An attempt at revisiting the factor structure of the Dysexecutive Questionnaire in the Chinese setting

Factor analysis of the DEX

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Abstract

This study examined the factor structure of the Chinese version of the Dysexecutive Questionnaire (DEX) in a large nonclinical sample of college students ($n = 1,586$). All participants completed the self-report version of the DEX. An exploratory factor analysis was first performed on a sub-sample (randomly split, $n = 766$) and produced a four-factor model (Volition, Intentionality, Inhibition, and Abstract Problem Solving), which was similar to previous models reported in Western samples. In addition, a series of confirmatory factor analyses were conducted on the remaining sample ($n = 820$). The findings suggested that a four-factor solution of the self-report DEX might better explain the latent structure in the present Chinese healthy sample.

Keywords

Dysexecutive Questionnaire (DEX)

executive function

factor analysis

1. Introduction

Executive function can be measured using laboratory-based neuropsychological assessment or self-report instruments. Widely used laboratory-based tests, such as the Wisconsin Card Sorting Test (Grant & Berg, 1948) and the Sustained Attention to Response Task (Robertson, Manly, Andrade, Baddeley, & Yiend, 1997) have been found to be effective in discriminating clinical groups from healthy controls. However, their predictive ability for everyday dysexecutive problems has been questioned (Burgess, Alderman, Evans, Emslie, & Wilson, 1998; R. C. K. Chan & Manly, 2002), as laboratory-based tests usually only tap into relatively isolated facets of executive function (R. C. K. Chan et al., 2008). On the other hand, self-report instruments, such as the Dysexecutive Questionnaire (DEX; Wilson, Evans, Alderman, Burgess, & Emslie, 1996), may provide a comprehensive coverage of a wide range of dysexecutive symptoms in daily life.

The DEX was originally developed by Wilson et al. (1996) to assess dysexecutive syndrome in patients with frontal lobe damage. The *dysexecutive syndrome* was defined as a series of observable executive problems related to frontal lobe dysfunction (Baddeley, 1986). Recently, the applicability of the DEX has gradually been extended to other clinical and nonclinical individuals (R. C. K. Chan, 2001; Evans, Chua, McKenna, & Wilson, 1997; Shaw, Oei, & Sawang, 2015; Shinagawa et al., 2007). On the one hand, the DEX may facilitate comparisons of dysexecutive symptoms across different clinical groups. On the other hand, it can also be useful to measure dysexecutive behavior in nonclinical samples. R. C. K. Chan (2001) found that nonclinical individuals manifested varying levels of executive problems in daily life. Although dysexecutive behavior in nonclinical groups did not reach the level of impairments, individual differences in everyday executive failure may reflect a premorbid personality and provide base-rate information for interpreting dysexecutive syndrome (R. C. K. Chan, 2001). Moreover, factor analysis of the DEX in

a nonclinical sample supported a fractionated system of executive function in this population (R. C. K. Chan, [2001](#)).

Two versions of the DEX, namely, the self-report DEX-S and the other-reported DEX-O, are commonly used. The DEX-S and the DEX-O have identical items and contents, except that the former adopts the first-person perspective, and the latter uses the third-person view. The DEX-S is answered by the participant, whereas the DEX-O is completed by another person who knows the participant well. The DEX-O has higher predictive value than the DEX-S in patients with frontal lobe damage and schizophrenia because of the self-awareness problem in these patients (Burgess et al., [1998](#); R. C. K. Chan et al., [2008](#)). Given that extra time and efforts are need to find suitable significant others, the DEX-O is not as easy to administer as the DEX-S when the sample size is large. For this reason, the DEX-S is more convenient and efficient for collecting a large amount of data, and thus may be a better choice for assessing daily executive problems in large nonclinical samples without having self-awareness deficits.

Three studies have examined the factor structure of the DEX-O. Results of an exploratory factor analysis (EFA) of the DEX-O conducted in 78 patients with frontal lobe damage showed three factors: Cognitive, Emotional, and Behavioral symptoms (Wilson et al., [1996](#)). Using EFA to analyze data collected from an extended neurological sample ($n = 92$), Burgess et al. ([1998](#)) reported a five-factor model that comprised: Disinhibition, Intentionality, Executive Memory, Positive Affect, and Negative Affect. In a later study, R. C. K. Chan ([2001](#)) found a similar five-factor solution for the DEX-O in 93 healthy volunteers in the Chinese setting. The factors were: Inhibition, Intentionality, Knowing–Doing Dissociation, In-Resistance, and Social Regulation.

For the DEX-S, two factor analytic studies have been conducted using Western samples. A four-factor model (viz., Inhibition, Intention, Social Regulation, and Abstract Problem Solving) was reported by Mooney, Walmsley, and McFarland ([2006](#)) based on a large sample comprising both healthy individuals ($n = 293$) and opiate-dependent patients ($n = 49$). Shaw et al. ([2015](#)) adopted a two-stage analysis (EFA

and then confirmatory factor analysis [CFA]) and showed that a stable three-factor model (viz., Inhibition, Volition, and Social Regulation) best explained the latent factor structure of the DEX-S in a large sample comprising 663 healthy volunteers, 214 patients with psychiatric illness, and 120 patients with neurological disorders.

Even though similarities in factor models were demonstrated in these studies, the number of factors between studies varied. These variations may be due to the different versions of the DEX and the different characteristics of the samples used in these previous studies. It is interesting to note that only one study has examined the factor structure of the DEX-O in a small Chinese sample (R. C. K. Chan, [2001](#)). The variation between the Chinese factor model and the other, Western, models might partly be due to cultural differences. Therefore, it is important to further validate the DEX in Chinese settings. Among the factor-analytic studies reviewed, all but one (viz., Shaw et al., [2015](#)) used the EFA in relatively small samples to validate the DEX-S. A more stringent method, that is, CFA, is needed to clarify the latent structure of the DEX-S.

The present study aimed to determine the factor structure of the DEX-S in a large nonclinical sample using a two-stage factor analysis strategy (EFA and CFA). To our best knowledge, no study has investigated the factor structure of the DEX-S in nonclinical Chinese samples.

2. Methods

2.1. Participants

We recruited 1,586 college students (35% male) from Beijing, Shanghai, and Guangzhou. The mean age and education duration of this sample were 18.94 years ($SD = 5.41$) and 12.30 years ($SD = 0.80$), respectively. Participants who had a family or personal history of mental illness were excluded. All participants completed the self-report version of the DEX.

The Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences approved the present study. All participants gave informed consent before the study

commenced.

2.2. Measures

The DEX (Wilson et al., 1996) was used to assess dysexecutive syndrome in everyday life (e.g., abstract thinking problems, impulsivity, confabulation, and planning problems). The captured dysexecutive problems could be observed in the daily lives of both clinical and nonclinical populations. Previous studies have demonstrated good psychometric properties of this questionnaire. The DEX-S is a 20-item, self-report 5-point Likert-type scale ranging from 0 (*never*) to 4 (*very often*), with higher scores indicating a higher frequency of executive function problems in everyday life. The Chinese version of the DEX-S was used in the present study (R. C. K. Chan, 2001). The items in the Chinese version are identical to those of the original English version. Participants were asked to complete this checklist according to their real-life experience.

2.3. Statistical analyses

We used SPSS (Version 22.0.0) and LISREL (Version 8.70) for data analyses. The total sample ($n = 1,586$) was randomly split into two subsamples. EFA was conducted in the first group ($n = 766$) and CFA was conducted in the second group ($n = 820$). The KMO and Bartlett's test of sphericity were used to test the fitness of the data for EFA in the first group. CFA analyses in the second group included the four-factor model identified based on the EFA in our first group. In addition, the two factor models of the DEX-S as suggested by Mooney et al. (2006) and Shaw et al. (2015), as well as the three factor models of the DEX-O as suggested by Burgess et al. (1998), Wilson et al. (1996), and R. C. K. Chan (2001) were also tested using CFA in the second group. Both absolute fit indices (χ^2 statistics, χ^2/df ratio, root mean square error of approximation [RMSEA]) and incremental fit indices (normative fit index [NFI], the comparative fit index [CFI], and the incremental fit index [IFI]) were included to gauge the goodness-of-fit between the hypothetical models and the actual data. Cut-off values of these indices were: (1) p -values of the χ^2 -test > 0.05 ; (2) $\chi^2/df < 5$

(Wheaton, Muthén, Alwin, & Summers, 1977); (3) RMSEA < 0.07 (Steiger, 2007); and (4) NFI, CFI, and IFI $\geq$ 0.95.

3. Results

3.1. Exploratory factor analysis of the DEX-S

The KMO of the first group was 0.95, and Bartlett's test of sphericity was significant ($\chi^2 = 4949.56$, $p < 0.001$). Both of these supported the fitness of our data for factor analysis. Principal component analysis and varimax rotation were used for data extraction and factor rotation. The following criteria were adopted for determining the final factor structure: (1) eigenvalue greater than 1; (2) excluding items with factor loading less than 0.4; and (3) excluding items with factor loading greater than 0.4 on two or more factors.

EFA based on the first subsample showed a four-factor solution that accounted for 52.73% of the total variance. Factor 1 accounted for 16.99% of the total variance (eigenvalue = 3.40) and comprised of items relating to apathy, disinhibition, variable motivation, aggression, lack of concern, and no concern for social rules. This factor was labeled "Volition" because it contains items associated with abnormal motivation. It overlaps with the Behaviour factor in the model suggested by Wilson et al. (1996) and the Volition factor reported by Shaw et al. (2015). Factor 2 accounted for 15.67% of the total variance (eigenvalue = 3.13) and was termed "Intentionality." It comprised items dealing with knowing–doing dissociation, distractibility, poor decision-making ability, inability to inhibit responses, and perseveration. This factor seems to assess problems in maintaining goal-directed behavior, and is similar to the Intentionality factor in the factor solutions of Mooney et al. (2006) and Burgess et al. (1998). Factor 3, accounting for 12.03% of the variance (eigenvalue = 2.41), comprised items relating to impulsivity, confabulation, euphoria, temporal sequencing deficits, and restlessness–hyperkinesis. We called it "Inhibition" because it is mainly associated with the ability to restrain thoughts, emotion, and behavior. This factor overlapped with the Inhibition factor in previous models (viz., the Mooney-model, Shaw-model, Burgess-model, and Chan-model).

Factor 4, accounting for 8.04% of the variance (eigenvalue = 1.61), comprised items dealing with abstract thinking problems, planning problems, and shallowing of affective responses. It was labeled “Abstract Problem Solving.” This factor seems to assess difficulties in abstract thinking, planning, and emotional responses, which are related to abstract problem solving. Table 2 shows the factor loadings for items of our four-factor model. For details on item attribution in the factor model determined by EFA and the other five models from the literature, please refer to Table 1.

3.2. Confirmatory factor analysis of the DEX-S

Table 3 summarizes the results of CFA conducted using the second subsample. When testing the Shaw-model, the CFI and IFI were equal to 0.95, and the NFI approximated 0.95, whereas the χ^2/df and RMSEA did not meet the criteria for goodness of fit. As can be seen in Table 3, none of the indices of the Wilson-model, Burgess-model, Chan-model, or the four-factor EFA solution of the present study meet the CFA cut-off criteria, suggesting that these models did not fit the current data well.

4. Discussion

Results from the EFA in this study suggested a four-factor model (Factor 1: Volition, Factor 2: Intentionality, Factor 3: Inhibition, Factor 4: Abstract Problem Solving) for the DEX-S in a large Chinese nonclinical sample. The first factor, Volition, included items describing abnormal motivation. The Intentionality factor contained items that are related to difficulties in maintaining goal-directed behavior. The Inhibition factor was mainly derived from items that capture difficulties in holding back thoughts, emotion, and behavior. The last factor, Abstract Problem Solving, consisted of items related to problems in abstract thinking, planning, and emotional response. The four-factor model was consistent with R. C. K. Chan’s (2001) model and suggested that executive function is a multifaceted system in a nonclinical population. Furthermore, our study replicated R. C. K. Chan’s (2001) finding that

nonclinical participants did exhibit varied levels of dysexecutive behavior that could affect their daily life. Although the DEX was first developed in neurologically impaired patients (Wilson et al., 1996), application of this instrument has been extended to nonclinical samples (R. C. K. Chan, 2001). This application highlights the importance of base-rate information of dysexecutive symptoms in the nonclinical population when interpreting self-reported dysexecutive functions in clinical groups.

Our four-factor model showed both some agreement and discrepancy with previous models of the DEX-S. The four-factor model shared a lot of similarities with factors reported by Shaw et al. (2015) and Mooney et al. (2006). Factor 1 (Volition) partially overlaps with the Volition factor in the Shaw-model. Factor 2 (Intentionality) contains all items of the Intentionality factor in the Mooney-model. And Factor 3 (Inhibition) shares common items with the Inhibition factor from both the Mooney-model and the Shaw-model. As for the fourth factor, Abstract Problem Solving, one of the items in this factor was also included in the Abstract Problem Solving factor of the model reported by Mooney et al. (2006). However, as illustrated in Table 1, different patterns of item attribution to factors were also observed in these models. The different characteristics of the samples between studies might have contributed to variations across these models. In addition, cultural differences between the samples may also be a possible reason for the discrepancies between our four-factor model, which used a Chinese sample, and the other two models, which used Western samples. The way people experience dysexecutive symptoms in daily lives may vary across different cultures (A. S. Chan, Shum, & Cheung, 2003).

It is interesting to note that similarities of the factor solution were also demonstrated for findings and models derived from the DEX-O. This is, nevertheless, not surprising, since the DEX-O and DEX-S have identical item content, except for the way respondents were asked the questions. The first factor (Volition) of our four-factor model was similar to the Behaviour factor in the Wilson-model (Wilson et al., 1996). In Factor 2 (Intentionality), three of the five items also appeared in the factor Intentionality in the Burgess-model (Burgess et al., 1998), and this factor also overlaps with Factor 2 of the Chan-model (R. C. K. Chan, 2001). In addition, our

Factor 3 (Inhibition) also resembles the Inhibition factor in both the Burgess-model and the Chan-model. Despite these similarities, factor solutions of the DEX-S differ with models of the DEX-O. While the DEX-S is based on self-awareness of the participant, the DEX-O depends on others' knowledge about the participant. Therefore, apart from the diversified samples and cultural differences we discussed before, different information sources could also have led to different factor loadings. As discussed above, despite the similarities of the models of DEX shared by different studies, the factor models generated by each study also varied across the studies. Comparisons of these models may therefore facilitate optimal application and administration of DEX in future research. Factor models based on different samples, cultures, and versions (self- or other-reported) have their unique values for interpreting everyday dysexecutive failures in various populations. It should be noted that limited statistical methods might also have partially led to the discrepancies observed in these models. Future studies using both EFA and CFA may further validate both the DEX-O and the DEX-S in large samples across cultures.

Several limitations of this study should be borne in mind. First, previous models and the four-factor solution determined by EFA did not strictly meet the goodness-of-fit indices when tested with CFA. It is reasonable that models in previous studies are not well fit with our data because of differences in sample characteristics. The variation in ratings in our college students sample is relatively small, which may have affected our four-factor model and resulted in a lack of fit to the data. Therefore, further studies are needed to validate the DEX in a more diversified, large nonclinical sample (such as a community sample). Secondly, although participants in this study were healthy individuals who probably have intact self-awareness, both the DEX-S and the DEX-O should be adopted in future studies to generalize these findings for both versions of the DEX to nonclinical and clinical samples in the Chinese setting.

In summary, our study demonstrated a four-factor solution of the DEX-S in a large healthy Chinese sample and supported the applicability of the self-report version of the DEX in the Chinese setting. The present findings suggest that the DEX-S has a similar (but not exactly the same) factor structure in the Chinese setting as those

reported in Western studies.

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Table 1. Item attribution to DEX factors for each model

Model	Factors and items			
For the DEX-S				
4-factor-solution (EFA)	F1 (Vol)	F2 (Int)	F3 (Inh)	F4 (Abs)
	8,9,10,12,13,2	14,16,17,18,19	2,3,5,6,15	1,4,11
	0			
Mooney-model (Mooney et al., 2006)	F1 (Inh)	F2 (Int)	F3 (Soc)	F4 (Abs)
	2,5,12,13,14,1	17,18,19	4,7,8,11,16,20	1,3,6,9
	5			
Shaw-model (Shaw et al., 2015)	F1 (Inh)	F2 (Vol)	F3 (Soc)	

	2,3,5,9,16,17	1,4,8,10,11,12,19	13,20		
For the DEX-O					
Wilson-model (Wilson et al., 1996)	F1 (Beh)	F2 (Cog)	F3 (Emo)		
	2,7,9,12,13,15, 16,20	3,6,14,18,19	5,8,11		
Burgess-model (Burgess et al., 1998)	F1 (Inh)	F2 (Int)	F3 (Exe)	F4 (Pos)	F5 (Neg)
	1,2,9,13,15,16, 20	4,7,17,18,19	3,6,14	5,10,12	8,11
Chan-model (Chan, 2001)	F1 (Inh)	F2 (Int)	F3 (Kd)	F4 (In-r)	F5 (Soc)
	5,9,13,15,16	2,4,18,19	7,8,11,17	1,3,14	12,20

Abs = abstract problem solving; Beh = behavior; Cog = cognition; Emo = emotion; Inh = inhibition;
 Int = intentionality; Exe = executive memory; Pos = positive affect; Neg = negative affect;
 Kd = knowing–doing dissociation; In-r = in-resistance; Soc = social regulation; Vol = volition.

Table 2. Factor Loadings for single item of the four-factor model by EFA

Factors and items	Factor loadings			
	1	2	3	4
Factor 1: Volition				
8	.68			

9	.62			
10	.51			
12	.57			
13	.69			
20	.61			
Factor 2: Intentionality				
14	.49			
16	.71			
17	.56			
18	.79			
19	.68			
Factor 3: Inhibition				
2		.72		
3		.66		
5		.47		
6		.52		
15		.53		
Factor 4: Abstract problem solving				
1			.62	
4			.56	
11			.50	
Variance explained	36.01%	6.16%	5.45%	5.11%

Table 3. Fit-indices of the different factor models for the CFA of the DEX-S

Index	Wilson- model (Wilson et al., 1996)	Burgess- model (Burgess et al., 1998)	Chan- model (Chan, 2001)	Mooney- model (Mooney et al., 2006)	Shaw- model (Shaw et al., 2015)	4-factor- solution (EFA)
χ^2	1,167.03	1,646.29	1,445.65	1,684.80	649.35	1,270.09
df	95	138	120	144	78	135

χ^2/df	12.28	11.93	12.05	11.70	8.32	9.41
RMSEA	0.12	0.12	0.12	0.11	0.10	0.10
NFI	0.91	0.91	0.91	0.91	0.94	0.93
CFI	0.91	0.92	0.92	0.91	0.95	0.93
IFI	0.91	0.92	0.92	0.91	0.95	0.93

χ^2 = chi-square-statistic; RMSEA = root mean square error of approximation; NFI = normative fit index;

CFI = comparative fit index; IFI = incremental fit index.