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Running Head: GERMAN NEED FOR COGNITION SCALE

University and School Students' Motivation for Effortful Thinking: Factor Structure,
Reliability, and Validity of the German Need for Cognition Scale

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Summary

Need for Cognition (NFC) reflects a relatively stable trait regarding the degree to which one enjoys and engages in cognitive endeavors. We examined whether the previously demonstrated one-dimensional structure of the German NFC Scale can be replicated in three samples of undergraduates and secondary school students. Moreover, we investigated the retest-reliability of the German NFC Scale, which has not been tested yet. Further, we investigated whether the scale proves to be valid in a sample of secondary school students. Multigroup confirmatory factor analyses established the one-dimensional factor structure of the long form as well as the short form of the German NFC Scale for undergraduates ($N = 559$), students of academic track secondary schools (German Gymnasium; $N = 555$), and students of vocational track secondary schools (German Realschule; $N = 486$). The scale proved to have a high retest-reliability in a university student sample ($N = 43$). For secondary school students, we again found a high retest-reliability ($N = 157$), and also found the scale to be valid ($N = 181$).

Keywords: cognitive style, motivation, scale, questionnaires

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Introduction

People can process information effortfully (i.e., intentionally, consciously, and analytically) or effortlessly (i.e., automatically, preconsciously, and heuristically). For instance, one can analyze whether another person's reasoning is logically consistent and contains strong arguments (effortful processing), or can instead be persuaded by peripheral cues like the other person's social status or the mere quantity of arguments (effortless processing). A person's dispositional *need for cognition* (NFC) influences how much effort he or she typically uses to process information. Cacioppo and Petty (1982) define NFC as an individual's tendency to engage in and enjoy effortful cognitive processing. NFC is conceptualized as a one-dimensional trait and individual differences in NFC are conceptualized as falling along a bipolar continuum from low to high (Cacioppo, Petty, Feinstein, & Jarvis, 1996). High NFC describes a high tendency to engage in and enjoy cognitive effort whereas low NFC means a relative absence of this tendency (Cacioppo et al., 1996).

In order to measure NFC, Cacioppo and Petty (1982) developed the NFC Scale, a 34-item self-report measure in the English language that has proven to be one-dimensional, reliable, and valid in numerous studies (see Cacioppo et al., 1996). The NFC Scale has been adapted to different languages including Chinese (Kao, 1994), French (Ginet & Py, 2000), Spanish (Gutiérrez, Bajén, Sintas, & Amat, 1993), and Turkish (Gülgöz & Sadowski, 1995). For the measurement of NFC in samples of German speaking participants, Bless, Wänke, Bohner, Fellhauer, and Schwarz (1994) developed a German adaptation of the NFC Scale based on the English original. Typical items of the German NFC Scale are "I tend to set goals

that can be accomplished only by expending considerable mental effort.” or “The notion of thinking abstractly is not appealing to me.” (reverse scored).

Applying exploratory factor analysis with a sample of $N = 226$ German undergraduates, Bless et al. (1994) eliminated from an initial item pool of 46 items any items with low loadings on the dominant factor. This resulted in a 33-item scale that constitutes today's German NFC Scale. Bless et al. (1994) once again conducted the exploratory factor analysis with these 33 items using the data from the same sample and, as expected, found the scale to be one-dimensional, which is consistent with the conceptualization of NFC. However, they did not try to confirm the factor structure with another sample. Based on factor loadings, Bless et al. (1994) also developed a one-dimensional 16-item short form of the German NFC Scale (the 33 items of the long form include the 16 items of the short form). Several studies have replicated the conceptualized one-dimensional factor structure of the English NFC Scale (see Cacioppo et al., 1996). However, so far, the factor structure of the German NFC Scale has been investigated only once before, namely in Bless et al.'s scale construction sample. In addition, Bless et al. only used the scree test (Catell, 1966) for extracting the number of factors, but did not use a more objective method (e.g., the Minimum Average Partial test; Velicer, 1976). In sum, there is a fundamental lack of empirical evidence for the German NFC Scale's factorial validity.

In order to fill this gap in empirical evidence, in study 1, we examined the factor structure of the German NFC Scale in three different samples. Sample 1 consisted of German undergraduates similar to those studied in Bless et al. (1994). To increase generalizability, we also administered the scale to German school students of different school types. Sample 2 consisted of academic track students (German Gymnasium), and sample 3 consisted of vocational track students (German Realschule). For confirmation of the one-dimensional factor structure, we applied multigroup confirmatory factor analysis. We tested the fit of two

models: The first model assumed a one-dimensional factor structure for all three different samples. The second model additionally assumed that the factor loadings were equivalent for the three samples. We tested the factor structure of the long form as well as the short form of the German NFC Scale.

In addition, we investigated the test-retest reliability of the German NFC Scale. Even if studies have repeatedly found a high reliability of the scale in terms of high internal consistencies, to our knowledge, nothing is known about its test-retest reliability. Since NFC is conceptualized as a relatively stable trait (Cacioppo et al., 1996), high test-retest correlations have to be expected for the German NFC Scale. In order to examine its test-retest reliability, in study 2, we administered the German NFC Scale two times to a sample of university students and, in study 3, two times to a sample of secondary school students. We considered reliability coefficients (test-retest correlations as well as inner consistencies) $\geq .80$ as high.

Moreover, we examined the convergent and discriminant validity of the German NFC Scale (study 3). Previous findings indicate that the scale is valid in samples of university students (e.g., Bless et al., 1994). We aimed to find additional evidence that the scale is also valid in samples of school students since motivation for cognitive engagement is of high relevance in the school context. Because NFC refers to cognitive motivation and not to cognitive ability, we expected NFC to be only slightly positively related, if at all, to a measure of basic cognitive ability (see Cacioppo et al., 1996). Further, we predicted that students with a higher NFC would more likely choose to work on a cognitive effortful task rather than on a cognitive non-effortful task. Consistent with previous theoretical assumptions and empirical findings, we expected to find a high positive correlation between NFC and scientific interest (Bless et al., 1994) and a moderate negatively directed correlation between NFC and the Need for Cognitive Closure (Schlink & Walther, 2007). No substantial correlation was expected

between NFC and the Personal Need for Structure (Machunsky & Meiser, 2006). Also, we investigated how the German NFC Scale relates to the Big Five factor structure; primarily, we assumed NFC to be related to Openness to Experience. Finally, we tested whether relations found with the German NFC Scale are robust in terms of socially desirable responding.

Study 1: Factor Structure in Three Different Samples

Method

Participants. The participating university students (sample 1; $N = 559$; 80% female; $M_{\text{age}} = 21.6$, $SD_{\text{age}} = 3.7$) were undergraduates training to be future teachers enrolled in a university in Southern Germany. The participating school students of the academic track (sample 2; $N = 555$; 49% female; age about 16 years, concrete age was not assessed) were recruited from grade ten classes at academic track secondary schools (German Gymnasium) in a middle-sized town in Germany. The participating school students of the vocational track (sample 3; $N = 486$; 54% female; $M_{\text{age}} = 14.0$, $SD_{\text{age}} = 0.6$) were recruited from grade eight classes at vocational track secondary schools (German Realschule) in the surroundings of a middle-sized town in Germany. Before data analyses, we excluded up to four additional participants from each sample because there were indications of non-compliance during responding (e.g., kidding around during the test session).

Procedure. Data conduction took place during regular lectures or during regular class sessions, respectively. The participants filled out several scales (for research purposes irrelevant for the present study) and the German version of the NFC Scale (Bless et al., 1994). The NFC Scale was administered as a paper and pencil test.

Measure. We administered the German adaptation of the NFC Scale (Bless, et al., 1994) consisting of 33 items. The 33 items of the long form also included the 16-item short form. Items were answered on a 7-point scale ranging from 1 (*completely disagree*) to 7 (*completely agree*). This measure was also used in studies 2 and 3.

Results

Table 1 displays the means, standard deviations, and inner consistencies of the long form and the short form of the German NFC Scale separately for all samples presented in the present article.

We wanted to find out whether the expected one-dimensional factor structure can be observed in all three samples, i.e., in three different groups. Furthermore, it had to be investigated whether the loadings of the items on the latent factor were equivalent for all three groups. Multigroup confirmatory factor analysis provides an appropriate technique to answer these two questions. We conducted a three group (i.e., university students, school students of the academic track, school students of the vocational track)-multigroup confirmatory factor analysis (maximum likelihood method) using AMOS. In the first model, all items were assumed to load on a single latent factor and this structure was assumed to be equivalent for all three groups (full configural invariance according to Steenkamp & Baumgartner, 1998). A second model included even more constraints: In this second model, the factor loadings were assumed to be the same for the three groups (full metric invariance according to Steenkamp & Baumgartner, 1998). Given the fact that we had such a large sample size, we refrained from using the χ^2 -difference test for model comparison. If the sample sizes are large, even small differences between the χ^2 -values for the both models may result in a significant value of the χ^2 -difference test (see Cheung & Rensvold, 2002). Therefore, we assumed full metric invariance if the fit of the corresponding model was acceptable. As indices of model fit, we used SRMR and RMSEA (see Hu & Bentler, 1998). Hu and Bentler (1998) recommend a cutoff value close to .08 for the SRMR and a cutoff value close to .06 for the RMSEA.

For the long form of the German NFC Scale, the fit of the model assuming configural invariance was good, $\chi^2(1485, N = 1600) = 4332.47, p < .001, SRMR = .054, RMSEA = .035$. Thus, the configural structure can be assumed to be equal for all three groups. The fit of the

model assuming full metric invariance was good, as well, $\chi^2(1549, N = 1600) = 4507.62, p < .001$, SRMR = .060, RMSEA = .035. Thus, the loadings of the items on the latent factor can be considered to be equal for all three groups. All loadings were statistically significant.

For the short form of the German NFC Scale, there was also a good fit of the model assuming configural invariance, $\chi^2(312, N = 1600) = 1370.92, p < .001$, SRMR = .052, RMSEA = .046. Thus, the configural structure of the short form can be assumed to be equal for all three groups. In addition, the fit of the model assuming full metric invariance was good, $\chi^2(342, N = 1600) = 1434.98, p < .001$, SRMR = .059, RMSEA = .045, meaning that the loadings of the items on the latent factor can be considered to be equal for all three groups. Again, the loadings of all items differed from zero significantly.

Study 2: Test-Retest Reliability in a Sample of University Students

Method

Participants and procedure. Participants were university students enrolled in a university in Southern Germany. From $N = 43$ students (72% female; $M_{\text{age}} = 24.7, SD_{\text{age}} = 4.2$), we received NFC scores for both times of measure. Data conduction took place during regular classes. Twice the participants filled out a paper and pencil form of the German NFC Scale (Bless et al., 1994) at intervals of four weeks.

Results

Table 1 shows the inner consistencies. The test-retest correlation was $r = .87, p < .001$ for the long form consisting of all 33 items. For the 16-item short form, the test-retest correlation was $r = .83, p < .001$.

Study 3: Test-Retest Reliability and Validity in a Sample of Secondary School Students

Method

Participants and procedure. The participating school students ($N = 181$; 59% female; $M_{\text{age}} = 15.4, SD_{\text{age}} = 0.6$) were recruited from grade ten classes at academic track secondary

schools (German Gymnasium) in a middle-sized town in Germany. Two additional participants were excluded due to obvious non-compliance. All materials were administered during a regular class session. At the beginning, one aspect of the participants' elementary cognitive ability was measured. Afterwards, the students filled out a paper and pencil questionnaire containing a choice task and several scales including the German version of the NFC Scale (Bless et al., 1994). Four weeks later, $N = 157$ students answered the NFC Scale a second time (determination of test-retest-reliability).

Cognitive ability measure. We applied the numbers connecting test (Zahlen-Verbindungs-Test, Oswald & Roth, 1987) to measure cognitive ability on a basic level. According to Oswald and Roth (1987), the numbers connecting test measures cognitive processing speed, i.e., the speed component of intelligence. Consistently, several examinations revealed relations between the numbers connecting test and different intelligence measures (see Oswald & Roth, 1987). Schmidt-Atzert, Bühner and Enders (2006) recently demonstrated that the numbers connecting test loads high on a factor reflecting concentration ability. Apparently, the numbers connecting test measures a person's information processing speed, which may be partly determined by the person's cognitive ability to be focused during information processing. For the numbers connecting test, the participants were asked to connect numbers on a sheet in correct order as fast as possible. After 30 seconds they were stopped and asked to work on the next number sheet for 30 seconds. Overall, participants completed four number sheets (the sheets differ in the arrangement of numbers). For analyses, the performances in bit/sec of the four sheets were averaged.

Choice task. The students were asked to choose one of two kinds of tasks that they would want to work on when the investigator returned in a few weeks. The tasks were not

specified, but task A was described as cognitive non-effortful and rather boring whereas task B was described as cognitive effortful and interesting.

Scale measures. In addition to the German NFC Scale, the participants filled out a scale for the measure of scientific interest (Hiesel & Lück, 1974), the Need for Cognitive Closure Scale (Schlink & Walther, 2007), the Personal Need for Structure Scale (Machunsky & Meiser, 2006), the Ten-Item Personality Inventory (Muck, Hell, & Gosling, 2007) in order to measure the Big Five of Personality, and the Social Desirability Scale-17 (Stöber, 2001). For all applied scales, evidence supporting their reliability and validity exists.

Results

Reliability. See Table 1 for inner consistencies. The test-retest correlation was $r = .92$, $p < .001$, for the long form and $r = .90$, $p < .001$, for the short form.

Validity. Table 2 displays the correlations of the German NFC Scale long and short form with the validation criterions. Because NFC was correlated with social desirability, Table 1 also displays the correlations controlling for social desirability. The correlations corresponded to the predictions for the long form as well as for the short form of the German NFC Scale. NFC as a motivational variable was unrelated to a cognitive ability measure and substantially related to behavior expressing the motivation to engage in cognitive effort (i.e., choosing the cognitive effortful task). Furthermore, NFC was highly positively correlated with scientific interest, moderately negatively correlated with the need for cognitive closure, and not statistically significantly correlated with the personal need for structure. The correlations were robust in terms of social desirability; only the correlations with conscientiousness fell under the significance level after controlling for social desirability.

As can be seen in Table 1, the applied Big Five measure revealed low inner consistencies ($\alpha < .50$) for three of the personality dimensions, particularly for openness to experience. This may be due to the fact that two items only assessed each personality factor.

Nevertheless, we found the expected positive relation between NFC and openness. The correlations between NFC and the other Big Five personality factors were small.

Discussion

We investigated the psychometric properties of the German NFC Scale in five samples. Thereby we aimed to fill empirical gaps: Namely, the one-dimensional factor structure of the scale had not been confirmed and nothing was known about the test-retest reliability of the scale. Furthermore, we examined the convergent and discriminant validity of the German NFC Scale in a sample of secondary school students since the motivation to engage in cognitive effort may be an important variable in educational and instructional settings.

In study 1 we found evidence for the one-dimensional factor structure of the long and the short form of the German NFC Scale in three different samples. Not only the factor structure but also the item loadings of the long and the short form were equivalent across the three samples. Apparently, the one-dimensional factor structure applies to university students as well as to school students of the vocational track and to school students of the academic track. Our findings indicate that the factor structure of the German NFC Scale corresponds to the conceptualization of NFC and to previous findings on the original English NFC Scale (see Cacioppo et al., 1996). Thus, the German NFC Scale seems to have factorial validity.

In studies 2 and 3, we found high test-retest reliabilities in a sample of university students and a sample of school students corresponding with the conceptualization of NFC as a relatively stable trait. This finding is also important for the literature on NFC itself as Cacioppo et al. (1996) in their comprehensive review found only two studies reporting test-retest reliabilities regarding NFC (one for the English short form and another for a Dutch 6-item short form). In addition, consistent high inner consistencies in all studies reported here

suggest that the long and the short forms of the German NFC Scale are very reliable measures.

Finally, in study 3, the long form as well as the short form of the German NFC Scale proved to be valid (convergent and discriminant) in a sample of secondary school students by showing theoretically reasonable relations to validation criteria. For instance, students higher in NFC expressed higher motivation to exert cognitive effort by preferring to work on a task that was described as cognitively effortful over working on a task that was described as cognitively non-effortful. This finding on task choice can also be described to mean that students lower in NFC prefer working on a cognitively non-effortful task even if it is additionally described as boring. Of particular relevance is the finding that NFC can be distinguished from a measure of cognitive ability since NFC is conceptualized as a motivational variable rather than an ability (Cacioppo et al., 1996). The relations between NFC and scientific interest as well as other cognitive styles (need for cognitive closure, personal need for structure) in the present sample of school students correspond to findings previously found with samples of undergraduate university students (Bless et al., 1994; Machunsky & Meiser, 2006; Schlink & Walther, 2007). NFC was moderately positively related to openness to experience, suggesting that the tendency to deal with novelty requires some motivation to engage in cognitive effort. The relations between NFC and the other Big Five personality factors were small, indicating that NFC can be distinguished from these personality variables. However, given the somewhat small inner consistencies of the applied Big Five measure, it may be appropriate to address the relation of NFC to personality in school student samples again in future research. The long and the short forms of the German NFC Scale were positively related to social desirability. Therefore, we additionally examined the relations between NFC and the validation criteria statistically controlling for social desirability. Since these analyses revealed relations similar to the relations without controlling

for social desirability, we assume that relations between the German NFC Scale and other measures can usually be interpreted independently from socially desirable responding.

Taken together, the German NFC Scale appears to be a one-dimensional, reliable, and valid measure of joy and engagement in effortful thinking, and seems to be applicable in samples of university students as well as in samples of school students. As the short form showed to be comparable to the long form in terms of factor structure, reliability, and validity, both forms equally seem to be useful to measure NFC. According to our results, the costs for reliability and validity when favoring the shorter, and thus faster, measure over the longer one seem to be low. Given the fact that the short form contains only half as many items as the long form, we would recommend applying the short form of the German NFC Scale in order to save time during data collection for both the experimenter and the participants. However, to be accurate, so far we have only examined which psychometric properties apply to the short form if it is embedded in the long form. So, one direction for future research may be to test the psychometric properties of the short form of the German NFC Scale separated from the long form. Future research could also examine the applicability of the German NFC Scale in further populations (e.g., the elderly).

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Table 1

Descriptive Statistics for the Long and the Short Form of the German NFC Scale (Studies 1 to 3)

	<i>M (SD)</i>		Cronbach's alpha	
	NFCS (long)	NFCS (short)	NFCS (long)	NFCS (short)
Study 1, sample 1	4.41 (0.77)	4.41 (0.88)	.90	.86
Study 1, sample 2	4.35 (0.74)	4.37 (0.87)	.89	.85
Study 1, sample 3	4.01 (0.69)	4.02 (0.86)	.86	.81
Study 2 (t1)	5.00 (0.73)	4.86 (0.87)	.92	.87
Study 2 (t2)	4.96 (0.69)	4.95 (0.80)	.92	.87
Study 3 (t1)	4.46 (0.85)	4.44 (1.00)	.89	.85
Study 3 (t2)	4.36 (0.89)	4.37 (1.01)	.93	.89

Note. NFCS = Need for Cognition Scale. t1 = first time of measure. t2 = second time of measure.

Table 2

Correlations Between the German NFC Scale (Long Form, Short Form, and Excluding Short Form Items, T1) and Validity Criteria (Study 3)

	α	NFCS (long)	NFCS (short)	NFCS (excl. SF)	Controlling for social desirability		
					NFCS (long)	NFCS (short)	NFCS (excl. SF)
Number connecting test	.91	.01	.04	-.03	.08	.12	.02
Choice task ^a	-	.42***	.41***	.38***	.40***	.38***	.37***
Scientific interest	.79	.69***	.61***	.69***	.67***	.58***	.68***
Need for cognitive closure	.72	-.45***	-.39***	-.46***	-.44***	-.37***	-.47***
Personal need for structure	.79	-.10	-.09	-.11	-.12	-.10	-.13
Big Five-extraversion	.47	.22**	.21**	.20**	.26***	.26***	.22**
Big Five-agreeableness	.35	-.05	.02	-.12	-.19*	-.12	-.18*
Big Five-conscientiousness	.72	.20**	.23**	.15	.12	.14	.10
Big Five-emotional stability	.55	.06	.07	.05	.09	.10	.09
Big Five-openness	.35	.44***	.41***	.41***	.42***	.39***	.41***
Social desirability	.73	.29***	.31***	.22**	-	-	-
Gender ^b	-	.03	-.03	.09	.06	.00	.15
Age	-	-.14	-.14	-.11	-.08	-.08	-.03

Note. NFCS = German Need for Cognition Scale. NFCS (excl. SF) = NFCS excluding the items of the NFCS short form ($\alpha = .76$).

^aCoding: 1 = task A (cognitive non-effortful and boring), 2 = task B (cognitive effortful and interesting). ^bCoding: 1 = female, 2 = male.

* $p < .05$. ** $p < .01$. *** $p < .001$.

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