a subset of the Brief Psychiatric Rating Scale (BPRS), an approach that was based on a recent factor analysis ([Kopelowicz et al., 2008](#)). The subset included the following seven scale items: (1) grandiosity; (2) suspiciousness; (3) hallucinations; (4) unusual thought content; (5) bizarre behavior; (6) disorientation; and (7) conceptual disorganization. Negative symptom severity was assessed using BNSS. Cognitive function was measured using the Schizophrenia Cognition Rating Scale (SCoRS). Functional outcomes were measured using SFS ([Birchwood et al., 1990](#)). All these evaluation scales were translated into Japanese. Their reliability and validity have been sufficiently verified in previous studies, as detailed below.

2.3.1. Brief psychiatric rating scale

The BPRS was created by Overall and Gorham in 1962 to evaluate a wide range of psychological symptoms. In this study, because the BPRS was used to identify the positive symptoms, seven items related to positive symptoms were evaluated, as just described. The Japanese version of the BPRS was used as translated by [Miyata \(1995\)](#).

2.3.2. Brief negative symptom scale

The BNSS is a scale based on the consensus statement by the National Institute of Mental Health (of the U.S. Department of Health and Human Services) to more clearly detect negative symptoms. This scale evaluates two factors of negative symptoms: the experience factor (anhedonia, asociality, and avolition) and the expression factor (blunted affect and alogia). The Japanese version of BNSS translated by [Hashimoto et al. \(2019\)](#) was used.

2.3.3. Schizophrenia cognition rating scale

The SCoRS is a cognitive and ability scale for schizophrenia based on recommendations from the Measurement and Treatment Research to Improve Cognition of Schizophrenia project of the National Institute of Mental Health. This scale evaluates seven cognitive domains: (1) vigilance; (2) working memory; (3) processing speed; (4) language learning and memory; (5) visual learning and memory; (6) reasoning and problem solving; and (7) social cognition. The Japanese version of the SCoRS was used as translated by [Kaneda et al. \(2011\)](#).

2.3.4. Social functioning scale

The SFS is used to evaluate functional outcomes in various fields for patients with schizophrenia. The scale has seven sub-items: (1) withdrawal, (2) interpersonal relationships, (3) social participation, (4) recreation, (5) self-reliance and ability, (6) self-reliance and execution, and (7) employment. Residential outcomes are evaluated with (4) and (6); social outcomes are evaluated with (1), (2), and (3); and vocational outcomes are evaluated with (7). However, unlike these items, item (5) on the scale is not evaluated as a functional outcome, but is considered as the ability to do relevant skills of the residential outcomes. We used the Japanese version of the SFS translated by [Nemoto et al. \(2008\)](#).

2.4. Statistical analyses

Structural equation modeling (SEM) was used to examine the relationships between the experience and expression factors and cognitive function. This approach to modeling uses a combination of confirmatory factor analysis and multiple regressions to determine the relationships among constructs and measured variables. Constructs (i.e., latent variables) are estimated in SEM through a factor analytic strategy using theoretically related measures (i.e., indicator variables). Factor loadings specify the association between an indicator and a latent variable. Regression analyses determine the relations between the latent variables. Associations reported between the latent variables are pathway coefficients, typically presented in a standardized form.

Usually, SEM carries out exploratory analysis many times in order to find the most appropriate model. But, in this study considering the error of $\alpha 1$ caused by the multiplicity of the tests used, only the two models were examined: the model with the most proximal SCoRS and BNSS experience (for the dual pathway) and the model with the most proximal BNSS experience (for the single pathway). These two pathway models had seven SFS domains, and the authors examined whether they showed good fitness. The model goodness of fit criteria is discussed below.

The fitness index was evaluated using the χ^2 values, the comparative fit indexes (CFI) and normed fit indexes (NFI), the root mean square of approximation (RMSEA), and the Akaike information content (AIC), and the validity was evaluated based on the model fitting criteria (χ^2 values $p > 0.05$, CFI ≥ 0.8 , NFI ≥ 0.8 , and RMSEA < 0.08).

The descriptive statistics of each measured variable and the Pearson correlation coefficients were determined before conducting SEM to provide an overall description of the data. The statistical software AMOS, version 26.0 (IBM) was used for statistical analysis.

3. Results

3.1. Descriptive statistics and correlations

Table 1 shows the basic attributes of the participants and the descriptive statistics parameters for each variable, and Table 2 shows the correlation coefficient between each pair of variables. All variables were correlated with all SFS domains, except for BPRS. Therefore, BPRS variables were not submitted for SEM analysis.

Table 1
Demographic information and descriptive statistics.

Variable	Mean (SD) or %
Age (years)	49.2 (13.9)
Years of education	12.7 (1.8)
Male, %	42.9
Assisted living, %	51
Duration of illness	20.3 (12.7)
Previous hospitalizations	1.6 (2.3)
Antipsychotic medication dose, mg	511.4 (435.4)
BPRS positive	7.3 (5.2)
BNSS experiential	14 (8.5)
BNSS expressive	8.4 (7.2)
SCoRS	37.8 (10.8)
SFS withdrawal	9.8 (2.6)
SFS interpersonal relationships	6.1 (2.9)
SFS social participation	7.8 (7.1)
SFS recreation	16.2 (7.7)
SFS self-reliance and ability	33.4 (6.2)
SFS self-reliance and execution	24.7 (8.6)
SFS employment	4.5 (3.7)

BNSS: Brief Negative Symptom Scale; BPRS: Brief Psychiatric Rating Scale; SCoRS: Schizophrenia Cognition Rating Scale; SD: standard deviation; SFS: Social Functioning Scale.

3.2. Single versus dual pathways to functional outcomes

Figs. 1–4 show SFS domains that met the fitness criteria with a single pathway. For withdrawal, interpersonal relationships, social participation, and recreation, the single route model was shown to be valid. Table 3 shows the goodness of fit when the dual pathway model is applied to withdrawal, interpersonal relationships, social participation, recreation, and self-reliance and ability. None of these factors met the fitness criteria for the dual pathway model.

The SFS domains that met the fitness criteria with dual pathways are shown in Figs. 5 and 6. For self-reliance and execution, employment in the dual pathway model was shown to be valid. Table 4 shows the goodness of fit when the single pathway model was applied to self-reliance and execution, employment, and self-reliance and ability. None of these factors met the fitness criteria for the single pathway model. All SFS domains except the ability to perform activities of residential outcome (self-reliance and ability) fit one of the two models as shown in Figs. 1–6 and Tables 3,4.

4. Discussion

These study results show that each outcome measured in the SFS domain can be dichotomized into a dual pathway model or a single pathway model. Social outcomes such as withdrawal, interpersonal relationships, and social participation and recreation outcomes showed the single pathway model; on the other hand, residential outcomes such as self-care (self-reliance and execution) and vocational outcomes showed a dual pathway model.

Interestingly, in contrast to studies (Strassnig et al., 2018a; Harvey et al., 2017) in which the influence of motivation was assessed, both cognition and motivation were the main determinants of outcomes related to residence and vocation in the present study. In this study, we used BNSS, which is different from previously reported negative symptom rating scales and which clearly evaluates motivational disorders (Kirkpatrick et al., 2011). Previous studies have reported that avolition of BNSS accounts for 30% of the variance in functional outcome, and or results support this observation (Muccia et al., 2019).

Furthermore, these results may be explained by the mechanism of cognitive function and motivation. One of the factors that hinders motivation in patients with schizophrenia is thought to be difficulties in “effort calculation,” defined as an estimate of the effort required to achieve a goal-orientated behavior (Kring and Barch, 2014; Gold et al., 2013); therefore, individuals with schizophrenia tend to feel overloaded with the actions required for goal-orientated behavior (Kring and Barch, 2014; Gold et al., 2013).

Regarding vocational and residential outcomes, it is thought that cognitive dysfunction causes poor performance such as self-care, resulting in many experiences that cannot be properly accomplished. In particular, individuals with schizophrenia may experience difficulties in learning from successful experiences and may learn excessively from failures (Fulford et al., 2018); as a result of the above, the necessary activities of residence may be overloaded and thus impair motivation, leading to further poverty in vocational and residential outcomes.

In contrast, among social and recreational outcomes, motivation was the most proximal determinant, and cognitive function only had an indirect effect. In this study, it can be concluded that these outcomes depend on the influence of motivation to participate in societal and recreational activities, rather than the ability required.

In particular, differences between recreational and residential outcomes may explain the differences in reports of associations between past residential outcomes and negative symptoms (Harvey et al., 2017; Strassnig et al., 2018a, 2018b). In these previous studies, most measures used to assess functional outcomes combined residential and recreational outcomes; as a result, there may be differences in the results of residential outcomes. Therefore, the results of this study suggest that residential and recreational outcomes may need to be assessed

Table 2
Correlations between Social Functioning Scale sub-items and symptoms (R).

SFS sub-item	Withdrawal	Interpersonal relationships	Social participation	Recreation	Self-reliance and ability	Self-reliance and execution	Employment
BNSS experiential	-0.460**	-0.603**	-0.496**	-0.607**	-0.466**	-0.540**	-0.551**
BNSS expressive	-0.302**	-0.417**	-0.283**	-0.404**	-0.432**	-0.404**	-0.365**
BPRS	-0.161*	-0.155*	-0.279**	-0.163*	-0.423**	-0.080	-0.355**
SCoRS	-0.305**	-0.357**	-0.570**	-0.443**	-0.658**	-0.363**	-0.612**

R = Pearson's product moment correlation coefficient (* $p < 0.05$, ** $p < 0.01$).

BNSS: Brief Negative Symptom Scale; BPRS: Brief Psychiatric Rating Scale; SCoRS: Schizophrenia Cognition Rating Scale; SFS: social functioning scale.

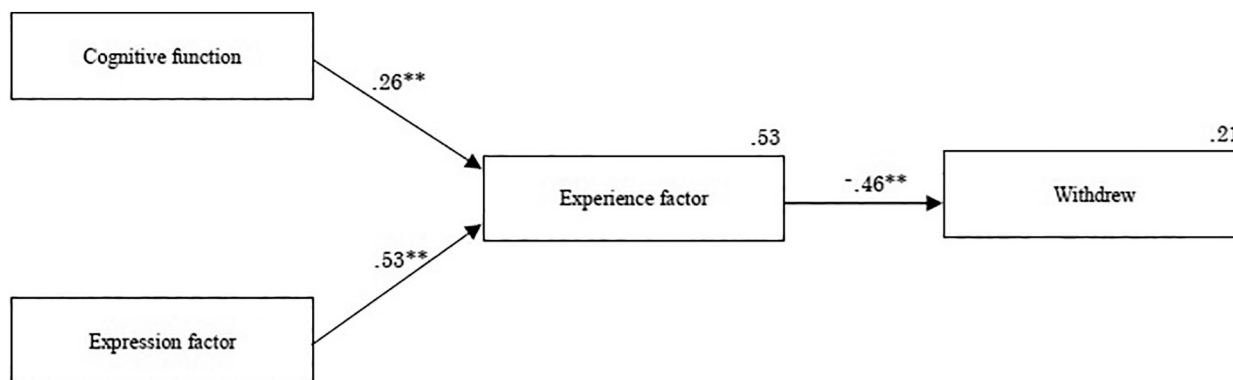


Fig. 1. Withdrawal in the single pathway model.

The fitness of the model was $\chi^2 p = 0.662$, CFI = 1.000, NFI = 0.997, RMSEA = 0.000, and AIC = 24.825. The value above each arrow is the standardized coefficient. The value in the upper right part of each factor is the coefficient of determination (R^2).

(a) Cognitive function, SCoRS-J; (b) experience factor, BNSS; (c) expression factor, BNSS; (d) withdrawal, SFS domain.

*Exogenous variables assume correlation.

** $p < 0.01$

AIC: Akaike information content; BNSS: Brief Negative Symptom Scale; CFI: comparative fit indexes; NFI: normed fit indexes; RMSEA: root mean square of approximation; SCoRS: Schizophrenia Cognition Rating Scale; SFS: social functioning scale; χ^2 values = p values.

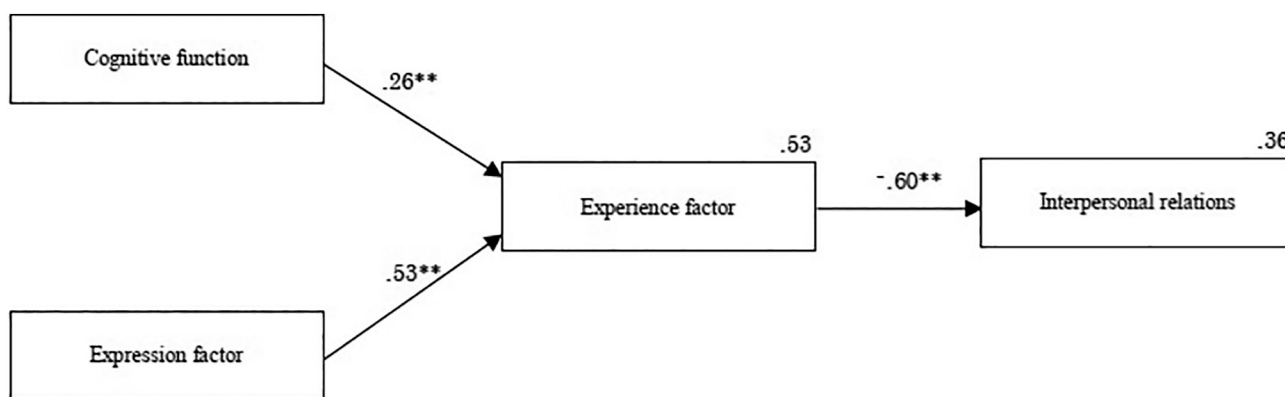


Fig. 2. Interpersonal relationships in the single pathway model.

The fitness of the model was $\chi^2 p = 0.995$, CFI = 1.00, NFI = 1.00, RMSEA = 0.000, and AIC = 24.001. The value above each arrow is the standardized coefficient. The value in the upper right part of each factor is the coefficient of determination (R^2).

(a) Cognitive function, SCoRS-J; (b) experience factor, BNSS; (c) expression factor, BNSS; (d) interpersonal relationships, SFS domain.

*Exogenous variables assume correlation.

** $p < 0.01$.

AIC: Akaike information content; BNSS: Brief Negative Symptom Scale; CFI: comparative fit indexes; NFI: normed fit indexes; RMSEA: root mean square of approximation; SCoRS: Schizophrenia Cognition Rating Scale; SFS: social functioning scale; χ^2 values = p values.

individually.

With regard to social outcomes such as withdrawal, interpersonal relationships, and degree of social participation, negative symptoms were the main determinants, and cognitive function seemed to be an additional contribution, as shown in previous studies (Strassnig et al., 2018a; Harvey et al., 2017). However, among withdrawal, interpersonal relationships, and social participation, the coefficient of withdrawal and social participation is low, and other factors (stigma,

resilience) that were not included in the study model, such as service/economic factors, or car ownership, should be evaluated in future research. Additional environmental factors may also be significantly involved (Galderisi et al., 2014).

These results may have implications for adapting patients to treatment based on whether the problem is identified by cognitive function or by motivation or by both pathways. In the current research, various psychosocial treatments have been developed, such as cognitive

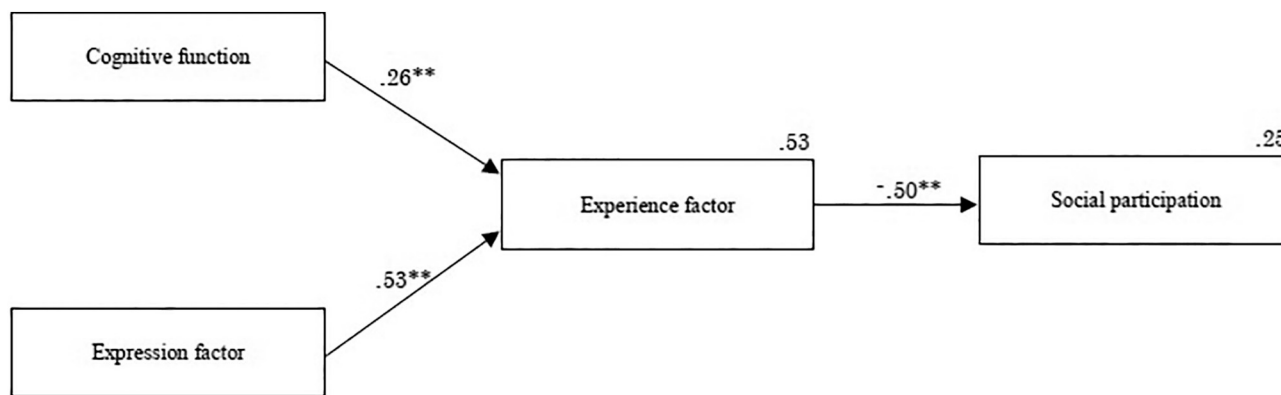


Fig. 3. Social participation in the single pathway model. The fitness of the model was $\chi^2 p = 0.174$, CFI = 0.995, NFI = 0.989, RMSEA = 0.068, and AIC = 17.849. The value above each arrow is the standardized coefficient. The value in the upper right part of each factor is the coefficient of determination (R^2).

(a) Cognitive function, SCoRS-J; (b) experience factor, BNSS; (c) expression factor, BNSS; (d) social participation, SFS.

*Exogenous variables assume correlation.

** $p < 0.01$.

AIC: Akaike information content; BNSS: Brief Negative Symptom Scale; CFI: comparative fit indexes; NFI: normed fit indexes; RMSEA: root mean square of approximation; SCoRS: Schizophrenia Cognition Rating Scale; SFS: social functioning scale; χ^2 values = p values.

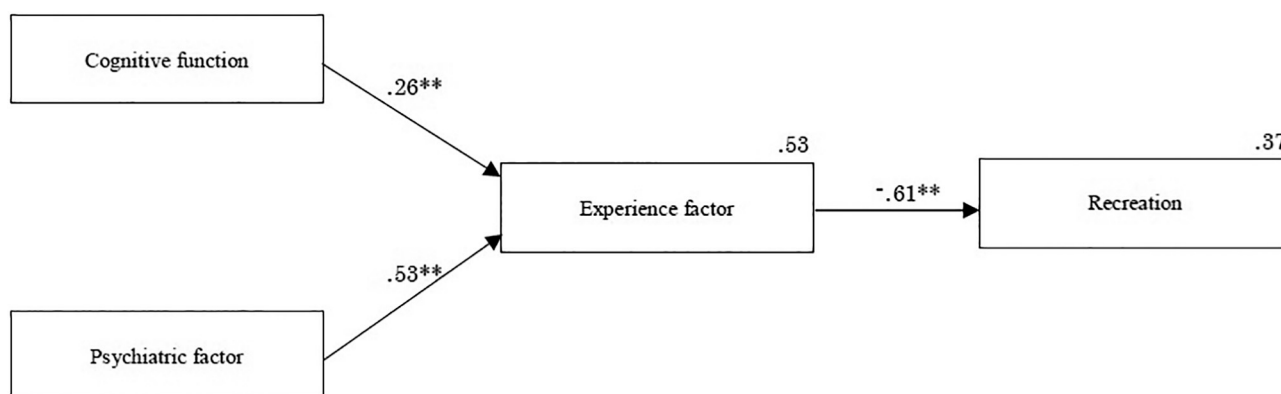


Fig. 4. Recreation in the single pathway model.

The fitness of the model was $\chi^2 p = 0.651$, CFI = 1.000, NFI = 0.999, RMSEA = 0.000, and AIC = 16.202. The value above each arrow is the standardized coefficient. The value in the upper right part of each factor is the coefficient of determination (R^2).

(a) Cognitive function, SCoRS-J; (b) experience factor, BNSS; (c) expression factor, BNSS; (d) recreation, SFS.

*Exogenous variables assume correlation.

** $p < 0.01$.

AIC: Akaike information content; BNSS: Brief Negative Symptom Scale; CFI: comparative fit indexes; NFI: normed fit indexes; RMSEA: root mean square of approximation; SCoRS: Schizophrenia Cognition Rating Scale; SFS: social functioning scale; χ^2 values = p values.

Table 3
Goodness of fit in the dual pathway model.

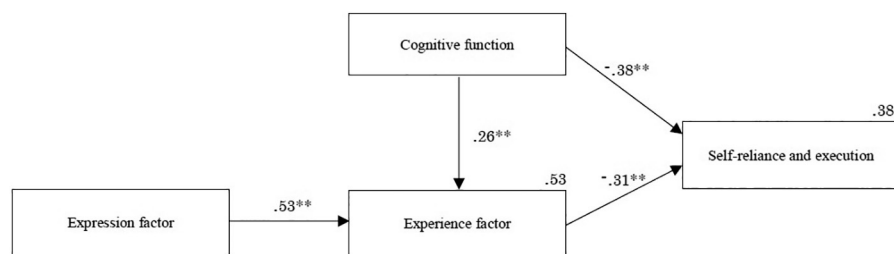
SFS sub-item	χ^2 values	CFI	NFI	RMSEA	AIC
Withdrawal	0.000	0.910	0.905	0.257	49.918
Interpersonal relationships	0.001	0.959	0.953	0.186	38.523
Social participation	0.000	0.941	0.935	0.214	42.600
Recreation	0.000	0.955	0.950	0.196	39.970
Self-reliance and ability	0.001	0.961	0.955	0.189	38.934

AIC: Akaike information content; CFI: comparative fit indexes; NFI: normed fit indexes; RMSEA: root mean square of approximation; SFS: Social Functioning Scale; χ^2 values = p values.

remediation therapy (CRT) and social skills training (SST), which compensate for fragile cognitive function, and cognitive-behavioral therapy (CBT) and motivational interviewing (MI) (Reddy et al., 2019), which increase the motivation of patients. The results of this study indicate that for interventions for residential and vocational outcomes, it is important to combine the intervention and the motivational

intervention in parallel. The usefulness of improving vocational outcomes has already been demonstrated by the combination of CRT, which directly improves cognitive function, and Individual Placement and Support (IPS), which includes interventions aimed at motivating and fostering work in the actual workplace (Rodríguez Pulido et al., 2019). Therefore, similar to the combination of CRT and IPS, it is necessary to combine CRT or SST to improve residential and vocational outcomes for cognitive function and CBT or MI to increase motivation.

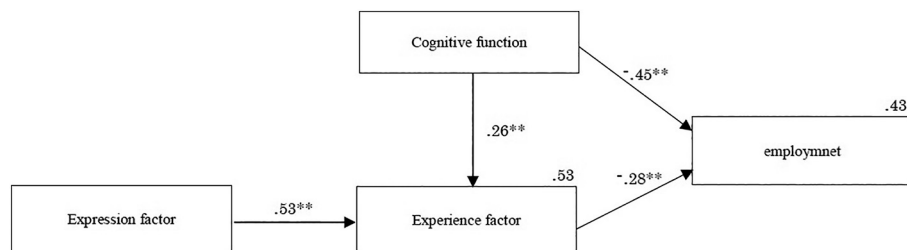
On the other hand, when intervening in social outcomes such as social participation and interpersonal relationships and recreational outcomes, even the intervention in cognitive function and emotional expression should be considered with the ultimate focus being motivation for social behavior. As reported by Granholm et al. (2018), interventions that allow an individual to learn interpersonal skills and to improve motivation using successful lived experiences are useful for social outcomes. The results of this study suggest that these interventions may be particularly useful for interventions for social outcomes. In fact, it has been reported that, as a result of sharing successful cases within the framework of CRT, and carrying out enriching such as peer



*Exogenous variables assume correlation.

***p* < 0.01.

AIC: Akaike information content; BNSS: Brief Negative Symptom Scale; CFI: comparative fit indexes; NFI: normed fit indexes; RMSEA: root mean square of approximation; SCoRS: Schizophrenia Cognition Rating Scale; SFS: social functioning scale; χ^2 values = *p* values.



***p* < 0.01.

AIC: Akaike information content; BNSS: Brief Negative Symptom Scale; CFI: comparative fit indexes; NFI: normed fit indexes; RMSEA: root mean square of approximation; SCoRS: Schizophrenia Cognition Rating Scale; SFS: social functioning scale; χ^2 values = *p* values.

Fig. 5. Self-reliance and execution in the dual pathway model.

The fitness of the model was $\chi^2 p = 0.147$, CFI = 0.996, NFI = 0.993, RMSEA = 0.078, and AIC = 28.104. The value above each arrow is the standardized coefficient. The value in the upper right part of each factor is the coefficient of determination (*R*²).

(a) Cognitive function, SCoRS-J; (b) experience factor, BNSS; (c) expression factor, BNSS; (d) self-reliance and execution, SFS domain.

Fig. 6. Employment in the dual pathway model.

The fitness of the model was $\chi^2 p = 0.676$, CFI = 1.000, NFI = 0.999, RMSEA = 0.000, and AIC = 16.174. The value above each arrow is the standardized coefficient. The value in the upper right part of each factor is the coefficient of determination (*R*²).

(a) Cognitive function, SCoRS-J; (b) experience factor, BNSS; (c) expression factor, BNSS; (d) employment, SES domain.

*Exogenous variables assume correlation

Table 4
Goodness of fit in the single pathway model.

SFS sub-item	χ^2 values ⁽³⁾	CFI	NFI	RMSEA	AIC
Self-reliance and execution	0.000	0.918	0.913	0.267	51.729
Employment	0.000	0.875	0.863	0.352	70.740
Self-reliance and ability	0.000	0.818	0.815	0.407	86.107

AIC: Akaike information content; CFI: comparative fit indexes; NFI: normed fit indexes; RMSEA: root mean square of approximation; SFS: Social Functioning Scale; χ^2 values = *p* values.

mentoring, the improvement effect among functional outcomes was higher for social outcomes (Ventura et al., 2019). These reports support the results of this study.

The limitation of this study is the large number of participants with stable positive symptoms as can be seen from the dosage and BPRS results, and the results of this study may not be applicable to treatment-resistant patients.

Also, because it is a multi-temporary test, to reduce the number of analyses, the authors did not perform route analysis tailored to each function individually, but only tried two routes for each function. Therefore, it is necessary to search various routes for each function in future studies.

5. Conclusions

The present study clarified whether each functional outcome follows a single pathway (motivation is a major determinant) or dual pathway (motivation and cognitive function). Furthermore, this study showed that residential outcomes (e.g., self-care) and recreational outcomes (e.g., hobby) have different pathways. These results may help resolve contradictions in past research. The authors emphasize the importance of using different treatment strategies for each outcome.

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CRedit authorship contribution statement

All authors contributed to the data collection, statistical processing, and manuscript writing. Dr. Tniguchi and Dr. Hirano contributed to the concept/design. All authors have approved the final article.

Declaration of competing interest

The authors declare no conflict of interest.

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