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資　料

Development of the Cognitive Flexibility Questionnaire by Incorporating Executive Function Aspects[1),2)]

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This study aimed to develop a cognitive flexibility questionnaire (CFQ) based on the executive functioning theory. Functional neuroimaging and clinical neuropsychological studies have provided information regarding executive function. One theory suggests that cognitive flexibility consists of conceptual transfer, feedback utilization, attention, and working memory. This study involved conducting an online survey of 557 adults using a self-report questionnaire. Based on the results of confirmatory factor analysis and factor inter-correlations, a CFQ with a three-factor structure of conceptual transfer, feedback utilization, and attentional control was developed. Test-retest reliability was conducted for 100 adults, and the results showed good reliability. The results showed a moderate positive correlation among the CFQ, creativity, and openness. These results support the validity of the scale.

key words: cognitive flexibility, cognitive flexibility questionnaire, executive function, creativity, openness

Introduction

Executive Function

Cognitive flexibility is a crucial component of executive function (EF), which governs various other functions. Studies using functional neuroimaging and clinical neuropsychology have provided insights into EF and cognitive flexibility. Functional neuroimaging studies have indicated that damage to the prefrontal cortex often leads to reduced EF, suggesting that the anterior regions of the brain are responsible for executive function (Stuss & Benson, 1986). Furthermore, substantial prefrontal cortex activation has been observed among participants performing executive function tests (Baker et al., 1996). The prefrontal cortex maintains extensive connections with all other brain regions, including the brainstem and occipital, temporal, and limbic areas, as well as subcortical structures. Consequently, damage or dysfunction at any level within these neural networks can lead to cognitive and behavioral deficits (Alexander & Stuss, 2000). Children with cognitive impairment often exhibit a range of deficits in executive function. These include poor impulse control, challenges in coordinating and monitoring task-oriented behaviors, inadequate planning skills, and difficulties with organization and logical reasoning. Additionally, such children frequently struggle to implement strategies effectively, display impatience and mental rigidity, have trouble utilizing feedback constructively, and show limitations in their working memory capacity (Gioia

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et al., 2000).

Cognitive Flexibility and Scales

Based on the findings of functional neuroimaging studies, factor analyses, and clinical neuropsychological research, Anderson (2002) defines cognitive flexibility as the ability to shift between response sets, learn from mistakes, devise alternative strategies, control attention, and process multiple sources of information simultaneously. Several self-report questionnaires have been developed to measure cognitive flexibility, and they are used in clinical psychology. The Cognitive Flexibility Scale (CFS; Martin & Rubin, 1995) was designed to measure the effectiveness of cognitive behavioral therapy (CBT). In the CFS, cognitive flexibility is defined as effective interaction and communication and is considered a sign of communicative competence (Martin & Rubin, 1995). The CFS measures three aspects: (a) awareness of alternative means of communication; (b) willingness to adapt to situations; and (c) self-efficacy in flexible situations. These domains are essential for interpersonal communication skills and are associated with communicative assertiveness and responsiveness (Martin & Anderson, 1998). Although the CFS is considered an effective predictor of the treatment effects of CBT on depression, previous research has failed to identify the three factors that the CFS theorizes (Dennis & Vander Wal, 2010).

In addition to the CFS, the Cognitive Flexibility Inventory (CFI) is another measure of cognitive flexibility (Dennis & Vander Wal, 2010). It assesses an individual's capacity to think adaptively when confronted with stressful life events. It is based on three key hypotheses: (a) the tendency to perceive difficult situations as controllable; (b) the ability to recognize multiple alternatives in life events and human behavior; and (c) the capacity to generate multiple solutions to problematic situations. Dennis and Vander Wal (2010) hypothesize that individuals lacking cognitive flexibility, as measured by the CFI, would be more susceptible to pathological reactions when facing difficult circumstances. However, contrary to the initial three-factor hypothesis, previous research has demonstrated that the CFI exhibits a two-factor structure: (a) a control subscale measuring the tendency to perceive problematic situations as controllable, and (b) an alternative subscale assessing the ability to recognize multiple alternatives.

Both the CFS and CFI, which measure cognitive flexibility, were developed primarily for psychological clinical settings to assess the therapeutic effects of CBT. These scales measure skills that are expected to change over a short period owing to interventions. This suggests that the CFS and CFI may measure a construct distinct from cognitive flexibility rather than cognitive flexibility itself. Studies have also shown that the factor structures of both the CFS and the CFI differ from those assumed at the time of development, raising questions about the validity of both scales.

Cognitive Flexibility Questionnaire

Both the CFS and CFI were developed for measuring the effects of CBT but not with the assumption of EF as their theoretical background. Therefore, this study aimed to create a scale that measures cognitive flexibility as part of executive functioning among adults, rather than cognitive flexibility acquired as a result of CBT. This study is based on Anderson's (2002) theory of developing a scale for measuring cognitive flexibility, which is considered a part of executive functioning. Anderson (2002) defines cognitive flexibility as the ability to shift between response sets, learn from mistakes, devise alternative strategies, control attention, and process various information sources simultaneously. Cognitive flexibility is assumed to be a function of four factors: attention division, working memory, conceptual transfer, and feedback utilization.

However, Diamond (2013) and Gopher (1996) do not limit the function of executive functions to the division of attention but rather to focus attention and attention control. Therefore, in this study, attention as a factor constituting cognitive flexibility was not limited to the division of attention but also

to attention control, and a cognitive flexibility questionnaire (CFQ) was developed to measure cognitive flexibility. The development of an EF-based measure of cognitive flexibility as an inherent ability rather than an acquired skill would facilitate research on its relationship with stable constructs, such as personality and cognitive styles. Additionally, this would enable further investigation within the context of neuropsychological findings.

The Aim and Hypotheses of This Study

I proposed the development of a CFQ consisting of four interrelated sub-factors: Conceptual Transfer (CT), Feedback Utilization (FU), Attention Control (AT), and Working Memory (WM). The CFQ serves as a comprehensive measure of cognitive flexibility grounded in the contemporary understanding of EF.

To confirm the construct validity of the CFQ developed in this study, I examined its correlations with openness and creativity. Openness is one of the factors measured using personality tests based on the Big Five personality theory, and it represents a fundamental dimension of personality. Research has shown that individuals with high openness levels tend to be less constrained by existing theories and exhibit high intellectual curiosity (McCrae & John, 1992).

Murdock et al. (2013) find a link between cognitive flexibility, which is considered part of EF, and openness. Both cognitive flexibility and openness are associated with dopaminergic function in the prefrontal cortex (DeYoung et al., 2005). Therefore, a significant correlation between openness and cognitive flexibility would provide evidence of the construct validity of the CFQ. I hypothesized a positive correlation between cognitive flexibility, as measured by my EF-based scale, and openness.

Next, I examined the relationship between cognitive flexibility and creative self-efficacy, as measured using the Short Scale of Creative Self (SSCS; Beghetto, 2006; Farmer & Tierney, 2017; Karwowski & Barbot, 2016). Creative self-efficacy is defined as the belief in one's ability to produce creative outcomes and involves the self-judgment of creative abilities and potential.

Csikszentmihalyi (1997) suggests a link between creativity and cognitive flexibility. He pointed out that one function of creativity is to transfer ideas from one domain to another, thereby reactivating that domain. This process is related to flexibility, which is the ability to switch between perspectives.

Although direct measures of creativity are still under debate, the SSCS has been shown to be a predictor of important performance outcomes in education and the workplace (Puente-Díaz & Cavazos-Arroyo, 2017).

The SSCS comprises two sub-factors: Creative Self-Efficacy (CSE) and Creative Personal Identity (CPI). CSE refers to the self-perceived potential for creative activity and development (Karwowski & Lebuda, 2016). CSE may serve as an overall belief in one's competence in creative thinking and problem solving, a domain-general characteristic (Pretz & McCollum, 2014). CPI refers to the extent to which creativity is treated as an important part of personal identity (Jaussi et al, 2007; Karwowski & Barbot, 2016). I expected a positive correlation between the CFQ, the SSCS, CSE and CPI.

Finally, the third objective of this study is to ascertain whether there are age or sex differences in cognitive flexibility. EF demonstrates variable developmental and aging profiles. This study shows EF was followed by declines, beginning from as early as 30-40 years old and continuing into older age (Ferguson et al., 2021). Women were found to have slower reaction times, consistent with another study (Giambra & Quilter, 1989). Indeed, a performance test reported no sex differences in EF. In the current study, sex differences were examined to confirm the results of previous studies. It was assumed that scores on the EF-based scale measuring cognitive flexibility would decrease with advancing age and that women would score lower on their self-reports of attention function than men.

Study 1

Purpose

To develop a CFQ based on executive function, I will create scale items and analyze the scale's factor structure, internal consistency, and inter-item correlations.

Method

Analysis Method

All analyses in this study were conducted using IBM SPSS version 25 and Amos version 26.

Item Collection and Confirmatory Factor Analysis (CFA) Study 1

Following Anderson's (2002) definition of cognitive flexibility, 40 items were developed with reference to the Cognitive Failures Questionnaire (Broadbent et al., 1982), Detail and Flexibility Questionnaire (Roberts et al., 2011), CFI (Dennis & Vander Wal, 2010), CFS (Martin & Rubin, 1995), and BRIEF-2 (Gioia et al., 2000).

The items in the preliminary questionnaire were categorized into four domains: (a) Transfer between response sets and devising alternative strategies. (b) Learning from mistakes and developing alternative strategies. (c) Attention control and the ability to process multiple sources of information simultaneously. (d) Working memory.

Responses were scored on a 5-point Likert scale (5=very true, 1=not true at all). Assuming correlations between factors, the analysis was performed using promax rotation.

Participants

An online survey was conducted among participants who registered with an online survey company (Cross Marketing, Inc.) in North America. The participants were North American residents, and the survey was conducted in English.

Eight blocks were set up to determine the number of groups in the age structure, with four age categories (20-29, 30-39, 40-49, and 50-59 years) and two sexes (men and women). 150 participants were assigned to each block.

Comrey and Lee (2013) suggest a graded sample size scale for scale development: 100=poor, 200=fair, 300 = good, 500 = very good, ＞= 1,000 = excellent. Therefore, the target sample size for this study was more than 500.

43 Responses with the same options for all the questions were deleted. After deleting, 557 (Age; M = 37.59, SD = 11.52) participants self-reported as White (67%), Black or African American (16%), Hispanic (12%), Asian (5%), or Other (less than 1%). The study was conducted in April 2022.

Ethical Consideration

This study (Study 1, 2 and 3) was approved by the Research Ethics Committee (University of Human Arts and Sciences. No.656) and the participants of Study 1, 2 and 3 were informed about the study, and their voluntary completion of the survey was considered consent.

Result

A four-factor structure was hypothesized and CFA was conducted, excluding items with similar content, high inter-item correlations, and those that were difficult to interpret. Forty items were initially created, and 24 were removed after item validation. The remaining 16 items were subjected to a confirmatory factor analysis. The four factors are as follows: (a) CT, the ability to process multiple sources of information simultaneously and transfer between response sets; (b) FU, the ability to process multiple sources of information simultaneously, devise alternative strategies, and learn from errors; (c) AT, the ability to process multiple sources of information simultaneously; and (d) WM, the ability to temporarily store and process information necessary for tasks and movements.

The fit indices of the model were examined in the four-factor model. The fit indices values were GFI =.91, CFI=.91, TLI=.89, RMSEA=.06. GFI is desired to be 0.90 or higher. CFI is desired to be 0.95 or higher. TLI is desired to be 0.95 or higher. RMSEA is desired to be less than 0.05. And, when I examined the correlations between FU and WM (r=-.03),

Table 1 CFA Factors for the CFQ items

Item	CFA Factors			Communality
	1	2	3	
Conceptual transfer				
3. I try to get the big picture when thinking about things	.68	.09	.08	.64
11. I am willing to listen and consider alternatives to solve problems	.61	.05	.07	.61
5. I prefer to think of other ways to tackle a problem	.60	.07	.06	.53
12. I have a wide variety of ways of thinking	.54	.16	.00	.69
Feedback utilization				
1. I take the time to consider multiple ways to solve a problem	.06	.72	.01	.68
13. I look at situations objectively to solve problems	.02	.70	.01	.60
15. I am able to adopt new ideas	.17	.67	.06	.62
8. I check myself for mistakes	.22	.58	.08	.55
Attention control				
7. I can work on more than one thing at a time	.09	.23	.69	.58
16. I can alternate the task of concentration between two things	.13	.01	.67	.51
4. I can quickly focus on one thing at a time when I need to	.11	.02	.63	.53
9. I am able to quickly find the right way on the spot	.18	.01	.60	.46
Working memory				
When I get nervous, it becomes difficult to solve problems in various ways*				
When an idea comes to mind, I can't think about other possibilities*				
I am in the middle of doing something, and I have difficulty remembering what I am doing*				
When I am asked to make a decision quickly, it becomes difficult to make a decision*				

* Reverse Item

Table 2 Intra-scale correlation of the CFQ

Items	1	2	3	4
1. CT	-	.65**	.61**	.87**
2. FU		-	.58**	.87**
3. AT			-	.85**
4. CFQ				-

** $p < .01$

CT and WM (r=.01), AT and WM (r=-.06), and Total (r=-.02), the correlations between WM and other factors were negligible.

Therefore, four WM items were excluded and CFA was conducted again, assuming a three-factor structure. Consequently, 12 items were used: four items each for Factor 1 (CT), Factor 2 (FU), and Factor 3 (AT). CFA was then employed to verify structural validity. The fit indices of the model were analyzed. The fit indices values were GFI=.95, CFI=.98, TLI=.95, RMSEA=.05 (Table 1).

Owing to the good fit of the three-factor model, I analyzed the reliability coefficients of the three factors.

The results were as follows: CT (ω=0.77), FU (ω=0.82), AT (ω=0.76), and the CFQ total (ω=.88). Correlations between the subscales and CFQ total were r=.87 (p<.01) for FU, r=.87 for CT, and r=.85 (p<.01) for AT. The correlation between FU and CT was r=.65 (p<.01), that between FU and AT was r=.58 (p<.01), and that between CT and AT was r=.61 (p<.01) (Table 2).

The CFA of the CFQ resulted in the development of a scale comprising 12 items in a three-factor structure: CT, FU, and AT. This structure excluded items measuring WM, which was initially included in the four-factor structure hypothesized at the beginning of the study. The fit indices of the model were examined for the CFQ. The consistency index values were GFI=.95, CFI=.98, TLI=.95, and RMSEA=.05. These results indicate a good fit for the three-factor model.

Conclusion

Confirmatory factor analysis of the CFQ, which measures cognitive flexibility, resulted in the devel-

opment of a scale consisting of 12 questions in a three-factor structure of CT, FU, and AT, excluding items measuring WM from the model, rather than the four-factor structure of CT, FU, AT, and WM that was assumed at the beginning of the study. The consistency indexes of the model were examined in the CFQ. The consistency index values were GFI=.95, CFI=.98, TLI=.95, RMSEA=.05. The fit of the three-factor model was good.

Study 2

Purpose

In Study 2, the CFQ was administered twice with a 3-week interval to determine its test-retest reliability. The rationale for setting the 3-week interval was based on previous TIPI study (Oshio, A., Abe, S., & Cutrone, P., 2012) measuring personality, which used a 2-week interval. The CFQ was considered to measure a relatively stable trait; therefore, a slightly longer interval of 3 weeks was chosen for this study.

Method

Questionnaire

The 12-item CFQ developed in Study 1 was used. Responses were scored on a five-point scale (5=very true, 1=not true at all).

Participants

An online survey was conducted among participants who registered with an online survey company (Cross Marketing, Inc.) in North America. The participants were North American residents, and the survey was conducted in English. Participants in Study 2 were different from those in Study 1.

Eight blocks were set up to determine the number of groups in the age structure, with four age categories (20-29, 30-39, 40-49, and 50-59 years) and two by sexes (men and women). 75 participants were assigned to each block. 8 Responses with the same options for all the questions were deleted.

After deleting, A total of 292 (Age; M=38.87, SD=11.17) participants responded. Of these, 100 participants (M=41.46, SD=10.92) self-reported as White (73%), Black or African American (17%), Hispanic (8%), Asian (2%), and Other (less than 1%) and completed a second survey three weeks later, from May to June 2022, for the retest reliability study.

Result

I analyzed the reliability coefficients of these three factors. The intrarater reliability was examined. The intraclass correlation coefficient (ICC) for the CFQ was ICC (1,2)=.86, 95% CI [.80, .92], for CT was ICC (1,2)=.75, 95% CI [.72, .78], for FU was ICC (1,2)=.72, 95% CI [.69, .75], and for AT was ICC (1,2)=.87, 95% CI [.82, .92].

Conclusion

Sufficient test-retest reliability of the CFQ was confirmed.

Study 3

Purpose

To confirm the construct validity of the CFQ developed in Study 1, I examined the correlations among the CFQ, SSCS, and openness. A moderate positive correlation was expected among the CFQ, SSCS, and openness.

Method

Questionnaire

(a) The 12-item CFQ developed in Study 1 was used. Responses were scored on a five-point scale (5=very true; 1=not true at all).

(b) To examine the relationship between the CFQ and creativity, I examined its correlation with a shortened version of the SSCS. The SSCS consists of CSE and CPI. The CSE has six items measuring the belief that one can produce creative outcomes and that creativity is an essential element of self. The CPI comprises five items measuring the extent to which creativity is treated as an important part of an individual's identity. For the SSCS, participants were asked to indicate the extent to which each statement described them on a five-point Likert scale (1=definitely not; 5=definitely yes). There-

fore, the possible total scores on the SSCS ranged from 6 to 30, with higher scores indicating greater creative self-efficacy.

(c) Two items of openness, a subfactor of the Ten Item Personality Inventory (TIPI), were used. The TIPI is a psychological scale developed by Gosling et al. (2003) that measures the Big Five personality traits. Responses were scored on a seven-point scale (1=strongly disagree; 7=strongly agree).

Participants

An online survey was conducted among participants who registered with an online survey company (Cross Marketing, Inc.) in North America. The participants were North American residents, and the survey was conducted in English. Participants in Study 3 were different from those in both Study 1 and 2.

Eight blocks were set up to determine the number of groups in the age structure with four age categories (20-29, 30-39, 40-49, and 50-59 years) and two sexes (men and women). 60 participants were assigned to each block. Participants were informed that the ethics committee had obtained permission to conduct the survey. A positive response to participation was considered consent for the study. 10 response with the same options for all the questions were deleted. After deleting, A total of 150 (Age; $M = 30.09$, $SD = 10.96$) participants self-reported as White (71%), Black or African American (17%), Hispanic (9%), Asian (3%), or Other (less than 1%). The study was conducted in September 2023.

Result

The ω coefficient of SSCS was found to be sufficient (ω=.91). And the ω coefficient of openness was confirmed (ω=.51). The correlation analysis was conducted to confirm construct validity. The results indicated a moderate positive correlation ($p<.01$) of .65 between the CFQ and CSE scores. A moderately positive correlation ($p<.01$) of .59 between CT and CSE was observed. A moderately positive correlation ($p<.01$) of .59 between FU and CSE, and a moderately positive correlation ($p<.01$) of .59 between AT and CSE were observed. A moderate positive correlation of .57 ($p<.01$) between AT and CSE was observed. A moderate positive correlation ($p<.01$) of .47 between the CFQ and openness was observed. A moderate positive correlation ($p<.01$) of .47 between the CT and openness was observed. A moderate positive correlation ($p<.01$) of .55 between FU and openness was observed. A weak positive correlation ($p<.01$) of .33 between AT and openness was observed. A moderate positive correlation ($p<.01$) of .48 between CSE and openness was found (Table 3).

To examine whether there were differences in CFQ by sex and age, a two-factor analysis of variance was performed. The results showed no significant differences for CT in sex (F (1,142)=0.826, p=.48, η^2=.02), age (F (3,142)=0.412, p=.52, η^2=.00), or the interaction of sex and age (F (3,142)=0.526, p=.67, η^2=.01). FU showed no significant differences in sex (F (1,142)=0.573, p=.63, η^2=.01), age (F (3,142)=0.011, p=.92, η^2=.00), or their interaction (F (3,142)=0.144, p=.93, η^2=.00). AT exhibited no significant differences in sex (F (1,142)=1.59, p=.20, η^2=.03), age (F (3,142)=.00, p=.96, η^2=.00), or their interaction (F (3,142)=.83, p=.48, η^2=.02). The CFQ exhibited no significant differences in sex (F (1,142)=1.04, p=.38, η^2=.02), age (F (3,142)=.07, p=.80, η^2=.00), or their interaction (F (3,142)=.50, p=.68, η^2=.01) (Table 4, Table 5).

Discussion

This study examined the reliability and validity of the CFQ, which measures cognitive flexibility, considered a component of EF, based on Anderson's (2002) theory. Based on the results of Study 1, the CFQ was developed to measure three factors: (1) CT, (2) FU, and (3) AT. In Anderson's theory, the four factors are assumed to correlate with each other. However, WM was excluded from this study. Some theories of EF propose that WM is part of EF but is an independent factor of cognitive flexibility (Diamond, 2013; Miyake et al., 2000). The four-factor structure proposed in Anderson's theory is based

Table 3 The Correlation between the CFQ, the SSCS and openness. Mean and standard deviation

Item	*M*	*SD*	1	2	3	4	5	6	7	8
1. CFQ	47.57	6.75	-	.90**	.88**	.86**	.67**	.57**	.65**	.67**
2. CT	16.23	2.56		-	.73**	.65**	.57**	.50**	.57**	.47**
3. FU	16.03	2.43			-	.61**	.61**	.51**	.59**	.44**
4. AT	15.31	2.67				-	.60**	.48**	.57**	.33**
5. CSE	24.11	4.14					-	.78**	.95**	.48**
6. CPI	19.75	3.98						-	.94**	.41**
7. SSCS	43.86	7.66							-	.48**
8. Openness	10.12	2.56								-

** $p < .01$

Table 4 Mean and Standard Deviations for CFQ as Functions of Age

Item	20-29 ($N = 37$)		30-39 ($N = 37$)		40-49 ($N = 41$)		50-59 ($N = 35$)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
CT	15.59	3.62	16.19	2.28	16.29	2.30	16.43	1.38
FU	15.81	3.15	16.08	2.24	16.49	2.29	16.11	1.59
AT	14.54	3.35	15.22	2.64	15.85	2.62	15.60	1.74
CFQ	45.95	9.27	47.49	6.43	48.63	6.17	48.14	4.11

Table 5 Mean and Standard Deviations for CFQ as Functions of Sex

Item	Male ($N = 76$)		Female ($N = 74$)	
	M	*SD*	*M*	*SD*
CT	16.04	2.37	16.22	2.69
FU	16.09	2.3	16.18	2.52
AT	15.36	2.67	15.27	2.71
CFQ	47.49	6.43	47.66	7.15

on findings of childhood developmental studies. And the participants in this study were at an age when EF development was relatively stable. This may have led to a three-factor structure for cognitive flexibility in adulthood and beyond, as opposed to the four factors proposed by Anderson as constituting cognitive flexibility in childhood and adolescence. Furthermore, some EF theory was developed based on clinical neuropsychology (Miyake et al., 2000). This difference could have resulted in differences in the factor structure. Research on whether WM is a component of cognitive flexibility remains inconclusive, and further studies using this scale are required.

Next, the CFQ correlated with the openness of the Big Five, a relationship suggested in previous studies (DeYoung et al., 2005; Murdock et al., 2013). Nijstad et al. (2010) propose a model of creativity that considers creativity functions because of cognitive flexibility and persistence. This study shows a relationship between the CFQ and SSCS, suggesting a relationship between the CFQ and creativity. The CFQ is developed using EF theory to assess self-regulation, emotional regulation, and motivation. This is thought to be related to the switching of attention in EF. Further research on the relationship between the CFQ and self-regulation, emotional regulation, and motivation, which are thought to be related to changes in attention in EF, are required.

Contrary to the hypothesis that there are age and sex differences in the CFQ, the results showed no such differences. Toplak et al. (2013) pointed out that the correlation between the results of performance-based tests and rating measures of EF is very small. They suggest that performance-based tests measure process efficiency, while rating measures assess introspection. The results of this study indicate that people's self-perceptions of cognitive

flexibility are stable across sex and ages. This result aligns with Toplak et al.'s (2013) findings and indicates that the CFQ has stability of results as a measure of self-perceived cognitive flexibility.

Finally, I discuss the limitations of this study. All the study participants were adults. Individuals younger than 19 years and older than 60 years were excluded. Therefore, the CFQ does not measure cognitive flexibility in children, adolescents, and older adults. Anderson (2002) indicates that EF develops during childhood and adolescence. Therefore, in this study, I measured cognitive flexibility among adults aged ＞20 years. Whether the adaptations and measurements are appropriate for these populations should be examined. Despite these limitations, this study successfully developed and validated the CFQ. Although this study measured cognitive flexibility using a self-reported questionnaire, the relationship between this scale and cognitive flexibility measured using functional magnetic resonance imaging (fMRI) was not examined. More advanced research on the relationship between directly measured cognitive flexibility and the CFQ is required.

In conclusion, a CFQ measuring cognitive flexibility comprising three factors—CT, FU, and AT—was developed with reference to Anderson's (2002) EF theory. A scale measuring cognitive flexibility has been developed and one source of validity has been obtained, but further validation is required.

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