Traditional-Chinese Dispositional Flow Scale-2 and Flow State Scale-2 in Taiwanese subjects with schizophrenia or schizoaffective disorder

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ABSTRACT

Introduction: The 36-item Dispositional Flow Scale-2 (DFS-2) and Flow State Scale-2 (FSS-2) were developed to assess flow experience in daily and specific activities. Although their validity and reliability had been examined in general populations and different cultures, little is known for schizophrenic subjects. Thus, this study aimed to validate Traditional-Chinese DFS-2 (TCDFS-2) and FSS-2 (TCFSS-2) in Taiwanese subjects with schizophrenia or schizoaffective disorder.

Methods: We recruited 229 adult participants from outpatient clinics, day care centers, and psychiatric rehabilitation centers in Taipei. They filled out 36-item TCDFS-2 and TCFSS-2 under guidance. The LISREL 9.30 software was used to conduct exploratory factor analysis for exploring measurement structures, and then confirmatory factor analysis for identifying factor models.

Results: The six first-order factor and one second-order factor measurement models were obtained for both 36-item TCDFS-2 (Chi-square statistic = 999.1, df = 545, $p < 0.0001$, Root Mean Square Error of Approximation [RMSEA] = 0.0603, and Comparative Fit Index [CFI] = 0.9213) and TCFSS-2 (Chi-square statistic = 987.9, df = 539, $p < 0.0001$, RMSEA = 0.0603, and CFI = 0.9213).

Conclusion: Our factor models differed remarkably from those of 36-item DFS-2 and FSS-2. Yet, they were barely acceptable to be used to measure flow experiences in schizophrenic subjects in clinical applications. Since the factor scores, measurement structures, or even definitions of flow experiences could differ substantially between healthy people and patients with mental illness, disease-specific instruments of flow experiences should be considered in the future.

1. Introduction

According to the flow theory, flow is an optimal psychological state that occurs when people perform and involve entirely in an activity. With a clear goal and unambiguous feedbacks, the compatible matches between the perceived challenges and the required skills provide the most acquired conditions to reach a flow state. In the flow state, a complete attention to the participation of the activity without self-awareness has become an intrinsic reward for the subject who is doing the task for its own sake and totally absorbed into it. Thus, in view of the depth of involvement in everyday life, flow experience can be produced through daily activities – for example, work, study, play, or religious ritual. By doing so, flow may help subjects shift anxiety, worry, or boredom into deep concentration and focus on the present with positive feelings for better well-being (Csikszentmihalyi, 1975, 1990, 2014; Csikszentmihalyi et al., 1993).

In clinical practice, occupational therapists are encouraged to give patients a "just-right challenge" to help him/her obtain a flow experience (Rebeiro and Polgar, 1999). As Yerxa (1990) and Rebeiro and Polgar (1999) pointed out, the just-right challenge, or an optimal fit between the demands of the occupation and the skills of the person, is considered necessary for initial and sustained engagement in occupation. Some review articles have linked the flow theory to occupational therapy and occupational science. As remarked by Wright (2004), the

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Table 1
The demographic and clinical characteristics of the 229 participants.

Variable	Male	Female	Total	p value
Number of subjects (n)	105 (45.85%)	124 (54.15%)	229 (100%)	
Age (years)	39.23 ± 10.63	40.96 ± 9.65	40.17 ± 10.13	0.1442
Onset age of illness (years)	24.23 ± 9.92	25.08 ± 8.64	24.69 ± 9.24	0.1428
Duration of illness (years)	15.15 ± 9.39	15.97 ± 10.15	15.59 ± 9.79	0.7094
Education				0.5840
Elementary school	8 (7.62%)	4 (3.23%)	12 (5.24%)	
Junior high school	17 (16.19%)	20 (16.13%)	37 (16.16%)	
Senior high school	48 (45.71%)	55 (44.36%)	103 (44.98%)	
College	31 (29.52%)	44 (35.48%)	75 (32.75%)	
Graduate school	1 (0.95%)	1 (0.81%)	2 (0.87%)	
Marriage				0.0336
Unmarried	96 (91.43%)	102 (82.26%)	198 (86.46%)	
Married	8 (7.62%)	9 (7.26%)	17 (7.42%)	
Separated	0 (0%)	1 (0.81%)	1 (0.44%)	
Divorced	1 (0.95%)	9 (7.26%)	10 (4.37%)	
Widower/Widow	0 (0%)	3 (2.42%)	3 (1.31%)	
Religion				0.5417
None	18 (17.14%)	23 (18.55%)	41 (17.9%)	
Christianity	20 (19.05%)	36 (29.03%)	56 (24.45%)	
Catholicism	2 (1.91%)	2 (1.61%)	4 (1.75%)	
Buddhism	48 (45.71%)	46 (37.1%)	94 (41.05%)	
Taoism	14 (13.33%)	15 (12.1%)	29 (12.66%)	
Others	3 (2.86%)	2 (1.61%)	5 (2.18%)	
Economic source				0.4257
Earned by self or saving	41 (39.05%)	41 (33.07%)	82 (35.81%)	
Supported by family	49 (46.67%)	56 (45.16%)	105 (45.85%)	
Supported by low-income subsidies from government	5 (4.76%)	5 (4.03%)	10 (4.37%)	
Supported by disability benefits from government	10 (9.52%)	21 (16.94%)	31 (13.54%)	
Others	0 (0%)	1 (0.81%)	1 (0.44%)	
Supporting system				0.5010
From religion	15 (14.29%)	17 (13.71%)	32 (13.97%)	
From family	69 (65.71%)	76 (61.29%)	145 (63.32%)	
From medical staffs	12 (11.43%)	11 (8.87%)	23 (10.04%)	
From friends	7 (6.67%)	17 (13.71%)	24 (10.48%)	
Others	2 (1.91%)	3 (2.42%)	5 (2.18%)	

The sample statistics presented in this table were mean ± standard deviation (SD) for continuous variables and frequency (percentage, %) for categorical variables. The listed *p*-values of statistical tests were calculated using the Wilcoxon rank-sum test for continuous variables and the Fisher's exact test for categorical variables.

flow theory may reveal the relationships between occupation and health. He advocated the application of flow to clinical practice because of the potential benefits of the flow experience from participating activities. Next, based on the review of Emerson (1998) and some other researchers' work (Carlson and Clark, 1991; Csikszentmihalyi, 1993; Han, 1988; Inghilleri, 1999; Jacobs, 1994; Massimini et al., 1988), a flow experience improves an individual's adaptation, growth, and benefits to increase his/her level of happiness, self-esteem, role satisfaction, work productivity, and life satisfaction. Emerson (1998) also concluded that the flow theory may potentially be applied to the disabled such as schizophrenic population in practice.

Nevertheless, Csikszentmihalyi (1990) pointed out that having difficulty in doing activities attentively may hinder persons with schizophrenia from obtaining flow experience and pleasure feelings. Controversially, Gerhardsson and Jonsson (1996) claimed that three schizophrenia inpatients could experience flow states when they participated in self-selected activities. And, Emerson et al. (1998) enrolled nine schizophrenia patients in their study and found that those patients could experience enjoyment and fulfillments through participating in interesting activities intently, and then obtain increasing energy and inspiration with decreasing sense of time and anxiety. Moreover, Emerson et al. (1998) surmised that the degrees of experience differences may depend on different stages of schizophrenia (e.g., acute or chronic), available activities, and patients' abilities to understand and focus on self-experience. These clinical literatures reveal that re-examining the status of flow experience in a larger sample of schizophrenia patients is necessary to test whether the flow experience exists in people with schizophrenia or not.

Various tools have been used to measure flow experience, including face-to-face interview, self-filled questionnaires, diaries, and the Experience Sampling Method (Csikszentmihalyi, 1975; Csikszentmihalyi and Csikszentmihalyi, 1988; Csikszentmihalyi and Larson, 1987). In particular, Jackson and her colleagues developed and revised the Dispositional Flow Scale-2 (DFS-2) and Flow State Scale-2 (FSS-2) based on Csikszentmihalyi (1990)'s nine dimensions of flow to assess trait and state flow experience tendency in sports or physical activities with extensive psychometric analysis (Jackson and Marsh, 1996; Jackson et al., 1998; Jackson and Eklund, 2002; Jackson et al., 2008). Moreover, Jackson et al. (2010) made wording changes slightly in several items of the DFS-2 and FSS-2 as measures to assess flow experiences in general activities for wider adaptable applications (Mind Garden, Inc., Menlo Park, CA, URL: https://www.mindgarden.com/100-flow-scales). Although the construct validity and reliability of DFS-2 and FSS-2 have been examined in general populations and cross cultures (Fournier et al., 2007; González-Cutre et al., 2009; Gouveia et al., 2012; Hamari and Koivisto, 2014; Jackson et al., 2008; Kawabata et al., 2008; Liu et al., 2012; Procci et al., 2012; Riva et al., 2017; Wang et al., 2009), little is known for schizophrenic population. Hence, this study aimed to apply the integrated statistical method of exploratory and confirmatory factor analyses to validate the Traditional Chinese versions of DFS-2 and FSS-2 in Taiwanese subjects with schizophrenia or schizoaffective disorder for clinical applications.

2. Methods

2.1. Study participants

The study protocol was approved by the Institutional Review Boards

of the Taipei City Hospital. After receiving informed consents, we recruited 229 Taiwanese subjects who were under regular treatments for schizophrenia or schizoaffective disorder from the participating outpatient clinics, psychiatric day-care centers, and the Psychiatric Rehabilitation Centers of the Taipei City Hospital in communities from July 2012 to March 2013. The screening criteria were (1) $20 \leq age \leq 65$ years, (2) schizophrenia or schizoaffective disorder according to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision (DSM-IV-TR), and (3) being able to perform paper-and-pencil tests. All study participants were tested in an isolated and quiet room at the participating hospital individually or in small groups. Standardized instructions were given to the participants when administering the tests.

As listed in Table 1, there were 105 men (45.85%) and 124 women (54.15%). Their mean age ± SD was 40.17 ± 10.13 years (39.23 ± 10.63 years for male and 40.96 ± 9.65 years for female). The mean onset age of illness ± SD was 24.69 ± 9.24 years (24.23 ± 9.92 years for male and 25.08 ± 8.64 years for female). Then, the mean duration of illness ± SD was 15.99 ± 9.54 years (15.15 ± 9.39 years for male and 15.97 ± 10.15 years for female). Among the demographic characteristics including education level, marriage status, religion, economic source, and supporting system, only the distribution of marriage status differed significantly between the male and female participants ($p = 0.0336$). Male had a higher percentage of "Unmarried" (91.43%) than female (82.26%), but female had a higher percentage of "Divorced" (7.26%) than male (0.95%).

2.2. Measurement instruments

The General versions of DFS-2 and FSS-2 are the self-reported instruments developed for evaluating individuals' dispositional flow tendency and the flow status while participating in general activities (Jackson and Eklund, 2002; Jackson et al., 2010). The original English versions of DFS-2 and FSS-2 were translated into the Traditional Chinese versions of DFS-2 and FSS-2 (abbreviated as TCDFS-2 and TCFSS-2 respectively) by the first author, the third author, and Ms. Chialing Cheng and finalized on March 31, 2012 with the written permission of the Mind Garden, Inc. (Menlo Park, CA, U.S.A.). The Simplified Chinese versions of DFS-2 and FSS-2 had been validated by Liu et al. (2012).

The DFS-2 and FSS-2 have similar structures but they differ in the tense of item sentence – the DFS-2 items use a present tense, whereas the FSS-2 items use a past tense. Both DFS-2 and FSS-2 consist of 36 items for measuring nine dimensions of flow (challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, loss of self-consciousness, transformation of time, and autotelic experience) with four items for each dimension. Each item is scored on a five-point Likert scale ranging from 1 to 5 for the following ratings of DFS-2, 'Never,' 'Rarely,' 'Sometimes,' 'Frequently,' and 'Always,' respectively and for the following ratings of FSS-2, 'Strongly Disagree,' 'Disagree,' 'Neither Agree nor Disagree,' 'Agree,' and 'Strongly Agree,' respectively.

2.3. Study design

First, each participant was asked to recall one most important and meaningful daily activity within two months, and then to fill out the TCDFS-2 without a time limit to reflect his/her flow experience in the above activity of his/her choice. Next, each participant was encouraged by the instructor with a fully supported autonomy to choose one preferred activity from the nine common activities on a pre-designed list (including dice stacking, paper box-folding, two target games, card-sorting, drawing, two table games, and puzzle game), and then to conduct the selected activity with the help of clear activity instructions. Once the selected activity is done, the participant was asked to fill out the TCFSS-2 without a time limit.

2.4. Statistical analysis

Data management and descriptive analysis of the 229 participants were performed in the R 3.4.3 software (R Foundation for Statistical Computing, Vienna, Austria). In statistical testing, two-sided p value ≤ 0.05 was considered statistically significant. The distributional properties of continuous variables were expressed by mean ± standard deviation (SD) and categorical variables were presented by frequency and percentage. The differences in the distributions of continuous variables, categorical variables, and survival outcomes between the female and male participants were examined using Wilcoxon rank-sum test and Fisher's exact test as appropriate for the data type.

Next, the LISREL 9.30 software (Scientific Software International, Inc., Lincolnwood, IL, U.S.A.) was used to analyze the covariance matrices of the 36 measured items of TCDFS-2 and TCFSS-2 respectively with the sample size of 229 in two steps. In **Step 1**, *exploratory factor analysis* (EFA) (using the principal factor estimation method) with the oblique 'promax' rotation was performed to explore the factor structures. Two six-factor EFA models (with the absolute values of factor loadings ≥ 0.3) were obtained for TCDFS-2 and TCFSS-2 respectively. Then, in **Step 2**, these two six-factor EFA models were taken as the initial factor models for *confirmatory factor analysis* (CFA) of the same two sample covariance matrices to verify and refine the measurement structure (Jöreskog, 1995; Kline, 2016, pp. 339–340). To ensure a good quality of analysis results, the available model fitting techniques were applied in our CFA. First, with the aid of substantive knowledge and insight, the stepwise variable selection procedure was implemented by iterating the following two actions: (1) using Wald's t test to drop an insignificant structural parameter one at a time and (2) using Modification Index (MI) to add an additional meaningful structural parameter one at a time. Next, in addition to Chi-square goodness-of-fit test (p value > 0.05 or Chi-square statistic $<$ degrees of freedom $\times$ 2), the Root Mean Square Error of Approximation (RMSEA) ≤ 0.06 (or, even better, RMSEA ≤ 0.05) and Comparative Fit Index (CFI) > 0.95 were particularly examined for assessing the adequacy of fit in CFA (Muthén and Muthén, 1998, p. 362). Finally, model diagnosis was conducted by examining the estimated factor loadings, the estimated correlations between latent variables and between measurement errors, and the standardized residual variance-covariance matrix to detect model problems and identify poorly fitted relationships. Given the final CFA models of TCDFS-2 and TCFSS-2, each factor was named based on the factor loadings of the included items with the guidance of the original factor names of DFS-2 and FSS-2.

3. Results

In Table 2, we listed the estimated factor loadings of the one-secondary factor and six-primary factor CFA model for the 36-item TCDFS-2 (Chi-square statistic = 999.0974, df = 545, $p < 0.0001$, RMSEA = 0.0603, and CFI = 0.9213). The six primary factors and the one secondary factor were named respectively. The measurement structure of the 36-item TCDFS-2 in Taiwanese subjects who were under regular treatments for schizophrenia or schizoaffective disorder notably differed from that of the original 36-item DFS-2 in healthy subjects, except that the meaning of our "Time distortion" (F5) was closely related to the original "Time transformation" (TT). Next, the derivation of the single secondary factor, "Flow experience and achievement" (SF), for the 36-item TCDFS-2 was a new discovery with the largest factor loadings on "Autotelic experience" (F1) and "Competence without loss of self-consciousness and autotelic experience" (F4).

In Table 3, we listed the estimated factor loadings of the one-secondary factor and six-primary factor CFA model for the 36-item TCFSS-2 (Chi-square statistic = 987.9215, df = 539, $p < 0.0001$, RMSEA = 0.0603, and CFI = 0.9213). The six primary factors and the one secondary factor were named respectively. Again, the measurement

Table 2

The one-secondary factor and six-primary factor confirmatory factor analysis (CFA) model for the 36-item Traditional Chinese Dispositional Flow Scale, Version 2 (TCDFS-2).[a,c]

Primary factors / DFS-2 Items[b]	Factor 1: Autotelic experience	Factor 2: Mastery with autotelic experience	Factor 3: Mastery without autotelic experience	Factor 4: Competence without loss of self-consciousness and autotelic experience	Factor 5: Time distortion	Factor 6: Loss of self-consciousness	Secondary Factor: Flow experience and achievement
Factor 1							2.21923
Factor 2							1.09302
Factor 3							1.00000
Factor 4							2.02980
Factor 5							0.83430
Factor 6							0.25062
DFS01-CSB		0.23061		0.32994			
DFS10-CSB			0.42948	0.36744			
DFS19-CSB	0.44584			0.24963	−0.25948		
DFS28-CSB		1.02562					
DFS02-MAA			1.21553	−0.15207		0.25810	
DFS11-MAA				0.48625		0.21093	
DFS20-MAA		0.41345	0.73816				
DFS29-MAA		1.01259					
DFS03-CG			1.00000				
DFS12-CG	0.47836						
DFS21-CG	0.27215	0.61527					
DFS30-CG		1.02598					
DFS04-F			0.94394				
DFS13-F				0.51906		−0.16583	
DFS22-F		0.74859		0.23607			
DFS31-F	−0.32578	1.72417					
DFS05-C			0.98298				
DFS14-C	−0.30584			0.89500			
DFS23-C		1.05240					
DFS32-C		1.00000					
DFS06-CTRL			1.15002				
DFS15-CTRL	−0.37287			1.00000			
DFS24-CTRL		1.14523					
DFS33-CTRL		0.96142					
DFS07-LSC			0.83278			0.65523	
DFS16-LSC	0.30820					0.70890	
DFS25-LSC		0.80346				0.71900	
DFS34-LSC					0.62887	1.00000	
DFS08-TT					0.77855		
DFS17-TT					0.88166		
DFS26-TT					1.00000		
DFS35-TT	−0.39617				1.32466		
DFS09-AE	0.50209						
DFS18-AE	1.00000			−0.55870			
DFS27-AE	0.54101	0.49187	−0.61566				
DFS36-AE		1.40137		−0.25258			
% of Variance	92.86%	85.76%	79.49%	85.57%	51.01%	3.56%	

[a] All the numbers listed inside this table were the estimated factor loadings, except the specified 1.00000 on selected one item for each latent variable, obtained from the LISREL software, version 9.30.

[b] The original nine constructs of DFS-2 (36 items) proposed by Jackson et al. (2010) were CSB = Challenge-Skill Balance, MAA = Merging Action and Awareness, CG = Clear Goals, F = Feedback, C = Concentration, CTRL = Control, LSC = Loss of Self-Consciousness, TT = Time Transformation, and AE = Autotelic Experience.

[c] Goodness-of-fit assessment of this CFA model: Chi-square statistic = 999.09739, df = 545, $p < 0.0001$, RMSEA = 0.06032, and CFI = 0.92127.

structure of our 36-item TCFSS-2 in Taiwanese subjects who were under regular treatments for schizophrenia or schizoaffective disorder notably differed from that of the original 36-item FSS-2 in healthy subjects. In particular, our "Mastery with autotelic experience" (F2) and "Mastery with sense of control" (F4) mixed up several original constructs of 36-item FSS-2. Next, the derivation of the single secondary factor, "Flow involvement" (SF), for the 36-item TCFSS-2 was also a new discovery with the largest factor loadings on "Mastery with sense of control" (F4) and "Time distortion and loss of self-consciousness" (F5).

Finally, the explained variance of each factor in our CFA models for TCDFS-2 and TCFSS-2 were listed in last rows of Tables 2 and 3 respectively. The factor scores of the first-order and second-order factors derived from our CFA models for TCDFS-2 and TCFSS-2 were estimated accordingly. They virtually represented the subjective feelings of flow experience in the Taiwanese subjects with schizophrenia or schizoaffective disorder while participating in daily activities (TCDFS-2) and specific activities (TCFSS-2).

4. Discussion

This clinical study aimed to apply the well-developed statistical methodology of integrated EFA and CFA to examine the measurement structures of TCDFS-2 and TCFSS-2 respectively in 229 Taiwanese subjects with schizophrenia or schizoaffective disorder for clinical applications. As shown in Tables 2 and 3, the identified measurement structures of 36-item TCDFS-2 and 36-item TCFSS-2 differed remarkably from those of the original 36-item DFS-2 and 36-item FSS-2 of Jackson and Eklund (2002) and Jackson et al. (2010). In particular, the six first-order factors of TCDFS-2 and TCFSS-2 mixed up several original constructs of DFS-2 and FSS-2 respectively.

In the past, the original nine constructs of 36-item DFS-2 and 36-item FSS-2 of Jackson and Eklund (2002) and Jackson et al. (2010) had

Table 3

The one-secondary factor and six-primary factor confirmatory factor analysis (CFA) model for the 36-item Traditional Chinese Flow State Scale, Version 2 (TCFSS-2).[a,d]

Primary factors / FSS-2 Items[b]	Factor 1: Autotelic experience without mastery	Factor 2: Mastery with autotelic experience	Factor 3: Mastery with self-consciousness	Factor 4: Mastery with sense of control	Factor 5: Time distortion and loss of self-consciousness	Factor 6: Goal feedback, concentration, and control	Secondary Factor: Flow involvement
Factor 1							0.12984[c]
Factor 2							1.02967
Factor 3							1.00000
Factor 4							1.19103
Factor 5							1.33888
Factor 6							0.78064
FSS01-CSB			0.50209	0.47027			
FSS10-CSB				1.00000			
FSS19-CSB		0.51629		0.51961			
FSS28-CSB	−0.62898	0.70001		0.61484			
FSS02-MAA				0.88841			
FSS11-MAA			0.63589		0.26100		
FSS20-MAA	−1.19574	0.56098		0.47255			
FSS29-MAA		0.77994	−0.24725	0.62653			
FSS03-CG	−0.68714		1.09466				
FSS12-CG	1.28245	0.29296	0.35531			0.37035	
FSS21-CG		0.71718	0.27387				
FSS30-CG			1.13157				
FSS04-F			1.00000				
FSS13-F			0.63088			0.65520	
FSS22-F	−0.92119	0.43087	0.58450				
FSS31-F			1.10932				
FSS05-C		0.22606	0.36096	0.37945			
FSS14-C		−0.32401				2.42760	
FSS23-C		0.69301		0.42891			
FSS32-C		0.83886	−0.38195	0.26749		0.60435	
FSS06-CTRL				1.00914			
FSS15-CTRL				0.57160		1.00000	
FSS24-CTRL	−1.00684	0.60777		0.64480			
FSS33-CTRL	−1.48435	0.75452		0.56166			
FSS07-LSC	1.00000				0.83565		
FSS16-LSC					0.86597		
FSS25-LSC		0.66967	−0.36670		0.49882		
FSS34-LSC		0.47393	−0.65798		1.00000		
FSS08-TT		0.39110	0.32857				
FSS17-TT		0.40526			0.25695		
FSS26-TT		0.77646					
FSS35-TT					0.14053		
FSS09-AE	1.73735	0.46163		0.42747			
FSS18-AE		0.93738					
FSS27-AE		1.00000					
FSS36-AE		0.97422					
% of Variance	9.85%	62.28%	64.40%	71.49%	49.37%	76.07%	

[a] All the numbers listed inside this table were the estimated factor loadings, except the specified 1.00000 on selected one item for each latent variable, obtained from the LISREL software, version 9.30.

[b] The original nine constructs of FSS-2 (36 items) proposed by Jackson et al. (2010) were CSB = Challenge-Skill Balance, MAA = Merging Action and Awareness, CG = Clear Goals, F = Feedback, C = Concentration, CTRL = Control, LSC = Loss of Self-Consciousness, TT = Time Transformation, and AE = Autotelic Experience.

[c] This factor loading was marginally significantly different from zero with $p = 0.063$.

[d] Goodness-of-fit assessment of this CFA model: Chi-square statistic = 987.92150, df = 539, $p < 0.0001$, RMSEA = 0.06031, and CFI = 0.92126.

been challenged and falsified in various empirical studies (Hamari and Koivisto, 2014; Procci et al., 2012; Wang et al., 2009), including cross-cultural examinations in various countries (Fournier et al., 2007; Kawabata et al., 2008; Liu et al., 2012). The original nine first-order factor models of DFS-2 and FSS-2 seemed to fit the observed data poorly. A large number of items overlapped among the original nine constructs; some items might be modified or dropped; and a global flow factor could be considered.

In this study, the final six first-order factor and one second-order factor CFA models of TCDFS-2 and TCFSS-2 revealed even more distinct profiles of flow experiences in schizophrenic subjects. Some second-order factor measurement models had been found in the literature (Fournier et al., 2007; González-Cutre et al., 2009; Gouveia et al., 2012; Hamari and Koivisto, 2014; Jackson and Eklund, 2002; Jackson et al., 2008; Jackson et al., 2010; Riva et al., 2017; Wang et al., 2009). Yet,

schizophrenia or schizoaffective disorder could cause dysfunctions of personal causations, lack of motivation to participating in activities, and cognitive impairments (Bortolato et al., 2015; Burke, 1977; Elvevag and Goldberg, 2000; Green, 2006), and then these mental deficiencies might in turn affect the flow experiences and the measurement structures of TCDFS-2 and TCFSS-2. Specifically, as listed in the last row of Tables 2 and 3, the "Autotelic experience" factor (F1) of TCDFS-2 accounted for 92.86% of the variance, but the "Autotelic experience without mastery" factor (F1) of TCFSS-2 accounted for only 9.85%. In contrast to TCDFS-2, the factors with clear goals and control possessed higher explained variances, instead of autotelic experience, in TCFSS-2. This discrepancy indicated that TCDFS-2 and TCFSS-2 might detect different 'kinds' of flow experiences in subjects with schizophrenia or schizoaffective disorder as compared with the parallel measurement structures of DFS-2 and FSS-2 in healthy people. Nevertheless, future

studies are needed to (1) examine the biological meanings and mechanisms for the discovered six first-order factors and one second-order factor of TCDFS-2 and TCFSS-2 respectively and (2) explore the associations between positive/negative symptoms and flow experiences in subjects with schizophrenia or schizoaffective disorder worldwide.

Finally, as shown in the bottoms of Tables 2 and 3, the Chi-square goodness-of-fit test statistic < degrees of freedom × 2, RMSEA ≈ 0.06, and CFI > 0.92 so that our CFA models of the TCDFS-2 and TCFSS-2 fitted the covariance data obtained from the 229 Taiwanese subjects with schizophrenia or schizoaffective disorder barely acceptable. Then, the estimated first-order and/or second-order factor scores of the TCDFS-2 and TCFSS-2 may be used to measure traits and states of flow experiences in subjects with schizophrenia or schizoaffective disorder for clinical applications. The second-order factors of the TCDFS-2 and TCFSS-2 suggested a core construct of flow experience deep inside subject's mind. Hence, when designing effective interventions and treatments for such patients to improve their flow experiences, we should develop an integrated program with focuses on the second-order factor and the first-order factors with larger factor loadings. Since factor scores, measurement structures, or even definitions of flow experiences may differ substantially between healthy people and patients with mental illness, we should consider disease-specific instruments of flow experiences in the future.

Nevertheless, this pilot study had two limitations. First, although 229 subjects participated in this prospective study, future studies with larger sample sizes from the same kind of patients or from the subjects with different clinical characteristics are needed to verify the findings. Second, we did not recruit healthy subjects for comparing the measurement structures of the flow experiences between schizophrenic patients and healthy subjects directly. We did not hypothesize a priori that the measurement structures of TCDFS2 and TCFSS2 in schizophrenic patients would be so different from the original nine first-order factor measurement model, implying that their experiences of flow might be different from what we thought before.

Conflict of interest

The authors claimed no conflicts of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2018.12.093.

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