



Research Paper

Associations between negative and positive automatic thoughts and clinical variables in patients with schizophrenia

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ARTICLE INFO

Keywords:

Negative and positive automatic thoughts
Neurocognition
Positive and negative symptoms
Depressive symptoms
Schizophrenia

ABSTRACT

This study investigated the relationships between negative and positive automatic thoughts and clinical variables in patients with schizophrenia. The participants included 36 patients with schizophrenia (male = 16; female = 20; age = 42.86 ± 9.40) who were outpatients in the Department of Psychiatry at Tokushima University Hospital. We used the Automatic Thoughts Questionnaire-Revised (ATQ-R), Positive and Negative Syndrome Scale (PANSS), Calgary Depression Scale for Schizophrenia (CDSS), and Brief Assessment of Cognition in Schizophrenia (BACS) to assess negative and positive automatic thoughts, positive and negative symptoms, depressive symptoms, and neurocognition, respectively. Spearman rank correlation coefficients were calculated to determine the relationships between negative and positive automatic thoughts and clinical variables. No relationship was observed between negative and positive automatic thoughts. Negative automatic thoughts were related to depressive symptoms. Positive automatic thoughts were related to neurocognition. We therefore surmise that each automatic thought might have different clinical features and outcomes, and should therefore be treated accordingly.

1. Introduction

Several meta-analyses demonstrate the benefits of cognitive behavioral therapy for psychosis (CBT-p) (Jauhar et al., 2014; Pfammatter, 2011; Wykes et al., 2008). In CBT-p, the cognitive model is applied to understand and treat psychotic symptoms. This model suggests that the way that we interpret events will have consequences for how we feel and behave (Beck, 1976). Morrison and Barratt (2010) examined the necessary elements of CBT-p using the Delphi method. The results showed that an understanding of cognition and intervention skills for cognition were also important components of CBT-p.

The cognitive model assumes automatic thoughts and beliefs in the concept of cognition (Beck, 1976). Automatic thoughts refer to the superficial part of cognition and represent the thoughts that arise when encountering an event. They are classified as negative or positive automatic thoughts according to the emotional valence associated with the thought content (Know and Oei, 1992; Sakamoto et al., 2004). On the other hand, beliefs are cognitions that are composed of experiences from childhood and exist at a deeper level. In the relationship between beliefs and automatic thoughts, it is assumed that beliefs influence

negative automatic thoughts (Alloy, 1988).

A characteristic belief in schizophrenia is the defeatist performance belief (DPB). DPB is a maladaptive belief (e.g., “If you cannot do something well, there is little point in doing it at all”) that guides overgeneralized conclusions about one’s ability to perform a task (Grant and Beck, 2009). DPB is associated with neurocognition and negative symptoms (Campellone et al., 2016; Grant and Beck, 2009; Horan et al., 2010). Regarding automatic thoughts, it has been shown that negative automatic thoughts occur more frequently in patients with schizophrenia than in healthy controls, and positive automatic thoughts occur as frequently as in healthy controls (Takeda et al., 2019). While negative automatic thoughts are associated with depressive symptoms in depressed and healthy individuals (Know and Oei, 1992; Koseki et al., 2013), this association is not known in patients with schizophrenia. In addition, positive automatic thoughts are associated with subjective quality of life in schizophrenic patients, but associations with clinical factors such as positive symptoms, negative symptoms, and cognitive dysfunction have not been examined.

It is therefore essential to not only determine the clinical factors associated with negative and positive automatic thoughts in patients

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<https://doi.org/10.1016/j.scog.2023.100298>

Received 17 July 2023; Received in revised form 27 November 2023; Accepted 27 November 2023

Available online 2 December 2023

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with schizophrenia, but also examine how each automatic thought relates to the pathophysiology of schizophrenia and to find interventions that can improve patient outcomes. Therefore, in this study, we measured negative and positive automatic thoughts in patients with schizophrenia and examined the extent of influence of each of these thoughts on clinical factors (positive symptoms, negative symptoms, depressive symptoms, and neurocognition).

2. Methods

2.1. Participants

In this study, 36 schizophrenic patients (male = 16; female = 20; mean age = 42.86 ± 9.40) attending the outpatient psychiatry department of Tokushima University Hospital were included. A psychiatrist diagnosed schizophrenia based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. The participants were receiving medication and regular medical care and were not receiving any specialized psychotherapy.

2.2. Measures

2.2.1. Positive and negative symptoms

Positive and negative symptoms were assessed by using the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1991). Higher scores indicate greater symptom severity.

2.2.2. Depressive symptoms

We used the Calgary Depression Scale for Schizophrenia (CDSS; Kaneda et al., 2000), to assess depressive symptoms. The CDSS was specifically developed to distinguish depressive symptoms from positive and negative symptoms and antipsychotic-induced adverse effects in patients with schizophrenia. Higher scores indicate greater levels of depressive symptoms.

2.2.3. Neurocognitive function

To assess neurocognitive function, we used the Brief Assessment of Cognition in Schizophrenia (BACS; Kaneda et al., 2007). The domains of neurocognitive function evaluated include verbal memory, working memory, motor speed, verbal fluency, attention and speed of information processing, and executive function. The composite BACS score (overall score) was calculated as the average of the z-scores for each subtest. The z-score for each subtest was calculated as “(each patient's raw score - applicable age/gender of healthy participants' mean)/applicable age/gender of healthy participants' standard deviation” (Kaneda et al., 2013). The healthy participant data used to calculate the composite scores in this study were those used by Kaneda et al. (2013). Higher scores indicate higher neurocognitive function.

2.2.4. Automatic thoughts

We used the Automatic Thoughts Questionnaire-Revised (ATQ-R; Sakamoto et al., 2004) to assess automatic thoughts. This 40-item self-report instrument was designed to measure the frequency of negative and positive self-statements. Higher scores indicate a greater frequency of negative and positive self-statements.

2.3. Statistical analyses

To examine the correlation between automatic thoughts and clinical factors, Spearman's rank correlation coefficients were calculated according to normality. False discovery rate (FDR) correction was then performed for multiple comparison corrections. After FDR correction, the significance level was set at $p < 0.05$. In the statistical analysis, SPSS statistics for Windows version 22.0 (IBM Corporation, 2012) was used to calculate the correlation coefficient, and the statistical software R version 3.3.3 (R Development Core Team, 2014) and its integrated

development environment R-studio (R studio team, 2015) were used for FDR correction.

2.4. Ethical considerations

All participants provided written informed consent, and the study was approved by the institutional ethics committee of Tokushima University.

3. Results

The demographic indices of patients with schizophrenia are summarized in Table 1. The BACS composite score was -1.11 , indicating that the neurocognition of patients with schizophrenia was more than one standard deviation lower than that of healthy participants.

The results of the Spearman rank correlation coefficient analyses are shown in Table 2. Negative automatic thoughts were significantly and positively correlated with depressive symptoms ($r = 0.50$, $p = 0.02$). Positive automatic thoughts showed significant positive correlations with motor speed ($r = 0.48$, $p = 0.03$) and verbal fluency ($r = 0.45$, $p = 0.03$). No significant correlation was found between negative and positive automatic thoughts ($r = -0.01$, $p = 0.94$).

4. Discussion

4.1. Association between negative automatic thoughts and depressive symptoms

In this study, negative automatic thoughts were significantly and positively correlated with depressive symptoms. Previous studies have also established a significant positive correlation between negative automatic thoughts and depressive symptoms in healthy participants and patients with depression (Know and Oei, 1992; Koseki et al., 2013). Yamamoto et al. (2010) reported that awareness of one's illness was associated with depressive symptoms in patients with schizophrenia who were in the chronic phase and had maintained social functioning, suggesting that depressive symptoms increase after experiencing situations in which one cannot adapt to the environment or by losing confidence. Negative automatic thoughts measure the frequency of negative thoughts about oneself, others, and the future. Experiences of inability to adapt to the environment and loss of self-confidence may increase the frequency of negative automatic thoughts about the self and the future,

Table 1
Participants' demographic data.

N (male/female)	36 (16/20)	
Age (years)	42.86 (9.40)	
Education (years)	14.03 (1.86)	
Duration of illness (years)	16.04 (7.12)	
Dose of antipsychotic (mg/day)	444.67 (327.16)	
JART	Premorbid IQ	98.72 (9.69)
WAIS-III	Present IQ	88.69 (15.66)
PANSS	Positive symptom	13.14 (3.59)
	Negative symptom	15.33 (4.14)
CDSS	Depression	3.33 (2.92)
	BACS	Verbal memory
	Working memory	-1.08(-1.10)
	Motor speed	-1.74(-1.75)
	Attention and speed of information processing	-1.36(-1.20)
	Verbal fluency	-0.88(-0.85)
	Executive function	-0.40(-0.30)
	Composite score	-1.11(-1.00)
ATQ-R	Negative automatic thoughts	67.64 (29.62)
	Positive automatic thoughts	18.19 (6.99)

Dose of antipsychotic: chlorpromazine equivalent, PANSS: Positive and Negative Syndrome Scale, CDSS: Calgary Depression Scale for Schizophrenia, BACS: Brief assessment of cognition in schizophrenia, ATQ-R: Automatic Thoughts Questionnaire-Revised.

Table 2
Relationship between automatic thoughts and clinical variables.

		Positive automatic thoughts		Negative automatic thoughts	
ATQ-R	Positive automatic thoughts	-0.01	p =	0.32	p =
	Negative automatic thoughts		0.94		0.33
PANSS	Positive symptom	0.02	p =	0.10	p =
	Negative symptom	-0.11	0.94	0.73	0.73
CDSS	Depression	-0.04	p =	0.50	p =
			0.94	0.02	0.02
BACS	Verbal memory	0.12	p =	-0.18	p =
	Working memory	0.21	0.69	0.11	0.57
	Motor speed	0.48	p =	-0.22	p =
			0.54	0.53	0.53
	Attention and speed of information processing	0.34	p =	-0.06	p =
	Verbal fluency	0.45	0.14	-0.08	0.78
	Executive function	-0.13	p =	-0.28	p =
	Composite score	0.40	0.03	-0.21	0.78
			0.69	0.42	0.42
			0.07	0.54	0.54

The *p*-values are listed after FDR correction.

ATQ-R: Automatic Thoughts Questionnaire-Revised; PANSS: Positive and Negative Syndrome Scale; CDSS: Calgary Depression Scale for Schizophrenia; BACS: Brief Assessment of Cognition in Schizophrenia.

which may, in turn, intensify depressive symptoms.

On the other hand, depressive symptoms have been reported to modulate accurate self-assessments of social functioning in schizophrenia (Harvey et al., 2017). Harvey et al. (2017) indicated that schizophrenia patients with very low self-reported depression overestimated their everyday functioning compared with informant reports. However, schizophrenia patients with higher levels of depression were associated with a more accurate self-assessment of their functioning. Negative automatic thoughts, which are correlated with depressive symptoms, may serve as the modulator for reflection by negatively assessing own's abilities. However, no studies have examined the association between negative automatic thoughts, depressive symptoms, and social functioning, and further research is needed on these associations.

Negative automatic thoughts and depressive symptoms are intervention targets when patients have excessive negative automatic thoughts and exacerbated depressive symptoms that interfere with daily life. Hazell et al. (2016) conducted a meta-analysis on the intervention effects of CBT-p and showed that depressive symptoms and functional impairment recovered during the follow-up period. Shriharsh et al. (2003) also implemented CBT, which combines psychoeducation, relaxation methods, and cognitive restructuring methods, for patients with schizophrenia in the non-acute phase and achieved improvement in negative automatic thoughts and negative emotions. As the participants in this study were not in the acute phase, CBT that intervenes in negative automatic thoughts may be effective in improving depressive symptoms and negative emotions.

4.2. Association between negative automatic thoughts and positive symptom

Negative automatic thoughts were more correlated with positive symptoms than negative symptoms, although not significantly. Negative self-cognition has been shown to correlate with the severity of auditory hallucinations and delusions (Smith et al., 2006). Furthermore, negative self-cognition is a predictor of auditory hallucinations (Thomas et al., 2015). These findings suggest that negative self-cognition and positive

symptoms are strongly associated and reinforce each other's severity. The results of the present study also reinforce those of previous studies.

4.3. Association between positive automatic thoughts and neurocognition

To our knowledge, this is the first study to examine the association between positive automatic thoughts and neurocognition in patients with schizophrenia. In this study, BACS motor speed and verbal fluency showed significant positive correlations with positive automatic thoughts.

Garrido et al. (2013) reported improvements in self-esteem and neurocognition in schizophrenia patients treated with cognitive remediation therapy (CRT). Taken together with the results of the present study, it is possible that neurocognition correlates with positive self-perception and thinking and that improving neurocognition may be effective in improving positive self-perception and thinking.

Regarding the neurocognition measured by BACS, motor speed and verbal fluency particularly showed significant associations with positive automatic thoughts. Motor speed was measured by placing 100 tokens into a container as quickly as possible with both hands, while verbal fluency measured processing speed, in which participants were asked to respond to as many words that begin with a category or letter as possible in 1 min. Although they use different functions for motor and information processing, both motor speed and verbal fluency measure the speed required to perform tasks. The results of this study suggested that the faster the speed required for movement and information processing, the more successfully individuals can perform their daily tasks and the more likely they are to generate positive thoughts about themselves.

Takeda et al. (2019) showed that positive automatic thoughts influence the motivation to engage in activities. Furthermore, Wykes et al. (2011) conducted a meta-analysis of CRT for patients with schizophrenia and showed that it improved not only neurocognition but also social function. These results suggest that improved neurocognition may increase positive automatic thoughts, which in turn may increase the motivation to engage in activities. However, few studies have examined the relationship between neurocognition and positive self-perception and thinking, and it remains unclear whether improved neurocognition improves positive self-perception and thinking. Although the present study revealed a significant association between positive automatic thoughts and neurocognition, future studies need to examine whether positive self-cognition and automatic thoughts improve before and after CRT and other interventions and whether these improvements help motivation.

4.4. Relationship between negative and positive automatic thoughts

No significant correlation was found between negative and positive automatic thoughts in patients with schizophrenia ($r = -0.01$). Sakamoto et al. (2004) examined the relationship between negative and positive automatic thoughts in 94 male and 92 female university students, and 83 male office workers. The results revealed significant negative correlations for all participants ($r = -0.65, -0.57, -0.54$). In the author's previous study, significant differences in negative automatic thoughts were found between patients with schizophrenia and age- and gender-matched healthy controls, but not in positive automatic thoughts (Takeda et al., 2019). These results suggest a difference in the balance of negative and positive thoughts between patients with schizophrenia and healthy controls.

To the best of our knowledge, no previous studies have reported a balance between negative and positive thoughts in patients with schizophrenia. Trémeau et al. (2010) found no significant differences between patients with schizophrenia and healthy controls in cognitive and affective aspects such as the degree and prediction of positive affect. Cohen and Minor (2010) conducted a meta-analysis of the subjective emotional experiences of patients with schizophrenia in the laboratory when they were presented with positive, negative, and neutral

emotional stimuli. The results showed that while patients with schizophrenia did not differ significantly from healthy controls in positive emotional arousal, they experienced negative emotions such as disgust and positive emotions in response to positive and neutral stimuli (Cohen and Minor, 2010). These studies of emotions in patients with schizophrenia indicate that patients with schizophrenia have different modes of positive and negative emotional arousal than healthy controls. Because a large portion of emotions are processed automatically and without conscious awareness, different emotional arousal styles may lead to a different balance between negative and positive thoughts about oneself and the future in patients with schizophrenia than in healthy controls.

4.5. Limitation

The current study has several limitations. First, the sample size was relatively small. Second, the participants showed relatively mild symptoms. Therefore, there is a possibility that our results do not reflect the characteristics of all patients with schizophrenia. Third, medications may have influenced on our findings.

5. Conclusion

The results showed that negative automatic thoughts were significantly correlated with depressive symptoms. Positive automatic thoughts were significantly correlated with neurocognition, such as motor speed and verbal fluency. Furthermore, there was no significant correlation between positive and negative automatic thoughts. These findings suggest that interventions for positive and negative automatic thoughts should be appropriately tailored for each type. The results also suggest that interventions for negative automatic thoughts may improve depressive symptoms and that improvements in neurocognition may lead to improvements in positive automatic thoughts, thereby enhancing overall patient outcomes.

Ethical approval

All participants provided written informed consent, and the study was approved by the institutional ethics committee of Tokushima University.

Funding sources

No funds, grants, or other support was received.

CRediT authorship contribution statement

Tomoya Takeda: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing, Visualization. **Masahito Nakataki:** Conceptualization, Supervision, Writing – review & editing, Investigation, Methodology, Project administration, Resources, Validation, Visualization, Writing – original draft. **Hidehiro Umehara:** Conceptualization, Supervision, Writing – review & editing, Resources, Validation, Visualization, Writing – original draft. **Shusuke Numata:** Conceptualization, Supervision, Writing – review & editing, Resources, Validation, Visualization, Writing – original draft.

Declaration of competing interest

The authors report no conflicts of interest in this work.

Acknowledgments

We would like to thank Editage (www.editage.jp) for English language editing.

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