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Research Article – Extended

A Question of Method and Subjective Beliefs

The Association of Need for Cognition With Self-Control

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Abstract: Need for Cognition (NFC) describes the relatively stable intrinsic motivation to engage in cognitive endeavors. Recent research has revealed the importance of NFC for affective adjustment, especially in combination with self-control. We followed up on those findings by addressing methodological issues as well as processes that may underlie relations of NFC to self-control. Study 1 ($N = 102$) examined whether NFC is associated with self-control independently of the measure or facet considered. Implicit willpower theories, that is, subjective beliefs concerning the limitation of self-control resources, were examined as a mediator for NFC predicting self-control. Higher NFC was associated with increased trait self-control but also with believing in unlimited self-control resources. The relation of NFC to willpower theories also mediated the prediction of trait self-control. Study 2 ($N = 188$) replicated relations of NFC to self-control. We further pursued the explanatory approach from Study 1 and experimentally manipulated willpower theories to provide insight into their association with NFC. Willpower theories were related to NFC but had no mediating role in predicting self-control. The experimental manipulation had no impact on situation-specific NFC. Altogether, both studies provided first evidence that relations of NFC to self-control depend on the self-control measure and that willpower theories may be crucial for explaining the association with self-control.

Keywords: Need for Cognition, self-control, self-regulation, implicit theories of willpower

The personality trait *Need for Cognition* (*NFC*) describes "individual differences in people's tendency to engage in and enjoy thinking" (Cacioppo & Petty, 1982, p. 130). Earlier research on NFC focused on its relations to information processing (Cacioppo & Petty, 1984; Cacioppo et al., 1996). Based on the Elaboration Likelihood Model, past research has provided evidence for associations with interindividual differences in the elaboration of information and with approaching vs. avoiding cognitive effort (Cacioppo & Petty, 1984; Cacioppo et al., 1996). Higher NFC can be beneficial in different contexts: It parallels higher achievement in academic contexts (e.g., Grass et al., 2017; von Stumm & Ackerman, 2013), probably mainly because it is associated with unfolding individual cognitive potential (e.g., Strobel et al., 2019). Furthermore, it could be shown that higher NFC is related to subjective well-being, including positive/negative affect (e.g., Fleischhauer et al., 2010; Strobel et al., 2017) and life satisfaction (e.g., Coutinho & Woolery, 2004; Grass et al., 2017, 2018), as well as to more effective coping with emotionally demanding situations (e.g., Bye & Pushkar, 2009).

Whereas NFC can be considered a well-established construct with regard to specific cognitive and academic outcome variables, research on relations to other constructs that also tap into the recruitment of cognitive resources is still sparse. Therefore, more nomological knowledge on NFC would improve the understanding of processes leading to its predictive value for the abovementioned outcomes. Self-control can be seen as a promising variable in this context. Research, including NFC and self-control, has found positive associations between these variables (e.g., Bertrams & Dickhäuser, 2012b; Nishiguchi et al., 2016). In a recent line of research, self-control and NFC were examined together to clarify their bivariate association and/or their interplay concerning subjective well-being and affective adjustment (e.g., Bertrams & Dickhäuser, 2012a, 2012b; Fleischhauer et al., 2019; Grass et al., 2018; Nishiguchi et al., 2016). These studies again have demonstrated a positive association of NFC with self-control. They also provided evidence that self-control can be considered a mediating variable for predicting affective outcomes by NFC. Hence, increased self-control mediated the association of increased NFC with less depressive mood (Bertrams & Dickhäuser, 2012b; Nishiguchi et al., 2016) and, in part, with reduced Burnout criteria (Grass et al., 2018). Whereas some studies on NFC and self-control examined their

interplay for predicting (affective) outcomes, others aimed at clarifying when and why NFC is associated with self-control or cognitive effort. Some of them followed the idea that higher levels of NFC and self-control share the commonality of an increased allocation of (cognitive) resources (Grass et al., 2019; Kramer et al., 2021; Mussel et al., 2016; Sandra & Otto, 2018; Westbrook et al., 2013). Hence, they assume that neither higher NFC nor higher self-control mainly depends on differences in underlying resources themselves but on interindividual differences in how individuals *use* resources.

In the context of self-control, research on implicit theories about willpower is an approach that also follows the idea of motivational processes of resource allocation that have implications for self-control (e.g., Job et al., 2010). It suggests that individuals differ in the extent to which they believe in self-control resources being (un-)limited. Previous research has shown reduced self-control when people tend to believe in limited self-control resources (Job et al., 2010). Though this could be a promising link, potential relations to NFC have not been examined yet.

In this background, in our two studies reported here, we aimed to extend the knowledge about relations of NFC to self-control. Specifically, we were interested in the following main research questions: Our first research question was whether the association of NFC with self-control can be replicated over different operationalizations of self-control. Second, we examined the role of implicit theories in the relation of NFC to self-control. Finally, and especially in Study 2, we considered whether the relations change when examining a situation-specific compared to a trait perspective.

Need for Cognition

Concerning its relation to other personality traits, NFC is conceptually close to the Big-Five facet Openness to Ideas and small to moderately associated with traits referring to goal orientation, emotional stability, and behavioral activation (Fleischhauer et al., 2010). NFC is clearly distinguishable from intelligence (Fleischhauer et al., 2010; von Stumm & Ackerman, 2013). It is rather associated with the way "when, where, and how people invest their time and effort in their intellect" (von Stumm & Ackerman, 2013, p. 841). Individuals with higher NFC levels process information more elaborated and consider more diverse sources of information as well as the quality of arguments to make decisions (for an overview, see Cacioppo et al., 1996). NFC is further positively associated with traits indicating goal orientation (Fleischhauer et al., 2010) and with interindividual differences in enjoying and engaging in cognitively demanding tasks (Cacioppo & Petty, 1982). Higher

levels of NFC are associated with less intrinsic costs and reduced avoidance of cognitive effort (Sandra & Otto, 2018; Westbrook et al., 2013). Furthermore, NFC is related to the recruitment of resources in response to cognitive demands on a neural level (Mussel et al., 2016).

Self-Control

Different approaches to self-control define it as the capacity that enables to override impulses to reach long-term or rather abstract goals (Duckworth & Kern, 2011; Fujita, 2011; Tangney et al., 2004). Furthermore, different theories of self-control characterize the initial point for exerting self-control by a dual-motive conflict (Fujita, 2011). One popular approach to explaining self-control is the strength model, which proposes an underlying resource that has to recover immediately after having practiced self-control once (also known as the ego-depletion effect; Baumeister, 2002). Critical views on the strength model and evidence against a limited self-control resource (e.g., Carter et al., 2015; Lurquin et al., 2016) have led to additional explanations for individual success or failure in self-control (for an overview e.g., Inzlicht & Berkman, 2015). By now, reviews have pointed out that exerting self-control relies on manifold processes like identifying a self-control-relevant conflict and being motivated to control (Inzlicht et al., 2014; Kotabe & Hofmann, 2015).

The initial conflict can also be seen as a tradeoff between cognitive labor and leisure (Kool & Botvinick, 2014) in that individuals aim at minimizing cognitive effort, avoiding cognitive demands, and exerting self-control based on individual (dis-)utility considerations (e.g., Kool & Botvinick, 2014; Kool et al., 2010, 2013). That idea complements other approaches that outline the role of motivational processes for successful self-control, especially immediately after an initial self-control task (e.g., Baumeister, 2014; Inzlicht et al., 2014).

Linking Need for Cognition to Self-Control

Studies examining the relation of NFC to self-control provided evidence for a positive association of about $r = .30$ (Bertrams & Dickhäuser, 2009a, 2012a, 2012b; Grass et al., 2018, 2019; Nishiguchi et al., 2016; Sandra & Otto, 2018). While first research on NFC and self-control also referred to the idea that effortful information processing associated with NFC strengthens self-control resources (Bertrams & Dickhäuser, 2012a, 2012b), process-oriented models suggest alternative lines of reasoning for an association of NFC with self-control. With increasing NFC, individuals should be more aware of abstract long-term goals

(e.g., Fleischhauer et al., 2010 for r = .30 with trait persistence), which is crucial to recognize and solve a behavioral conflict between a current temptation and a long-term goal in a given situation (Kotabe & Hofmann, 2015). Having formed a control intention, successful self-control depends on the following effort to implement control intentions (e.g., Kool & Botvinick, 2014; Kotabe & Hofmann, 2015). Again, higher NFC levels can be assumed advantageous because they are related to increased motivation for (Cacioppo & Petty, 1982; Kramer et al., 2021; Sandra & Otto, 2018; Westbrook et al., 2013) as well as actual recruitment of resources in response to higher cognitive demands (Cacioppo & Petty, 1982; Mussel et al., 2016).

The Role of Implicit Theories About Willpower

A promising social-psychological approach to self-control that relates to (motivation for) resource allocation deals with implicit theories about willpower (e.g., Job et al., 2010), which are also likely to correlate with NFC. Willpower theories describe subjective beliefs of individuals concerning the limitation of self-control resources so that "some people may think that self-control is a limited resource as described in the strength model" (Job et al., 2010, p. 1687) and others rather tend to believe in an unlimited-resource theory. Previous research provided evidence that such implicit theories explain differences in self-control depletion after demanding tasks and their association with self-regulation in different settings (e.g., Job et al., 2010, 2015).

For relations with NFC and their additive role in the prediction of self-control reciprocal directions can be assumed: Individuals with higher NFC levels are more likely to experience that they are not exhausted after mental engagement and may develop an unlimited-resource theory. Similarly, individuals with lower NFC levels tend to save cognitive resources and therefore should not be able to collect evidence for unlimited resources, which could contribute to developing a limited-resource theory. Hence, enhanced motivation for self-control with higher NFC levels may (partly) result from a stronger belief in unlimited cognitive resources. Vice versa, higher NFC levels could result from expectations concerning unlimited resources: If an individual is convinced that mental effort does not lead to states of exhaustion, they should tend to perceive the mental effort as less costly and thereby increasingly engage in effortful mental processing. Hence, NFC could mediate associations of willpower theories and self-control by enhancing the motivational effect on the willingness to recruit resources (e.g., Kramer et al., 2021) and by actually increasing resource allocation (Mussel et al., 2016).

Research Aims and Hypotheses

Need for Cognition and Self-Control

Previous studies that reported an association of NFC with self-control mostly assessed self-control by self-report (Bertrams & Dickhäuser, 2009a, 2012b; Grass et al., 2018, 2019; Nishiguchi et al., 2016). Behavioral tasks were limited to inhibition tasks (Bertrams & Dickhäuser, 2012a; Sandra & Otto, 2018), although they do not cover self-control in its complexity and run the risk of mixing up target behavior with a possible means to an end (Fujita, 2011). In general, it is known that different operationalizations assess different aspects of self-control (Allom et al., 2016; Dang et al., 2020; de Ridder et al., 2012; Duckworth & Kern, 2011) and empirical results depend on the appropriate operationalization of self-control (Strobel et al., 2020). Hence, sound conclusions on the relation of NFC to self-control need conceptual replications (see Fabrigar & Wegener, 2016) by using multiple methodological approaches and assessment methods, respectively.

At this background, we hypothesized (1) that there will be positive associations of NFC with different measures of self-control. As an additional research question, we (2) aimed to test whether the association between NFC and self-control remains stable independently of the operationalization of self-control. To this end, we first varied the operationalization referring to the context of self-control behavior and considered self-reported trait self-control as well as domain-specific *Academic Delay of Gratification* (i.e., to postpone immediate gratification to achieve distant academic goals; Bembenutty & Karabenick, 1998). Second, we varied the method and used an experimental behavioral measure additionally to self-report, which assesses individual Delay Discounting in a computer-based task. The task reflects the idea of a conflict between distal and proximate options as the starting point of self-control behavior (Berns et al., 2007; Fujita, 2011). Because no previous studies with a similar comparative approach exist, we examined that research question without having explicit hypotheses.

Willpower Theories

Our two studies should further contribute to understand why self-control and NFC may be associated. As outlined above, there are different theoretical assumptions about why NFC and self-control should be associated and what steps preceding self-control may be affected by different NFC levels. While the reasoning referring to the so-called strength model (Baumeister, 2002) of self-control (Bertrams & Dickhäuser, 2012a) is difficult to falsify/verify and part of a controversial debate (e.g., Inzlicht & Berkman, 2015), attempts of explicitly testing other underlying processes are quite rare (Grass et al., 2019; Sandra & Otto, 2018).

Implicit theories about willpower may play a role in the association of NFC with self-control, which has not been examined yet. As explained above, we (3) assumed a positive association of NFC with unlimited-resource theories.

Furthermore, we aimed to clarify the role of implicit willpower theories in the process of predicting self-control by NFC. Study 1 examined the assumption of (4) NFC predicting self-control partly through willpower theories. That hypothesis follows the idea that NFC as a personality trait is more stable and less malleable than implicit theories (Cacioppo & Petty, 1982; Cacioppo et al., 1996), and those willpower theories may be, among others, formed by experiences dependent on NFC levels (see section The Role of Implicit Theories About Willpower). Although little is known about the development and malleability of NFC (von Stumm & Ackerman, 2013), in Study 2, we (5) aimed to test the reciprocal path of NFC mediating the prediction of self-control by willpower theories. We used an experimental manipulation of willpower theories and a situation-specific perspective on NFC to examine whether (manipulated) implicit theories influence situation-specific NFC and thus, whether NFC may also have a mediating role for predicting self-control. Taken together, we tested the path with NFC predicting self-control via willpower theories in Study 1 and 2, and we additionally tested the contrary path with NFC as mediating variable by using an experimental approach to manipulate willpower theories in Study 2. We expected to find evidence for both mediating paths.

Study 1

Material and Methods

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study. Raw data are uploaded in Grass and colleagues (2020).

Procedure

The procedure of Study 1 was evaluated by the local Ethics committee (V-157-BM-AS-Kognition-20102016). It was not considered to require further ethical approval and hence, as uncritical concerning ethical aspects according to the criteria used by the local Ethics committee. Study 1 consisted of two parts: The first part (T1) was an online survey implemented with EFS Survey (version: EFS Fall 2016; QuestBack GmbH, 2016/2018), and the second part (T2) was a laboratory session for the computer-based assessment of self-control.

Participants gave informed consent at the beginning of T1 before answering all self-report measures. At the end

of the online survey at T1, they were asked to take part in the laboratory session (T2). To match both study parts and for compensation, participants created an individual code after agreeing to take part in the laboratory session. At the beginning of T2, NFC and implicit theories were assessed again. After a 5-minute break, Delay Discounting was measured. As control variables, task-related enjoyment, the motivation to work on the task, and task engagement were subsequently assessed via self-report on a 5-point rating scale, respectively. Two additional tests followed that assessed intelligence (Baudson & Preckel, 2016) and concentration (Brickenkamp et al., 2010). Their results were out of the scope of the current article. At the end of T2, additional control variables were assessed. Then, participants were comprehensively informed about the study aims. They could leave their e-mail address to get further information about the study results. As compensation, we provided course credits and the chance to win 10 € (three participants) and 20 € (one participant). At T2, not more than four individuals were tested simultaneously to reduce disturbing influences.

Sample

Participants were recruited via mailing lists and advertisements on the campus of the Chemnitz University of Technology, Germany, social networks, and personal contacts. One hundred four people gave informed consent and started the online survey at T1; 103 completed it. We suspected one person of having taken part twice because the participation code, gender, and age were the same. Hence, we excluded the second participation. The final online sample of T1 consisted of 102 participants (73% female, 27% male; age: $M \pm SD$ = 22.04 ± 3.17 years, range = 18–34 years). Most participants studied Psychology (67.6%) or a closely related subject (26.5%). At T2, 85 of the 102 individuals participated in the laboratory session. One participant was excluded because they chose the farther option consistently in all trials of the discounting paradigm leading to no intraindividual variance, resulting in a sample size of 84 for T2 (63 female; age: $M \pm SD$ = 21.81 ± 2.95 years, range = 18–33 years).

Measures

Except for NFC, internal consistencies are displayed in Table 1.

Need for Cognition

NFC was assessed with the German 16-item short scale (Bless et al., 1994). Responses to items (e.g., not enjoying thinking, recoded) were recorded on a 7-point rating scale from −3 (= *completely disagree*) to +3 (= *completely agree*) and summed. Cronbach's α (T1/T2) was .81 and .83, respectively. In the laboratory session, one item value was

missing for one participant and substituted by the mean of all remaining items. Test-retest reliability of the NFC scale was $r_{s,t1t2}$ = .83.

Willpower Theories

Implicit theories about willpower were measured with a German 12-item questionnaire (V. Job, personal communication, August 15th, 2016) based on Job and colleagues (2010). Six items each refer to strenuous mental activity (e.g., feeling energized for challenging activities after strenuous mental activity, reversed) and resisting temptations (e.g., becoming better at facing upcoming temptations after resisting temptations). Answers were recorded on a 6-point rating scale from 1 = *strongly disagree* to 6 = *strongly agree* and averaged. Higher values indicated stronger agreement with a limited-resource theory. Test-retest-reliability of the (sub)scales ranged from $r_{s,t1t2}$ = .70 to .79.

Trait Self-Control

Trait self-control was assessed with a German 13-item questionnaire referring to the capacity to exert long-term oriented behavior (Bertrams & Dickhäuser, 2009b). Items (e.g., ability to work effectively toward long-term goals) were rated on a 5-point scale from 1 = *completely disagree* to 5 = *completely agree*. Ratings were averaged.

Academic Delay of Gratification

We assessed Academic Delay of Gratification with five German items (Dörrenbächer & Perels, 2015). Each item consisted of two behavioral alternatives (e.g., A: spending time with friends before an exam or B: learning daily for the exam and reducing time with friends) and had to be rated by 1 = *definitely choose A*, 2 = *probably choose A*, 3 = *probably choose B*, or 4 = *definitely choose B*. Ratings were averaged.

Delay Discounting

Delay Discounting was assessed via a choice computer game (for a more detailed description of the paradigm and derived coefficients, see Scherbaum et al., 2013). A short exercise trial allowed them to get familiar with the virtual environment before participants played the game for three blocks of eight minutes. Participants controlled an avatar, moving it around in a virtual world to collect coins of different sizes (see Figure 1 for a screenshot of the computer game). They moved the avatar within a 20 × 20 virtual field by clicking on a field next to the avatar. The task was to collect as much reward as possible: In each trial, participants had to choose between a nearer smaller option and a larger option at a farther distance. Hence, the nearer option could be reached sooner, and the farther option could be reached later. Therefore, we will refer to the options as *soon small* (SS) and *late large* (LL) as they are common in delay discounting paradigms.

Coin sizes represented different values ranging from 0.01 to 0.1 cent. The relations within SS/LL-pairs varied between 1/10, 2/9, 3/8, 4/7, and 5/6. Distances ranged from 1 to 14 fields: Nearer options were at a distance of 1, 3, or 7 fields and the additional intervals to the farther option were 1, 2, 4, or 7 fields. Reward values, smaller distance, and interval to the larger distance were varied orthogonally with randomized trial order. Immediately after collecting a reward, participants could see the remaining time of the respective block above and their current reward sum below the avatar. We derived two indices from participants' choice behavior: The log-transformed k-value indicates individual discounting, with higher k-values representing stronger discounting of a reward depending on its spatial distance. The ratio of LL-choices (ratio$_{LL}$) assesses time preferences related to self-control. A higher ratio$_{LL}$ indicates a stronger LL preference. Hence, both indices reflect subjective delay costs and illustrate in different ways to what extent individuals tend to self-control and long-term oriented behavior. To further assess the optimality of decisions, individually optimal options were calculated per trial, and the ratio of advantageous choices (choice$_{Adv}$) was computed as the individual probability to choose LL if it was the optimal choice (cf. Scherbaum et al., 2013). This measure was thought to complement the other two indices by rather referring to the quality of decisions than to self-control in the sense of preferring long-term gratification.

Further Variables

We assessed demographics (age, gender, study subject, semester, and current grade point average), disturbing influences, and honesty of responses. For validation purposes out of scope, an NFC questionnaire for elementary schoolchildren was administered. Furthermore, alcohol and cigarette consumption were assessed with two screenings as part of a doctoral thesis (Grass, 2018). More information referring to the screenings is provided in the Electronic Supplementary Material 1 (ESM 1). At T2, we asked for individual motivation and effort in playing the game, concentration and relaxation during the session, previous participation in comparable studies, and compliance with instructions.

Data Analysis

Data were analyzed with IBM SPSS Statistics (versions 24, 25). To test univariate normal distribution, we considered Kolmogorov-Smirnov tests (p > .05), histograms, and PP-Plots. The results suggested that some questionnaires deviated from normality, so correlations were estimated as Spearman rank correlations. For multiple comparisons, Bonferroni-corrected α was calculated. An a priori power analysis (G*Power version 3.1; Faul et al., 2007) based on previous results (Bertrams & Dickhäuser, 2009a, 2012a, 2012b) suggested a required sample size of N = 84 to detect
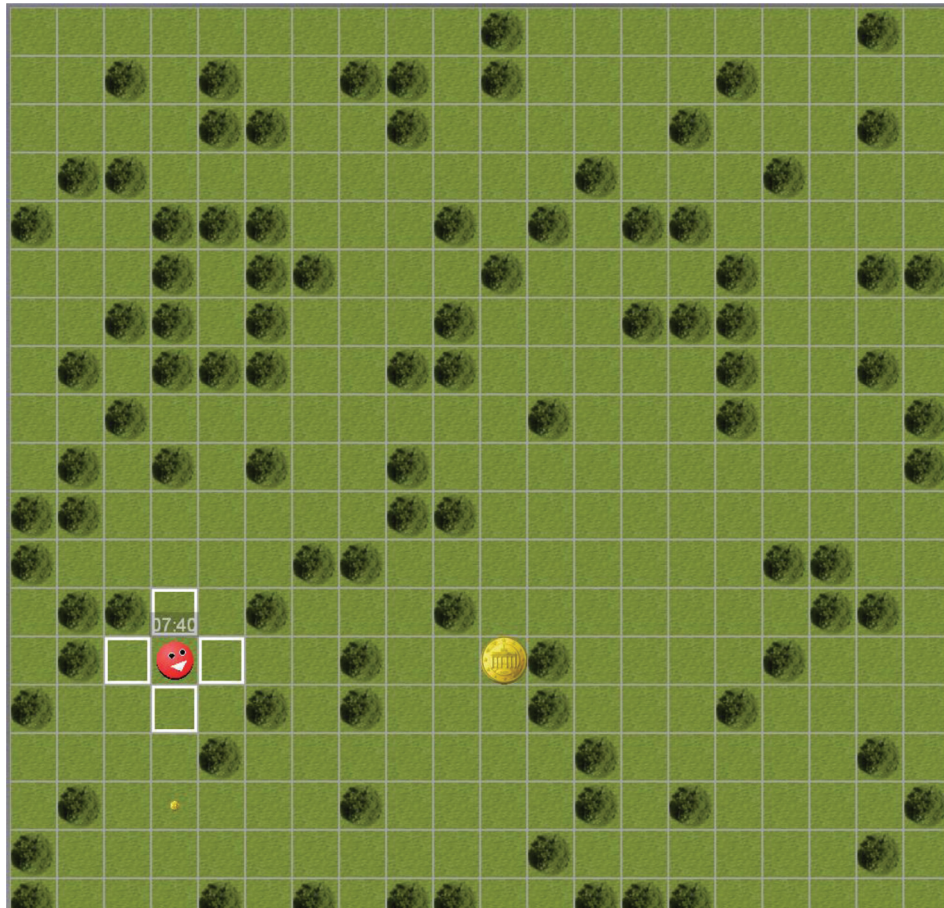
Figure 1. Screenshot of the Delay-Discounting paradigm. Participants had to decide which reward (coin) they want to collect with the red avatar. Coin size represented the reward value. Remaining time was displayed above the avatar. White fields: Fields the avatar can be moved to by clicking on it with the computer mouse.

Table 1. Correlations with NFC and descriptive statistics of self-control related measures

	Online sample				
	Willpower theories[a]			Self-control	
	General	Mental activity	Resisting temptations	Trait self-control	Academic DoG
NFC[c]	**−.60**	**−.39**	**−.52**	**.38**	.11
M	3.60	4.13	3.08	3.07	2.92
SD	0.63	0.76	0.84	0.60	0.57
Range	1.92 to 5.00	2.00 to 5.83	1.00 to 5.00	1.85 to 4.54	1.40 to 4.00
Cronbach's α	.83	.86	.83	.82	.68
	Laboratory sample[b]				
	Willpower theories[a]			Delay discounting	
	General	Mental activity	Resisting temptations	k-value$_{log}$	Ratio$_{LL}$	Choice$_{Adv.}$
NFC[d]	**−.38**	**−.32**	−.28*	0.07	−.06	−.02
M	3.57	4.14	3.00	−1.92	.76	.77
SD	0.61	0.72	0.81	0.63	.12	.04
Range	2.08 to 4.92	2.00 to 5.83	1.00 to 4.67	−3.29 to −0.27	.64 to .87	.42 to .96
Cronbach's α	.83	.86	.80	_[e]	_[e]	_[e]

Note. N = 102. Spearman rank correlations. NFC = Need for Cognition; ADoG = Academic Delay of Gratification; k-value$_{log}$ = discount rate, higher values indicate stronger discounting. Ratio$_{LL}$ = percentage of choices of the later-larger (LL) option, higher values indicate a stronger LL-preference; Choice$_{Adv}$ = ratio of advantageous choices. [a]Higher values = limited-resource theory. [b]n = 84. [c]M = 15.50, SD = 10.82; [d]M = 15.73, SD = 10.68. [e]Internal consistency no appropriate reliability measure. *$p < .05$; **$p < .01$; Bold = $p < .005$ (Bonferroni-corrected significance: .05/11). All two-tailed.

correlations of $r \geq .30$ ($\alpha = .05$, $1 - \beta = .80$, two-tailed testing). Mediation analyses were calculated with PROCESS (version 3.2; Hayes, 2018) when NFC was associated with a self-control measure. Because NFC correlated with age ($r_{s,T1/T2} = .22/.20$, $p = .023/.061$) and gender ($r_{pb,T1/T2} = .21/.12$, $p = .036/.262$), mediation analyses were run controlling for age and gender. Significant effects were indicated by 95% confidence intervals based on 5,000 bootstrap samples that excluded zero. Effect sizes of correlations were interpreted following the recommendations by Gignac and Szodorai (2016).

Results

Descriptives and Intercorrelations

All participants indicated honesty and compliance with instructions. Concerning the computer game, all participants stated they had made a great effort ($MD = 5$ with $5 = made\ a\ great\ effort$) and that they enjoyed the computer game more ($MD = 3.50$) than computer experiments on average ($MD = 3.00$; asymptotic Wilcoxon-Test: $z = -3.132$, $p = .002$). Table 1 provides the descriptive statistics of all measures; Tables 1 and 2 display intercorrelations of NFC and self-control related measures.

NFC was moderately associated with trait self-control ($r_s = .38$, $p < .0005$). Other self-control measures did not correlate with NFC (all ps > .05). NFC and general willpower theories were strongly associated in that higher NFC was associated with an unlimited-resource theory ($r_{s\ T1/T2} = -.60/-.38$, $p < .0005$). That is, with increasing NFC, individuals tended to report believing in unlimited resources. Subdimensions of willpower theories (mental activity, resisting temptations) intercorrelated moderately ($r_s = .20/.30$, $p = .039/.006$). They did not differ in their associations with NFC ($z_{T1/T2} = -1.16/-0.28$, $p = .124/.390$). Higher trait self-control was associated with higher Academic Delay of Gratification ($r_s = .29$, $p = .003$), albeit not significant at the Bonferroni-corrected level, and with an unlimited-resource theory ($r_s = -.43$, $p < .0009$).

Indirect Effects

We tested willpower theories as mediating variable for the association of NFC with trait self-control. Results for the T1 sample are displayed in Table 3, including power analyses (Schoemann et al., 2017). General willpower theories completely mediated the prediction of trait self-control by NFC.

For exploratory purposes, we additionally examined subdimensions of implicit theories as parallel mediating variables. The mediation analysis identified implicit theories regarding resisting temptations as a significant mediator variable. However, the difference between the indirect effects through both subdimensions ($-.115$ [$-.258$, .027]) was not significant.

Discussion

Need for Cognition and Self-Control

The first aim of Study 1 was to test whether the association of NFC with self-control remains stable across different operationalizations of self-control. Study 1 replicated the finding of a correlation of NFC with trait self-control of about $r = .3$. Rather, specific or behavior-oriented measures were not related to NFC; that is, we found no association of NFC with Delay Discounting or Academic Delay of Gratification. In light of our results and in line with the idea that the strength of associations could depend on the operationalization (e.g., Strobel et al., 2020), the association of NFC and self-control depends on the kind of self-control measure and could only be found for self-reported dispositional self-control uniting various behaviors across situations.

Contrarily to our hypothesis, the strength of association did not only vary depending on the operationalization but did nearly not exist for Delay Discounting and Academic Delay of Gratification. For Academic Delay of Gratification, the average score was relatively high (about 3 on the theoretical range from 1 to 4), indicating high average self-control in academic settings in our sample. Hence, the small association with NFC ($r_s = .11$) may have resulted from ceiling effects. The relatively low reliability of the 5-item measure ($\alpha = .68$) could be another methodological explanation.

Willpower Theories

The second aim of Study 1, was to examine willpower theories as a potential mediating variable behind the relation of NFC to self-control. Consistent with our hypothesis, higher NFC was associated with an individual tendency to think about one's own resources as unlimited. Furthermore, we found first (though only cross-sectional) evidence that willpower theories indeed contribute to the prediction of self-control by NFC as mediating variable.

Study 2

In Study 1, we examined the relation between NFC and self-control and added to the existing literature in that we used different operationalizations to cover different facets of self-control. We could confirm previous findings of an association of NFC with self-reported trait self-control but found no relations with other self-control measures. Furthermore, in Study 1, we elaborated on the understanding of relations between NFC and self-control and considered willpower theories as mediating variables for the prediction of trait self-control. We could confirm NFC is a mediator in the relation of willpower theories to self-control.

Table 2. Intercorrelations of measures related to self-control

		1	2	3	4	5	6	7	8	9	10
T1 Online	1. General WP[a]	–									
	2. WP: Mental activity[a]	**.74**	–								
	3. WP: Temptations[a]	**.78**	.20*	–							
	4. Trait self-control	−**.43**	−.29**	−**.40**	–						
	5. ADoG	−.17	−.08	−.16	.29**	–					
T2 Laboratory	6. General WP[a]	**.79**	**.59**	**.56**	−**.36****	−.17	–				
	7. WP: Mental activity[a]	**.66**	**.77**	.19	−.33**	−.03	**.74**	–			
	8. WP: Temptations[a]	**.61**	.25**	**.70**	−.29**	−.17	**.84**	.30**	–		
	Delay discounting										
	9. k-value$_{log}$	.04	.14	−.05	.15	−.00	−.02	−.11	−.12	–	
	10. Ratio$_{LL}$	−.05	−.14	.03	−.13	.02	.02	−.11	.11	−**.99**	–
	11. Choice$_{Adv.}$	.03	.05	−.01	−.10	.04	−.04	.03	−.06	.17*	−.13

Note. N = 102. Spearman rank correlations. WP = Willpower theories; ADoG = Academic Delay of Gratification; k-value$_{log}$ = discount rate, higher values indicate stronger discounting; Ratio$_{LL}$ = percentage of choices of the later-larger option, (LL) higher values indicate a stronger LL-preference; Choice$_{Adv}$ = ratio of advantageous choices. [a]Higher values = limited-resource theory. [b]n = 84. For correlations between measures of both sessions n = 83 because one code of T2 not be matched to T1. *p < .05; **p < .01. Bold = p < .0009 (Bonferroni-corrected significance: .05/55). All two-tailed.

Table 3. Indirect effects of Need for Cognition on trait self-control through willpower theories

		Indirect effect	
Mediator	Direct effect (unstandardized)	Unstandardized	Completely standardized
General willpower theory[a]	−.011 [−.001, .023]	−.012 [.005, .020]*	.224 [.096 .363]*
Mental activity[b]	.010 [−.002, .022]	.003 [−.001, .008]	.059 [−.012, .141]
Temptations[b]	.010 [−.002, .022]	.010 [.003, .027]*	.174 [.062, .297]*

Note. N = 102. Total effect (unstandardized) was .023 [.013, .034]. 95% BCa confidence intervals based on 5,000 bootstrap samples. Control variables = age, gender. [a]Achieved power for that mediation analysis was .82. [b]Mediation analysis with subdimensions of willpower theories = parallel multiple mediator analysis. No significant difference in indirect effects. Achieved power was .43 for mental activity and .75 for temptations as mediators. *Confidence intervals excluding zero.

Based on the results of Study 1, we focused on self-report measures and again examined the association of NFC with self-control assuming a positive association similar to Study 1. Additionally, we again considered willpower theories in order to replicate the findings of Study 1. Consequently, we assumed an unlimited resource theory to be associated with higher NFC and higher self-control.

In addition to Study 1, we examined in Study 2 two theoretically derived paths for predicting self-control by NFC and willpower theories with two measurement occasions: (1) NFC predicting self-control mediated through willpower theories with focusing on those variables at trait-like level and (2) willpower theories in a concrete situation predicting state self-control mediated trough NFC as perceived by the participants in a concrete situation. The first path corresponds to the one we tested in Study 1. NFC was treated as an independent variable due to its stable conceptualization, and implicit theories were treated as mediating variables because of knowledge about their malleability and closer reference to self-control (e.g., Job et al., 2010). However, we assumed that the reciprocal path could additionally exist because, from a developmental perspective, assuming cognitive resources as unlimited should lead to less subjective costs of mental effort, promoting higher NFC levels. To separately test this second path, we applied an experimental manipulation at T2 in order to test the reciprocal path with willpower theories as predictor and NFC as mediating variable for the prediction of self-control. To this end, we experimentally manipulated beliefs concerning willpower and tested whether that manipulation influences how much effort individuals put into cognitive tasks (i.e., NFC) and whether that process predicts self-control in a concrete situation.

Altogether, higher NFC was assumed to predict rather believing in unlimited resources because individuals experience being able to put a lot of effort into cognitive tasks and may develop rather unlimited resource theories over time. Additionally, inducing beliefs in (un-)limited willpower resources could influence cognitive engagement in (self-control) tasks because individuals tend to adapt their resource allocation depending on whether they believe they have to save resources. Hence, we assumed to find evidence for both mediation models to predict self-control by including NFC and willpower theories as correlated predictors.

Material and Methods

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study. Raw data are uploaded in Grass and colleagues (2020).

Procedure

Similar to Study 1, the procedure was evaluated by the local Ethics committee (V-275-15-JG-NFC-Willen-13062018) and was not considered to require further ethical approval. Study 2 consisted of two measurement occasions and was completely conducted online (version: EFS Spring 2018; QuestBack GmbH, 2016/2018). At the beginning of part 1 (T1), participants gave their informed consent for participation. First, they were asked for demographic information and the workload of the current day. Then, questionnaires assessed willpower theories, NFC, and self-control from a trait perspective. Finally, control variables were assessed, and an individual code was created by each participant to match both study parts and to provide compensation. Participants entered their e-mail addresses in a separate survey to be informed about part 2 of our study (T2). After giving their informed consent at T2 again, all participants were randomly assigned to one out of two experimental conditions via EFS survey (version: EFS Spring 2018; QuestBack GmbH, 2016/2018). Depending on the condition, participants got different versions of the questionnaire for willpower theories. Then, NFC and self-control were measured, referring to the current situation. At the end of the survey, control variables were assessed, and participants were provided with transparent information about the experimental manipulation at T2. In order to not influence the responses of prospective attendants, participants were asked to keep this information secret. Finally, information on compensation options was provided, and participants had to decide whether they wanted to get course credit or to participate in a raffle (per 100 participants, 50 and 10 € could be won once, respectively, and 20 € twice). All participants could enter their e-mail addresses to get information about the study results. The questionnaires for T1 and T2 were completed in about 15 minutes each.

Sample

Participants were recruited via mailing lists, social media, university wide advertisements, and personal contacts. At T1, 191 participants created an individual code. Two participants were excluded: one because of a very short responding time (203 s ≈ 3 min) and responding to all items using only the middle rating points, and another one because of an indicated age younger than 18. Two participations had the same code, gender, and age, so it was very likely that the codes belonged to the same person. Hence, we excluded the second participation, resulting in a general sample size of $N = 188$ (67% female, 31% male, age: $M \pm SD = 26.59 \pm 9.3$ years). Of them, 143 (76.1%) were students.

At the beginning of T2, 168 individuals gave their individual codes. Of them, 161 continued the survey after responding to the questionnaire that manipulated implicit theories. Two participants had the same individual code as previous participation at T2 and were excluded. As at T2 willpower theories were manipulated and we needed to ensure a successful manipulation, we excluded participants who interrupted participation or needed double time or more to complete ($\geq$ 30 min = 1,800 s). This was true for 14 participants, so the final sample of T2 consisted of $n_{T2} = 145$ participants (96 female, 46 male). Individual codes were used to match the data of T1 and T2. All codes of T2 should be assignable to T1 because the link to take part in T2 was provided to individuals that took part in T1. If codes at T2 differed only in one part from a T1 code and the gender and age of the participants were equal, we adapted the code in order to combine both participations. Three participants of the T2 sample could not be assigned to participate in T1. Hence, the subsample for analyzing data of both timepoints was $n = 142$. The average time between both measures in this group was seven days.

Measures

All reliabilities are displayed in Table 4.

Need for Cognition

At T1, NFC was assessed similar to Study 1 (Bless et al., 1994). For T2, the instruction of the questionnaire was slightly adapted: At the beginning and before the second half of the items, participants were instructed to refer their responses to the current moment and not to their general attitude towards the behavior addressed in each item in order to assess NFC as experienced in the concrete situation.

Willpower Theories

At T1, we used the same 12-item questionnaire as in Study 1 (V. Job, personal communication, August 15th, 2016) to assess implicit theories about willpower. Item responses were recorded on a 6-point rating scale from 1 = *strongly disagree* to 6 = *strongly agree* and averaged. Higher values indicated stronger agreement with a limited-resource theory.

Self-Control

Trait self-control was assessed at T1 with the same questionnaire as in Study 1 (Bertrams & Dickhäuser, 2009b). State self-control was measured with a German 10-item measure of currently available self-control (e.g., "I feel like I have no willpower left"; Bertrams et al., 2011) at T2. Items

Table 4. Descriptive statistics of all measures at T1 and T2

	Need for Cognition	WT[a]	SC
T1 (trait level)			
M	16.10	3.58	3.17
SD	13.14	0.59	0.57
Min	−22.00	2.17	1.77
Max	44.00	5.08	4.77
Cronbach's α	.87	.77	.79
T2 (situation-specific)			
Total sample T2 (*n* = 145)[b]			
M	13.38	3.75	4.71
SD	12.60	1.23	1.14
Min	−16.00	1.00	1.40
Max	43.00	6.00	6.60
Cronbach's α	.86	.88/.85[c]	.89
Subsample T2: Limited-resource theory (*n* = 81)[c]			
M	13.77	4.63	4.64
SD	11.94	0.69	1.17
Min	−16.00	2.00	1.40
Max	37.00	6.00	6.50
Subsample T2: Unlimited-resource theory (*n* = 64)[c]			
M	12.89	2.64	4.79
SD	13.46	0.77	1.11
Min	−16.00	1.00	2.10
Max	43.00	5.00	6.60

N = 188. WT = Willpower theories; SC = Self-control; PA = Positive affect; NA = Negative affect. [a]1 = unlimited-resource theory, 6 = limited-resource theory. [b]Sample size refers to all analyzed participants at T2. Sample size was $n_{T1/T2}$ = 142 for participants that could be assigned to T1 participation. [c]Questionnaire fostering a limited-resource theory/questionnaire fostering a nonlimited-resource theory.

were rated on a 7-point rating scale from 1 = *completely untrue* to 7 = *completely true*. Item responses were averaged.

Further Variables

Within this study, measures of subjective well-being were also included (Glaesmer et al., 2011; Janke & Glöckner-Rist, 2014) that are out of the scope of this paper. The data is included in the uploaded data set (Grass et al., 2020). In the beginning, all participants had to answer questions about demographic aspects and estimate the workload they had already experienced the same day they started the questionnaire (hours of work today and rating of experienced workload today from 1 = *very low* to 5 = *very high*). At the end of both questionnaires, participants were asked for disturbing influences, breaks during their participation, and honesty in answering one item each.

Experimental Manipulation and Manipulation Check

At T2, participants were randomly assigned to one out of two questionnaires as experimental conditions (Job et al., 2015; personal communication, February 2nd, 2018) manipulating willpower theories. Each biased questionnaire

version entailed seven items that fostered either a limited-resource theory (e.g., "Working on a strenuous mental task can make you feel tired such that you need a break before accomplishing a new task") or a nonlimited-resource theory (e.g., "Sometimes, working on a strenuous mental task can make you feel energized for further challenging activities") (Job et al., 2015, p. 699). The questionnaire used the same instruction as the unbiased questionnaire of T1, including a short explanation of willpower and asking to answer on a 6-point-rating scale from *strongly disagree* to *strongly agree*. For the questionnaire fostering a limited-resource theory, coding was 1 = *strongly disagree* and 6 = *strongly agree*; for the questionnaire fostering an unlimited resource theory, coding was 1 = *strongly agree* and 6 = *strongly disagree*. Hence, similarly to T1, higher values of average item answers indicated stronger agreement with a limited-resource theory in both versions of the questionnaire.

For the manipulation check, we followed Job and colleagues (2010) and calculated one-sample *t*-tests that compared the mean of the manipulated willpower questionnaire in each experimental condition with the scale's midpoint of 3.50. The results indicated that participants agreed with the suggested theory in both conditions. In the limited-resource-theory condition the difference from the midpoint was 1.13 (*M* = 4.63, *SD* = 0.69) with Cohen's *d* = 0.69 [*t*(80) = 14.688, *p* < .001]. In the nonlimited-resource-theory condition, the mean deviated −0.86 from the theoretical midpoint (*M* = 2.64, *SD* = 0.77) with Cohen's *d* = 0.77 [*t*(63) = − 8.914, *p* < .001]. For comparison, the mean of T1 (*M* = 3.58, *SD* = 0.59) differed not significantly from the theoretical midpoint [*t*(187) = 1.791, *p* = .0.75].

Additionally, willpower theories at T1 correlated only small with manipulated theories at T2 ($r_{s,T1/T2}$ = .16, *p* = .054). Those results indicate a successful experimental manipulation.

Data Analysis

Data were analyzed with IBM SPSS Statistics (version 25). Kolmogorov-Smirnov tests (*p* > .05), histograms, and PP-Plots suggested that some variables deviated from normality. Hence, correlations were estimated as Spearman rank correlations. For multiple comparisons, α was Bonferroni-corrected. Correlations were classified similar to Study 1 (Gignac & Szodorai, 2016). To compare correlations, Fisher's *z* transformation was used. Mediation analyses were calculated with PROCESS (version 3.2; Hayes, 2018). At T1, when the unbiased questionnaire assessed willpower theories, willpower theories were included as a continuous mediating variable; at T2, using the biased questionnaire of willpower theories as experimental manipulation, the dichotomous experimental condition was used as a predictor. Significant effects were indicated by 95% confidence intervals based on 5,000 bootstrap samples

excluding zero. Mean differences were compared with t-tests and with the Mann-Whitney test if data deviated from normality.

An a priori power analysis (G*Power version 3.1; Faul et al., 2007) based on Study 1 resulted in a sample size of $N = 84$ to detect correlations of $r \geq .30$ ($\alpha = .05$, $1 - \beta = .80$, two-tailed). Post hoc analyses (G*Power version 3.1; Faul et al., 2007) calculated a sensitivity ($\alpha = .05$, $1 - \beta = .80$, two-tailed) of $r = .20/23$ for $n = 188/142$ and of $d = 0.47$ (independent samples; $\alpha = .05$, $1 - \beta = .80$, $n = 145$).

Results

Table 4 presents descriptive statistics. Preliminary analyses for all participants with data for T1 and T2 showed that the experimental groups did neither differ in their NFC level ($U_{T1} = 2,530.50$, $p_{T1} = .887$; $U_{T2} = 2,401.00$, $p_{T2} = .697$) nor in their subjective workload ($U_{T1} = 2,061.00$, $p_{T1} = .057$; $U_{T2} = 2,546.50$, $p_{T2} = .830$). At T1, the group manipulated toward a limited-resource theory stated they had more hours worked before *the same day* ($U_{T1} = 1,819.50$, $p_{T1} = .005$), whereas both groups differed not at T2 ($U_{T2} = 2,552.50$, $p_{T2} = .815$).

Intercorrelations

Table 5 displays the main correlational findings (for intercorrelations between dispositional and situation-specific variables, see ESM 1, Table E3).

NFC was relatively strong associated with self-control both with the usual instruction as well as the adapted situation-specific instruction ($r_{sT1/T2} = .30/.47$, $p < .001$). At T1, higher NFC went along with an unlimited-resource theory ($r_{sT1} = -.23$, $p = .001$).

Indirect Effects

Because NFC correlated small with age ($r_{sT1/T2} = .26/.21$, $p_{T1/T2} < .001/= .010$), mediation analyses were run controlling for age (see Table 6).

At the trait level, willpower theories were no mediating variable at T1, and the direct effect of NFC on self-control remained. Achieved power was .88 (Schoemann et al., 2017). At T2, the experimental condition was not related to situation-specific NFC and state self-control. Hence, the levels of both variables were not influenced by the manipulation of willpower theories. That contradicts the assumption of manipulated willpower theories influencing state self-control via NFC because we assumed correlations in the same direction between experimental condition and NFC, between NFC and self-control, and between experimental condition and self-control as the basis for an indirect effect. Hence, suppression effects leading to non-existent bivariate correlations were implausible.[1]

At T2, situation-specific NFC and state self-control were not associated with the experimental manipulation of willpower theories. NFC_{T1} correlated strongly with NFC_{T2} ($r_s = .80$, $p < .001$).

Discussion

Study 2 extended Study 1 by elaborating the role of willpower theories for NFC and its implications with an experimental approach. We found the expected association of NFC with self-control again. The association was even stronger, focusing on a specific situation compared to the trait level. The association of trait NFC with willpower theories was small, and the manipulation of implicit theories had no impact on NFC levels.

In contrast, NFC levels at T1 and T2 were strongly correlated ($r_s = .80$), indicating the stability of NFC levels and an independence from the manipulated willpower theories. Hence, a temporary change in willpower theories did not influence NFC levels simultaneously. That contradicts the idea of implicit theories as a causal influence on individual NFC levels. In fact, the causality may be vice versa in that higher NFC levels and the willingness to engage in cognitively demanding tasks foster the belief in unlimited resources for self-control from a long-term perspective as modeled in the mediation at trait level. In Study 2, we found no indirect effect of NFC at trait level through willpower theories but only a direct one on self-control. Consequently, the positive association between self-control and NFC was independent of implicit theories in Study 2 and probably based on other processes preceding self-control (for an overview, Kotabe & Hofmann, 2015).

General Discussion

The reported two studies were conducted to extend previous research on associations of NFC with self-control. Study 1 examined whether previous results of associations of $r \approx .30$ between NFC and self-control are generalizable over different self-control measures. Both studies further examined willpower theories as predictors additional to NFC. We examined the relations of NFC to willpower theories and tested two mediation hypotheses concerning the interplay of NFC and willpower theories for predicting self-control. Study 1 used a correlative approach and tested willpower theories as mediators. Study 2 examined the

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[1] During the review process, the mediation Experimental condition → NFC → State self-control for T2 was calculated and confirmed our assumption with a non-significant partially standardized indirect effect of the experimental condition through NFC of −.033 [−.199, .127].

Table 5. Correlations of Need for Cognition and willpower theories with self-control

		Willpower theories[a]	Trait self-control
T1 (trait level)	Need for Cognition	−**.23**	**.30**
	Willpower Theories[a]	−	−**.34**
		Manipulated willpower theories[a]	State self-control
T2 (situation-specific)[b]	Need for Cognition	−.14	**.47**
	Manipulated Willpower Theories[a]	−	−.18*

Note. N = 188. Spearman rank correlations except point-biserial correlations for correlations with experimental group. r_{pb} of Need for Cognition with experimental group was −.03 (p = .679). [a]Continuous variable, higher values = limited-resource theory. [b]n = 145. *p < .05; **p < .01; Bold = p < .006 (Bonferroni-corrected significance: .05/9). All two-tailed.

Table 6. Indirect effect of trait Need for Cognition through willpower theories (T1)

			Indirect effect	
Criterion	Total effect (unstandardized)	Direct effect (unstandardized)	Unstandardized	Completely standardized
Trait self-control	.011 [.005, .017]*	.011 [.005, .017]*	.000 [−.001, .001]	.002 [−.026, .029]

Note. N = 188. 95% BCa confidence intervals based on 5,000 bootstrap samples. Controlled for age. *Confidence intervals excluding zero.

association of NFC with willpower theories more comprehensively by considering additionally the reciprocal mediation path with willpower theories as independent variable and NFC as mediator. Therefore, participants were examined twice: At T1, NFC, self-control and willpower theories were examined with questionnaires focusing on the general or trait level of those variables. At T2, willpower theories were manipulated in order to examine NFC as mediating variable for the prediction of self-control by willpower theories. Therefore, a situation-specific (state-like) perspective of assessing NFC was used.

Our results confirm previous research (e.g., Bertrams & Dickhäuser, 2012a, 2012b) that reported associations of NFC with self-reported self-control across different situations. This was true for both trait and situation-specific measures. NFC was not related to the Academic Delay of Gratification and to the performance in a computerized Delay-Discounting paradigm. NFC was associated with unlimited-resource theories at trait level. In Study 2, NFC was weaker associated with willpower theories at trait level compared to Study 1. Situation-specific NFC was not affected by manipulated willpower theories. Only in Study 1, willpower theories mediated the prediction of self-control by NFC at the trait level; in Study 2, both assumed mediating paths did not exist.

Need for Cognition and Self-Control

In line with previous research (e.g., Bertrams & Dickhäuser, 2012b; Grass et al., 2019; Nishiguchi et al., 2016), we found a moderate to relatively strong association of NFC with self-control at trait (r_s = .30/.38) and state level (r_s = .47) In Study 1, the gamified Delay-Discounting paradigm assessed self-control in a rather complex and less artificial way (Scherbaum et al., 2013). Hence, we expected an

association also without previous depletion in contrast to a previous study (Bertrams & Dickhäuser, 2012a), which was not confirmed. A reason for that finding could be the intrinsic value of the game that could have compensated effects of NFC by situationally motivating higher self-control. Furthermore, the missing association is in line with previous research that reported NFC to be related to inhibition only after a strenuous, potentially depleting task (Bertrams & Dickhäuser, 2012a) and to research pointing out difficulties in reflecting interindividual differences with behavioral and experimental measures (Strobel et al., 2020; for a summary, Dang et al., 2020).

NFC was even stronger associated with self-reported self-control in Study 2 when referring to the currently available state self-control capacity (r_s = .47). We did not assume a stronger association of NFC with self-control from a situation-specific compared to a trait perspective and can imagine two methodological reasons apart from an incidental finding: First, state self-control was measured after implicit theories and NFC in Study 2. Especially the inverted items of the NFC questionnaire are verbally difficult (Bors et al., 2006). Answering them may already have depleted participants and increased NFC's meaning for state self-control. Second, considering the item material of both questionnaires, the state-related self-control questionnaire includes three items that refer to cognitively challenging tasks and (cognitive) engagement (not able to process further information, would like to give up every difficult task, want to give up) whereas the trait questionnaire includes only one (do something often without thinking through all alternatives).

Our results and previous research suggest that NFC and self-control are related when referring to situations with high self-control demands (Bertrams & Dickhäuser, 2012a), to trait like self-control across situations, or to subjective

self-control capacity in a specific situation. The discrepancy that NFC was related to self-reported trait self-control but not to an experimental Delay-Discounting paradigm together with the – at best – moderate intercorrelations of the self-control measures among each other provide further evidence that self-report and behavioral measures assess different kinds of behavior related to self-control (e.g., Allom et al., 2016). Additionally, research has attested experimental paradigms' difficulties in reflecting inter-individual differences (Dang et al., 2020). Besides methodical explanations, a theoretical explanation may be that NFC is especially related to self-control when the control needs to be maintained across different situations, that is, when individuals are facing higher demands or refer to different real-life contexts. More generally speaking, our results confirm previous results pointing to the necessity not to overgeneralize across self-control measures and to examine different facets separately (e.g., Allom et al., 2016; Duckworth & Kern, 2011).

Need for Cognition and Willpower Theories Predicting Self-Control

We found associations of higher trait NFC with unlimited-resource theories in both studies. This finding provides an alternative to the explanatory approach of the same shared resource that underlies self-control as well as effortful information processing related to NFC (Bertrams & Dickhäuser, 2012a). The lack of an association with manipulated, situation-specific willpower theories in Study 2 together with the high association of NFC at T1 and T2 ($r_s = .80$) may point at the trait character of NFC and its stability as NFC was originally conceptualized (Cacioppo & Petty, 1982; Cacioppo et al., 1996). Study 2 provided evidence that differences in willpower theories do not causally lead to differences in NFC and thereby suggests the contrary causal path: Intrinsically motivated engagement in cognitive challenges may strengthen the belief in unlimited resources for willpower, which would also match the mediating role of willpower theories reported in Study 1. Those willpower theories were no significant mediator in Study 2, which may be due to the lower association with trait self-control compared with Study 1.

Limitations and Future Research

As often in psychological research, our participants were mainly students. Thus, our results must be confirmed in other samples to derive more generalizable conclusions. The self-control measures used for testing the generalizability were not exhaustive: Our study was an initial attempt to examine the generalizability and should be expanded in

further studies. We could only speculate why trait self-control assessed by self-report was related to NFC whereas other measures were not. Because the paradigm used to assess Delay Discounting has not been established in many studies, prospective studies using comparable alternative experimental or behavioral paradigms related to self-control have to reproduce our findings for generalizable conclusions. Underlying processes for (measure-dependent) associations of NFC with self-control need to be further specified. To test whether other self-control measures correlate with NFC when task demands are increased and situational aspects are varied, prospective research could, for example, implement the dual-task paradigm similar to Bertrams and Dickhäuser (2012a) with different self-control measures. Our studies provide the first evidence for associations of higher NFC with unlimited-resource theories. However, we still do not know the background of that relation, and it is unclear whether the manipulation of implicit theories had long-term effects on NFC, which were not examined in Study 2. In order to profoundly test assumptions of reciprocal paths about the interplay of NFC and willpower theories for the prediction of self-control, longitudinal studies with large samples would allow for detailed insights and more conclusive results. Developing interventions to manipulate NFC levels would further allow testing reciprocal mediating paths more consistently. The different findings referring to correlation sizes and mediation effects of both reported studies should be the starting point for prospective studies in order to derive sound conclusions based on different samples. Whereas our results point to an explanatory value of willpower theories for associations of NFC with self-control, our results were inconclusive. Future studies have to further clarify those relations and integrate other explanatory variables like action orientation (Grass et al., 2019).

Conclusion

Our current research provides evidence that higher NFC is associated with self-reported self-control and unlimited resource theories. Our results underline the necessity not to generalize findings of specific self-control measures and to specify what behavior is really measured with an instrument. For the first time, associations between NFC and willpower theories were examined. We found higher NFC to be associated with stronger assuming willpower resources to be unlimited, which may explain relations of NFC to self-control. Our results point to a possible mediating role of willpower theories, especially referring to Study 1. Because of our ambiguous results, the interplay of NFC and willpower theories for predicting self-control needs further research on diversified samples and alternative behavioral measures. Nonetheless, our results confirm the

relevance of NFC to self-control. They further strongly encourage future research on processes behind these associations, especially concerning implicit theories of willpower.

Electronic Supplementary Material

The electronic supplementary material is available with the online version of the article at https://doi.org/10.1027/1614-0001/a000381

ESM 1. Tables E1–E2. Analyses of alcohol and cigarette consumption behavior in Study 1. Table E3: Intercorrelations of NFC, willpower theories, and self-control measures at state and trait level in Study 2.

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