

Other Papers

Polish Psychological Bulletin
 2016, vol. 47(3) 346–355
 DOI - 10.1515/ppb-2016-0041

Edward Nęcka*
 Radosław Wujcik*
 Jarosław Orzechowski*
 Aleksandra Gruszka*
 Beata Janik*
 Michał Nowak*
 Natalia Wójcik*

NAS-50 and NAS-40: New scales for the assessment of self-control

Abstract: In this paper, we present a new questionnaire for the assessment of self-control as an individual trait. We describe the process of construction of this assessment tool. We also report the results of relevant validation studies. The questionnaire has two independent versions, one based on self-reports (NAS-50) and another one based on other-reports (NAS-40). The first version consists of five subscales (10 items each), called Initiative and Persistence (IP), Proactive Control (PC), Switching and Flexibility (SF), Inhibition and Adjournment (IA), and Goal Maintenance (GM). Seven samples of participants ($N = 934$ altogether) took part in the validation study. The second version has not been split into subscales. Both versions obtained satisfactory indices of internal consistency, assessed with Cronbach's alpha (for NAS-50 total score $\alpha = .861$, for the subscales α between $.726$ and $.867$; for NAS-40 $\alpha = .844$). The NAS-50 and NAS-40 scores were highly correlated with other measures of self-control, including Tangney, Baumeister, and Boone's (2004) self-control scale. They also proved to be entirely independent of general intelligence. In conclusion, both versions can be regarded reliable and valid enough, and therefore suitable for the assessment of trait self-control for research purposes.

Key words: self-control, questionnaire, scale, self-report, other-report, psychological assessment

Introduction

Self-control is the human ability to initiate, maintain, and regulate our goal-directed behavior, notwithstanding external pressures, innate or learned automatisms, or physiological impulses (Baumeister & Tierney, 2011; Krug & Carter, 2010; Muraven & Baumeister, 2000). It manifests itself in such instances as refraining from unnecessary or harmful responses, postponement of gratification, skillful regulation of emotions, attentive treatment of other people, or behavioral adjustment to social context. Since self-control is one of the most important predictors of life achievement and social adjustment (Casey et al., 2011; Moffitt et al., 2011), it is necessary to measure it properly. In this paper, we present new questionnaires called NAS-50 and NAS-40. They have been developed and validated as instruments for scientific research, suitable for the assessment of trait self-control.

Measurement of self-control is involved in serious theoretical and methodological problems. Firstly, it is not

clear to what extent self-control can be defined as a stable individual trait, similarly to personality dimensions. If it is not regarded a trait, it could be treated as a fluctuating state. The trait versus state distinction seems to work in such issues as anxiety (Spielberger, Gorsuch, Lushen, Vagg, & Jacobs, 1983) or depression (Clark, Vittengl, Kraft, & Jarrett, 2003). We believe that such a distinction must be clarified and empirically investigated in the realm of self-control, too. However, in this paper we focus on the trait approach, offering assessment tools that seem suitable for measurement of the relatively stable and inter-individually differentiated ability to exert control over one's behavior. Secondly, self-control seems to be a complex and multifaceted entity, meaning that it consists of several components and manifests itself through distinct symptoms (Kotabe & Hofmann, 2015). There are attempts to reduce self-control to one type of behavior, e.g., delay of gratification (Mischel, 1974; Mischel, Shoda, & Peake, 1988; Case et al., 2011), or one type of underlying mechanism, e.g., ego depletion (Baumeister, Bratslavsky,

* Institute of Psychology, Jagiellonian University in Kraków, ul. Ingardena 6, 30-060 Kraków, Poland

All correspondence should be sent to: Edward Nęcka, Instytut Psychologii UJ, ul. Ingardena 6, 30-060 Kraków. Email: edward.necka@uj.edu.pl

Muraven, & Tice, 1998; Muraven & Baumeister, 2000), but such decisions seem problematic. If self-control has many facets, it should be assessed accordingly to its complexity. From this point of view, paper-and-pencils questionnaires are good candidates for valid assessment tools, as they are able to capture all the dimensions of self-control that are predicted by a relevant theory.

We have already developed and published one questionnaire of this type, called AS-36 (Nęcka, 2015). Although it seems valid and reliable enough, we decided to construct a new one for the following reasons. Primarily, AS-36 captures only three dimensions of self-control: inhibition, switching, and goal maintenance. We believe that the number of dimensions should be increased in order to assess self-control in all its complexity. Particularly, in this new approach we aim at capturing the motivational aspects of self-control, since it may be argued that people are sometimes able to control themselves but lack motivation to do so (Kotabe & Hofmann, 2015). Next, AS-36 revealed some weaknesses, particularly, not quite satisfactory (though acceptable) levels of internal consistency of the Inhibition subscale. What is more, confirmatory factor analysis failed to support the solution obtained through exploratory analyses. Finally, it is sometimes advisable to administer not one but a number of empirical indices of assessed dimensions, for instance, in structural equation modeling. Having two independently constructed questionnaires, researchers or diagnosticians may either apply both, in order to achieve more valid approximation of latent variables, or choose the one that seems more justified in the given context.

A theoretical rationale

Similarly to AS-36 (Nęcka, 2015), the new questionnaire was designed on the basis of a theoretical model of self-control, which draws on two assumptions. First, we differentiate between reactive and proactive type of the self-control exertion (Braver, Gray, & Burgess, 2007; Chuderski, 2010; Chevalier, Martis, Curran, & Munakata, 2015; Criaud, Wardak, Ben Hamed, Ballanger, & Boulinguez, 2012). Reactive self-control amounts to the adjustment of one's own behavior to external requirements, such as demands or prohibitions. This type of self-control works when we are trying to resist temptations or to refrain from improper actions. Colloquially, such situations are referred to as restraint, prudence or temperance. In contrast, proactive self-control consists in setting goals and striving for them in spite of obstacles and restrictions. Colloquial language speaks here about persistence, consistency in action, and far-sightedness.

Second, self-control requires integration of many diverse behavioral tendencies, which correspond to all of the goals pursued by the person. These goals, in turn, correspond to the person's needs. Striving to satisfy our needs, and simultaneously complying with prohibitions, directions, and expectations imposed on us by the environment, we must constantly organize our activities in the temporal dimension (i.e., in time), and also in the hierarchic dimension (i.e., according to their importance).

Integration of goals and actions happens to be difficult, as is the case of someone who pursues primarily urgent goals, ignoring important ones, or vice versa. Effective self-control requires creation and careful application of a "timetable" for activities (*contention scheduling*, Norman and Shallice, 1986), because neither the temporal nor the hierarchic order emerges spontaneously. The human ability to create and apply the order within one's own actions manifests itself, for instance, in task switching (e.g., Arrington & Logan, 2005). Dysfunctions of task switching cause *perseveration*, i.e., persistent carrying out of activities which previously were proper, but are currently inadequate because of significant changes of circumstances. A manifestation of rigidity, complementary to perseveration, is *learned irrelevance* (see, e.g., Słabosz et al., 2006), consisting in the lack of ability to reuse a rule that previously turned out to be useless, but now again requires applying. Perseveration and learned inadequacy can be observed in intensified form in patients with disorders of control functions (e.g., Sandson & Albert, 1984), although in lesser intensity they can also be seen in healthy and able individuals.

Drawing on these assumptions, and taking inspiration from other sources (e.g., Kotabe & Hofmann, 2015), we have developed a componential model of self-control. The model predicts five behavioral manifestations of self-control, corresponding to the components of human action control. First of all, a person has to set goals to pursue, so as to act in relative autonomy from internal impulses, external pressures, and innate or learned automatisms. It seems that any act of self-control must start with getting rid of the "autopilot", that is, the tendency to respond reactively to external or internal stimuli. Setting the goals must be complemented by the motivation to pursue them in due time. Dysfunctions of this aspect of self-control often amount to procrastination, which results either from inability of efficient motivation induction or lack of persistence. We call this component of self-control *initiative and persistence* (IP). Next, the goals must be pursued with necessary planning and precaution. People often fail in self-control because they cannot undertake necessary prearrangements, or they cannot foresee possible obstacles. Particularly, goal-directed behavior requires taking into account that our actions are divided into sub-actions, sub-sub-actions, etc., every ingredient of an action requiring proper planning and time scheduling. This component of self-control is called *proactive control* (PC). Furthermore, goal-directed behavior must be accomplished together with competing behavioral tendencies, sometimes reflexive and sometimes caused by other important goals. It means that, when we go "beyond automaticity", we have to switch between tasks and actions in order to avoid perseveration or learned irrelevance. Therefore, we call this component of self-control *switching and flexibility* (SF). What is more, pursuing the goals usually requires that possible competing tendencies be inhibited or at least deferred. Unwanted or improper actions must be either suppressed or delayed as long as the circumstances would allow their implementation. This component of self-control, called

inhibition and adjournment (IA), seems particularly important in the context of impulse control (e.g., dieting, addictions) but also in the social context (e.g., aggression control). Finally, one has to remember one's own plans and goals, particularly in pertinence to time scheduling. For instance, forgetting one's goals, plans, or intentions is likely to result in not meeting deadlines. This component of self-control is called *goal maintenance* (GM).

The construction of the scale

The scale construction procedure progressed in several stages. It began with the creation of the initial list of 325 items describing various behavioral and cognitive control processes, including:

- initiative and persistence,
- proactive control,
- switching and flexibility,
- inhibition and adjournment, and
- goal maintenance.

In the second stage, each item's content, stylistic features, intelligibility, and explicitness were evaluated by the whole research team. The analyses resulted in the list of 200 items that were verified by a linguist.

In the third stage, the previously selected items formed the first, *working version* of the questionnaire. A pilot study was conducted ($N = 15$) in order to choose the most adequate rating scale. Participants were given 3 versions of the questionnaire with 3-point, 5-point, and 7-point answer scale respectively, each with 20 different items. On the basis of the pilot study and a series of interviews with experts in psychometrics, a Likert 5-point scale was chosen as the most appropriate and sufficiently extensive answer scale for obtaining satisfactory variance of the collected data. The questionnaire sheet was provided with the following instruction: "For each of the statements below, please indicate to what extent the statement is characteristic of you. Please read the sentences carefully before giving an answer and make sure to answer all of them. If you do not recall being in a given situation, please imagine how you *would* behave in that situation. Do not concentrate on a given statement for too long." A 5-point Likert scale was provided on the right side of each item. The description of the rating scale was provided at the top of the first page of the questionnaire.

In the next stage, the working version of the questionnaire was used in an empirical study that aimed at selecting the final, shortened list of the best items, as well as establishing the factorial structure of the questionnaire. We collected data from 2084 participants, 1266 of whom were women, 684 were men, and 134 did not provide information about their sex. The participants' age ranged from 16 to 65 ($M = 24.34$, $SD = 9.94$). The sample consisted of high-school students, undergraduate students, workers and pensioners. The participants' education ranged from primary school completion to graduate degrees. They resided in cities of small (up to 100 000 inhabitants) and

large populations (over 500 000 inhabitants). The more precise data concerning the participants' demographics was not collected. Participants filled in the questionnaire in groups. Each session took 40 minutes and began with the researcher reading the questionnaire instruction aloud.

In the fifth stage of the study, an exploratory factor analysis was employed in order to reduce the number of the questionnaire items and identify the factors. At this point, the number of factors was not specified, and rotation was not applied. We used the method of principal components. The five-factor solution, consistent with the adopted theoretical model, was selected on the basis of the scree graph and the amount of explained variance (Table 1). Subsequently, the factor analysis was run again, with the imposed number of five factors and direct oblimin rotation with Kaiser normalization. The choice of rotation method was dictated by the anticipation that factors may be inter-correlated. As a criterion for assigning items to the factors, we assumed factor loading with a value greater than +0.30, or lesser than -0.30. Moreover, we excluded items that highly loaded more than one factor and items that were similar to one another as to their content or form. Ultimately, the analyses revealed five factors with 10 items in each of them. Additionally, 3-, 4-, 6 and 8- factor solutions were examined, using both *varimax* and *oblimin* rotations. None of them yielded results better than the 5-factor solution. The *final version* of the tool, consisting of 50 items, 10 on each of five dimensions, was named NAS-50 (*Nowy Arkusz Samowiedzy*, Self-Knowledge New Sheet) and used in the subsequent validation and reliability studies¹.

Table 1. Initial Eigenvalues and the amount of explained variance for the first 10 factors

Factor	Initial Eigenvalues		
	Total	% total of Variance	Cumulative %
1	19,535	9,768	9,768
2	9,102	4,551	14,319
3	6,249	3,125	17,444
4	4,509	2,255	19,698
5	3,749	1,874	21,573
6	2,989	1,495	23,067
7	2,568	1,284	24,351
8	2,325	1,163	25,514
9	2,260	1,130	26,644
10	2,093	1,047	27,691

In the second study, we tested the formerly developed five-factor model of the questionnaire. We collected data from 270 participants, 110 of whom were women, 160 were men. The participants' age ranged from 25 to 37 ($M = 26.64$,

¹ The scale can be obtained from the corresponding author for academic purposes.

SD = 1.47). Confirmatory factor analysis revealed that the five-factor solution based on the componential model of self-control obtained partial support. We analyzed data set consisting of 50 test items extracted in an earlier study using exploratory factor analysis (EFA). The method of generalized least squares (GLS). The χ^2 index did not obtain required value ($\chi^2(655) = 2519; p < 0.001$) but it showed acceptable fit if degrees of freedom were taken into account ($\chi^2/df = 3.52$, that is, below 5). Other indicators of fitting the model to the data were as follows: RMSEA = 0.076; GFI = 0.748; Gamma = 0.772.

Standardization and validation studies

Participants

The final 50-items Self-Control Scale, called NAS-50, was administered in a series of studies in order to determine its reliability and validity. In these studies, a total of $N = 933$ participants took part voluntarily. Their age ranged between 18 and 66 ($M = 34.23$; $SD = 11.23$), and they included 485 women, 306 men, and 142 persons of unknown sex. All participants belonged to one of the following samples:

1. A sample of employees from several branches of an international bank operating in Poland participating in a PhD thesis study ($N = 313$). The sample included 101 men and 212 women. Their age ranged between 18 and 66 ($M = 37.51$; $SD = 10.43$). The participants completed secondary (18.8%) and higher (81.2%) education. They did not receive any financial compensation. NEO-FFI and NAS-50 included in the study were completed in groups or individually.
2. A sample of students participating in the study concerning the influence of amusement regulation on cognitive control ($N = 88$). The sample included 42 men and 46 women. Their age ranged between 21 and 35 ($M = 23.25$; $SD = 2.26$). They received payments of 20 PLN and completed NAS-50, NAS-40², and NEO-FFI in groups.
3. A sample of students participating in a course 'Introduction to Psychology' taking part in a study aimed at assessing the reliability of NAS-50 ($N = 77$). The sample included 13 men and 64 women. Their age ranged between 17 and 27 ($M = 19.27$; $SD = 1.25$). They did not receive any financial compensation. All of the students completed NAS-50, NAS-40, and AS-36 during one session.
4. A sample of 151 volunteers recruited and examined with NAS-50 by PhD students for the purpose of assessing validity and reliability of NAS-40. The sample included 69 men and 76 women. Six participants did not provide information about their sex. The participants' age ranged between 18 and 60 ($M = 27.37$; $SD = 9.65$). One participant did not provide information about age. The participants did not provide information about their education level. The volunteers did not receive any financial

compensation and completed the questionnaires both in groups or individually.

5. A sample of 178 volunteers recruited through an online portal. The study concerned the validation of the AS-36 questionnaire (Nęcka, 2015). The sample included 60 men and 116 women. Two participants did not provide information about their sex. The age of the participants ranged between 18 and 66 ($M = 23.72$; $SD = 6.23$). They completed primary (5.8%), secondary (23.3%) and higher (49.2%) education or were undergraduates (21.7%). Fifty-eight individuals did not provide information about their education level. The participants received payments of 25 or 30 PLN for completing a battery of questionnaires and tests that included NAS-50, AS-36, NEO-FFI, Self-Control Scale, Raven's Advanced Progressive Matrices, and Word Knowledge Test.
6. A sample of 58 volunteers recruited by an Internet portal, participating in a study of cognitive mechanisms of self-control. The sample included 7 men and 50 women. One participant did not provide information about sex. Their age ranged between 19 and 31 ($M = 23.31$; $SD = 2.76$). The participants completed secondary (22.8%) and higher (54.4%) education. The sample also included undergraduates (22.8%). They received payments of 25 PLN for completing a battery of questionnaires, tests, and computerized tasks. The questionnaires included in the study were NAS-50, NAS-40, NEO-FFI and Self-Control Scale, and were completed in pairs.
7. A sample of 68 volunteers, the parents of children taking part in a developmental research project. The sample included 34 men and 34 women. The data concerning age and education level was not collected. The participants did not receive any financial compensation and completed NAS-50 and NAS-40 individually.

Descriptive statistics

Descriptive statistics for the overall score in NAS-50 and all its subscales are shown in Table 2. The overall score in NAS-50 has almost perfectly normal distribution ($\chi^2 = 2.14$, $df = 8$, $p = .98$). However, all the subscale scores significantly diverge from normality.

Some concern may be caused by a left-sided asymmetry in the distribution, manifested by the negative index of skewness, especially in GM (Goal Maintenance), PC (Proactive Control), and SF (Switching and Flexibility) subscales. Another problem is a slight deviation from normal distribution in the form of kurtosis: the results in IP (Initiative and Persistence) subscale show a leptokurtic distribution, i.e., the participants' tendency to aggregate around the average values, rather than at the extremes. We suppose that the application of NAS-50 scale in a study involving people who are less efficient or belong to vulnerable groups (e.g., drug addicts) would weaken the leptokurtic character of the distribution.

² NAS-40 is described below, in the section of this paper entitled "Third-person version".

Table 2. Descriptive statistics of NAS-50

	N	Mean	Std dev	Skewness	Kurtosis
NAS-50	934	166.418	20.174	-.001	-.148
GM subscale	934	37.584	6.093	-.368	-.133
PC subscale	934	36.235	5.527	-.470	.027
IP subscale	934	29.038	8.078	.047	-.660
SF subscale	934	36.393	6.212	-.349	.037
IA subscale	934	27.169	6.478	.026	-.276

Explanations: NAS-50 – the overall score in NAS-50, GM – goal maintenance, PC – proactive control, IP – initiative and persistence, SF – switching and flexibility, IA – inhibition and adjournment

Table 3. Correlation matrix of the NAS-50 scores (N = 934)

	NAS-50	GM subscale	PC subscale	IP subscale	SF subscale	IA subscale
NAS-50	–	0.70***	0.53***	0.78***	0.47***	0.58***
GM subscale	–	–	0.15***	0.41***	0.20***	0.42***
PC subscale	–	–	–	0.40***	0.09**	0.06
IP subscale	–	–	–	–	0.18***	0.28***
SF subscale	–	–	–	–	–	0.02

Explanations: NAS-50 – the overall score in NAS-50, GM – goal maintenance, PC – proactive control, IP – initiative and persistence, SF – switching and flexibility, IA – inhibition and adjournment

** $p < 0.01$ (two-tailed), *** $p < 0.001$ (two-tailed)

Table 3 shows the results of correlation analyses within all the indicators of NAS-50. All NAS-50 subscales are moderately or highly correlated with the overall score, which is understandable, considering that it is their sum. The correlations between subscales are rather weak. Nevertheless, it is worth noting that the IP scale (Initiative and Persistence) is strongly correlated with the overall score. Correlation analyses suggest that in some cases – besides the overall score – it is worth analyzing the results in particular subscales, because they can allow the creation of the profiles representing diverse levels of the development of the particular dimensions of one's self-control.

Reliability analysis

Reliability analysis was performed on the data collected from 933 participants. Additionally, we examined whether particular samples differed in reliability. Cronbach's index in relation to the overall score had the value $\alpha = .861$, whereas in relation to particular subscales it had values between .726 and .867 (see Table 4). Despite the

differences in samples sizes the reliability was very similar in all of them (Cronbach's α ranged from .812 to .886). Therefore, we can say that the examined tool shows at least a good level of internal consistency in the case of the overall score as well as particular dimensions. Moreover, the analysis of particular questionnaire items did not reveal even a single item that would significantly decrease the reliability of both the overall score and the particular dimensions.

Since Cronbach's alpha is heavily dependent on the length of scales, we decided to supplement the reliability indices with mean inter-item correlations that are good estimates of content saturation of scales (John & Benet-Martinez, 2000). The mean inter-item correlations were as follows: .21, .23, .39, .24, and .24, respectively for the GM, PC, IP, SF, and IA subscales.

Internal consistency measures of NAS-50 appeared good or at least acceptable. Nevertheless, we decided to check its test-retest stability so as to obtain another evaluation of reliability of the questionnaire. For that,

Table 4. Reliability analysis of the NAS-50 scale and its five subscales (N = 934)

	NAS-50	GM subscale	PC subscale	IP subscale	SF subscale	IA subscale
Cronbach alpha coefficient	.861	.727	.726	.867	.755	.764

Explanations: NAS-50 – the overall score in NAS-50, GM – goal maintenance, PC – proactive control, IP – initiative and persistence, SF – switching and flexibility, IA – inhibition and adjournment

Table 5. The intraclass correlation coefficient matrix (average ICC) between test-retest scores obtained with NAS-50

	NAS-50	GM subscale	PC subscale	IP subscale	SF subscale	IA subscale
Average ICC	.94	.85	.80	.89	.92	.86

Explanations: NAS-50 – the overall score in NAS-50, GM – goal maintenance, PC – proactive control, IP – initiative and persistence, SF – switching and flexibility, IA – inhibition and adjournment

we administered NAS-50 at two different points in time separated by the three months interval. Sample No. 3 took part in the test-retest measurement ($N = 57$, due to drop-outs). We applied the intraclass correlation analysis in order to determine the stability values. The intraclass correlation coefficient (ICC) for the overall score of NAS-50 was very high (.94). The ICCs for particular subscales of NAS-50 ranged from .80 to .92 (see Table 5).

Validity analysis

We assessed the convergent validity of NAS-50 scale through the correlation analysis of the results obtained with it and the scores in the AS-36 scale (Nęcka, 2015) and Tangney, Baumeister, and Boone's (2004) Self-Control Scale. Moreover, for comparison purposes, we used the Conscientiousness scale from the NEO-FFI questionnaire (Costa & McCrae, 1992) in the Polish adaptation (Zawadzki, Szczepaniak, Strelau, & Śliwińska, 1998), because the nature of this personality trait is close to self-control understood as a trait. The tests on selected samples showed strong covariances of the overall score in NAS-50 scale with the results of the AS-36 (samples 3 and 5, $r = .80$, $p < .001$) and the Tangney, Baumeister, and Boone's scale (samples 5 and 6, $r = .76$, $p < .001$). Moderately strong correlation between NAS-50 scale and the Conscientiousness scale from the NEO-FFI questionnaire was found (samples 1, 2, 5, and 6, $r = .54$, $p < .001$). Therefore, it can be concluded that NAS-50 scale allows measuring self-control in a manner similar to other tools used for this purpose.

At the same time, we found some interesting differences between the subscales (see Table 5). The four samples used in this analysis were selected on the basis of the completed questionnaires and tests: Raven's Advanced Progressive Matrices and Word Knowledge Test ($N = 145$), NEO-FFI ($N = 600$), AS-36 ($N = 222$) and Self-Control Scale ($N = 233$).

1. The sample of participants who completed Raven's Advanced Progressive Matrices and Word Knowledge Test included 51 men and 94 women. The age of the participants ranged between 17 and 66 ($M = 23.87$; $SD = 6.76$). The 119 participants who provided information about their education level completed primary (5.9%), secondary (22.7%) and higher (49.6%) education or were undergraduates at the time of the study (21.8%).
2. The sample of participants who completed NEO-FFI consisted of 188 men and 402 women whose age ranged between 18 and 66 ($M = 30.80$; $SD = 10.83$). The participants who provided information about their education level ($N = 579$) completed primary (1.5%),

secondary (19%) and higher (63.2%) education. The sample also included undergraduates (16.2%).

3. The sample which was selected on the basis of AS-36 completion included 64 men and 157 women. One person did not provide information about sex. Their age ranged between 18 and 66 ($M = 22.26$; $SD = 5.91$). The participants completed primary (3.6%), secondary (13.8%) and higher (30.1%) education, and 52.6% were undergraduates.
4. The sample consisting of participants who completed Self-Control Scale included 58 men, 143 women and 32 individuals of unknown sex, with age ranging between 18 and 66 ($M = 23.71$; $SD = 5.90$). The participants who provided information about their education level ($N = 176$) completed primary (4%), secondary (22.7%) and higher (51.1%) education or were undergraduates at the time of the study (22.2 %).

The divergent validity was assessed through the correlation analysis of the results in NAS-50 scale with the scores in intelligence tests and the scales of other personality traits, besides Conscientiousness. The analysis on the fifth sample showed lack of significant correlations of the overall score in NAS-50 scale with the results in the advanced version of Raven's test ($r = .05$, $p = .59$), which is an index of fluid intelligence (Raven, Court, & Raven, 1983; Polish adaptation: Jaworowska & Szustrowa, 2010), and also with the results in Choynowski's (1967) Word Knowledge Test, which is a good measure of crystallized intelligence ($r = .13$, $p = .12$). In the samples 1, 2, 5, and 6 ($N = 600$), we observed very weak but significant positive correlations of NAS-50 with Extraversion ($r = .14$, $p = .001$) and Agreeableness ($r = .17$, $p < .001$), and moderate negative correlations with Neuroticism ($r = -.45$, $p < .001$) (see Table 5 for detailed data). Therefore, it can be concluded that NAS-50 scale does not show any correlations with fluid and crystallized intelligence, whereas it shows a reverse covariance with a personality dimension associated with anxiety and emotional instability (see Table 6).

As to the relationship between neuroticism and self-control, Schnabel, Asendorpf, and Ostendorf (2002), testing replicability of the well-known Asendorpf–Robins–Caspi typology of personality, linked high neuroticism (and low extraversion) with the tendency to overcontrol. However, in this study overcontrollers were characterized by moderate levels of conscientiousness, whilst particularly low levels of conscientiousness (and agreeableness) were understandably attributed to undercontrollers. Nevertheless, in a more recent study Chapman and Goldberg (2011) have reported that undercontrollers were characterized by a significantly

Table 6. Results of the validity analysis of the NAS-50 scale

	N	NAS-50	GM subscale	PC subscale	IP subscale	SF subscale	IA subscale
Convergent validity							
AS	222	.80***	.46***	.39***	.52***	.52***	.50***
S-S	233	.77***	.46***	.46***	.64***	.22**	.59***
C	600	.54***	.34***	.34***	.54***	.26***	.19***
Divergent validity							
RAPM	145	.05	-.06	.15	-.04	.02	.08
TZS	145	.13	.12	.01	.08	.01	.18*
N	600	-.45***	-.30***	-.12**	-.39***	-.26***	-.34***
E	600	.14***	.13**	.01	.04	.28***	-.01
O	600	-.02	.01	-.012	-.13***	.05	.05
U	600	.17***	.18***	.04	.09*	-.05	.28***

Explanations: AS – Self-Knowledge Sheet (Arkusz Samowiedzy; Nęcka, 2015), S-S – Self-Control Scale (Tangney, Baumeister, & Boone, 2004), C – Conscientiousness (NEO-FFI), RAPM – Raven’s Advanced Progressive Matrices, TZS – Words Knowledge Test (Choynowski, 1967), N – Neuroticism (NEO-FFI), E – Extraversion (NEO-FFI), O – Openness to experience (NEO-FFI), U – Agreeableness (NEO-FFI), NAS-50 – the overall score in NAS-50, GM – goal maintenance, PC – proactive control, IP – initiative and persistence, SF – switching and flexibility, IA – inhibition and adjournment

* $p < 0.05$ (two-tailed). ** $p < 0.01$ (two-tailed). *** $p < 0.001$ (two-tailed)

higher level of neuroticism (and lower conscientiousness) than overcontrollers. Resilient type of personality was related to low neuroticism and high conscientiousness. This pattern of results is supportive of the current results.

The observed relationship between neuroticism and self-control can be supported by the meta-analytic study by Judge, Erez, Bono and Thoresen (2002). The authors suggested that due to their high mutual inter-correlations, neuroticism, self-esteem, and generalized self-efficacy may be markers of the same higher order concept. Self-efficacy represents a judgment of how well one can perform across a variety of situations. The results of the meta-analytic study (Judge et al., 2002) revealed that the estimated population correlations among neuroticism (i.e., its low pole – emotional stability), self-esteem, and generalized self-efficacy were indeed high, ranging from .62 (for neuroticism) to .85. Moreover, confirmatory factor analysis undertaken by the authors to explicitly address whether the measures indicate a single higher order construct, confirmed these expectations. The authors concluded that “4 trait measures display relatively poor discriminant validity” (p. 693).

Finally, neuroticism seems related to more specific instances of self-control failures. For example, highly neurotic subjects are prone to online gaming addiction (Chen et al., 2008; Mehroof & Griffiths, 2010), or eating disorders (Elfhag & Morey, 2008). In sum, in the light of the review presented above, the relationship between neuroticism and self-control observed in the current study can be seen as expected.

Validity analysis – between group approach

Finally, we considered individual differences in self-control measured by NAS-50 and NAS-40 in relation to sex and age. In the case of sex differences, there was no significant difference in the overall NAS-50 score between women ($M = 166.32$, $N = 485$) and men ($M = 168.41$, $N = 306$). However, in the scales of GM (goal maintenance) and IA (inhibition and adjournment) the difference is rather small, but significant. In the case of GM, the mean score for men ($M = 40.00$) was significantly higher than for women ($M = 37.01$) ($t = 4.31$, $p < .0001$). Similarly, in the case of IA, men ($M = 29.01$) obtained higher scores than women ($M = 26.35$) ($t = 5.71$, $p < .0001$). The third-person self-control measure, assessed by NAS-40, differed in groups of men and women: women received higher scores ($M = 134.88$, $N = 157$) than men ($M = 129.26$, $N = 145$) ($t = -2.79$, $p < .01$).

Gender is a strong predictor of self-control. Girls are known to score higher on a variety of measures of self-control. For example, Higgins (2004) using multiple measures of self-control, as well as parental management and a deviance index, has shown that all the measures were different across genders. Such findings are so consistent in the literature that some authors suggest gendered etiology of self-control and propose new, gender-specific measures of self-control (Chapplea, Vaskeb, & Hopec, 2010). Thus, our findings are consistent with the results of other studies but only in reference to the other-rating scores. Maybe men tend to over-estimate their self-control, or maybe women under-estimate it, as long as self-reported data are concerned. In a more objective assessment obtained

through other-ratings, the gender differences appear to favor women.

In the case of age-related individual differences, we found a weak positive correlation of age with the overall NAS-50 score ($r = .11, p < .01, N = 728$). Interestingly, the correlation was positive in the case of IP subscale (initiative and persistence) ($r = .30, p < .0001$), but negative for SF (switching and flexibility) ($r = -.1, p < .01$). The observed correlation of age and self-control as measured by the overall NAS-50 score is also consistent with the literature. It has been repeatedly shown that an increased age is associated with higher level of Conscientiousness (McCrae et al., 2005; Terracciano et al., 2005; see also Soubelet & Salthouse, 2011, for meta-analysis). However, the correlation coefficients that we have observed were very weak and their statistical significance probably resulted from large sample size.

As to the particular subscales of NAS-50, the current observations of their co-variance with age or gender should be regarded as preliminary. Further studies on the construct validity of NAS-50 subscales are needed before such specific results can be explained.

Third-person version

Assuming that people may not have sufficient insight into their own traits (Vazire, 2010), and therefore they may have difficulties in giving reliable answers about themselves, we decided to construct a third person version of the self-control scale (cf. Ball et al., 1997; Kurtz, Puher, & Cross, 2012). It was created as a mutation of the first-person version through replacing grammatical forms of the questionnaire items (cf. Ball et al., 1997). Some items have been rejected on the basis of their inadequacy for the third-person form, so the final third-person version of the NAS scale includes 40 items. The purpose of this operation was to develop a tool that could complement self-reports with peer-reports, or reports made by other persons, called informants. Other-rated reports require involvement of people who know the proper participant well – they can be colleagues, family members, friends, close friends, or spouses (partners). It seems that the scale in the third-person version, called NAS-40³, can be

a valuable complement of data obtained from self-reports (see Vazire, 2006, 2010). It can also be used in the studies on consistency of the self-report and other-report scores.

Data were obtained from a total of 364 people who had earlier been taken into account in the validation studies of the first-person version (samples no. 2, 4, 6). These participants served as informants. We asked them to complete the third-person version only if they declared that they had known the rated person for at least six months, had lived with him/her, or had collaborated with him/her every day. In the case of 150 people, we collected both their self-reports and the data obtained independently from two friends or acquaintances. Therefore, it was possible to examine the correlations between self-reports and two independent descriptions in the third-person version.

Reliability analysis

The reliability of the full NAS-40 scale, assessed by Cronbach's alpha index, was $\alpha = .844$. No item significantly increased the α index after its exclusion, which means that the reliability of the whole scale was not lowered by any particular item. As to the stability analysis, we used the same procedure of test-retest assessment as in the case of NAS-50. The group of 57 participants from the sample no. 3 completed NAS-40 twice, with a three months interval. The intraclass correlation coefficient (ICC) for overall score of NAS-40 was as high as .92.

Descriptive statistics and correlation analyses

The mean for overall score of NAS-40 was 132.55; standard deviation = 17.5; skewness = -.20; kurtosis = -.19. We obtained similar tendencies as in the first person version, perhaps with stronger indicators of the skewness. Again, we can see a left-skewness and leptokurtic character of distributions. However, the distribution of results in the overall scale does not differ significantly from the normal distribution ($Chi^2 = 6.72, df = 6, p = .35$). Therefore, there are reasons to consider NAS-40 scale as a sufficiently good tool to examine individual differences.

In Table 7, we can see the relationship measures between first- and third-person assessments. The correlation between those two measures is not strong. It becomes stronger if we take into account the mean score in

Table 7. The correlation matrix between first- (NAS-50) and third-person (NAS-40) assessments

	N	NAS-50	GM subscale	PC subscale	IP subscale	SF subscale	IA subscale
NAS-40 (1)	364	.26***	.17**	.16**	.32***	-.01	.14**
NAS-40 (2)	150	.32***	.16	.13	.32***	.08	.17*
NAS-40 (M)	149	.33***	.21**	.15	.37***	-.01	.16*

Explanations: NAS-40 (1) – the score in NAS-40 given by first friend, NAS-40 (2) – the score in NAS-40 given by second friend, NAS-40 (M) – the mean score in NAS-40 given by two friends, NAS-50 – the overall score in NAS-50, GM – goal maintenance, PC – proactive control, IP – initiative and persistence, SF – switching and flexibility, IA – inhibition and adjournment

* $p < 0.05$ (two-tailed). ** $p < 0.01$ (two-tailed). *** $p < 0.001$ (two-tailed)

³ It is available from the corresponding author for academic purposes.

NAS-40 scale given by two friends of the rated person. The correlations between self- and other-reports are significant for some subscales, especially for GM (Goal Maintenance) and IP (Initiative and Persistence), but they disappear for SF (Switching and Flexibility). The correlation between independent assessments of two informants completing NAS-40 questionnaire is $r = .35, p < .0001$.

Validity analysis

Validity analysis of NAS-40 (third-person version of the questionnaire) contains investigations of the relationships between NAS-40 and Tangney, Baumeister, and Boone's (2004) self-reported scale ($N = 58$, sample no. 6), and NEO-FFI ($N = 146$, samples no. 2 and no. 6). The correlation between the third-person NAS-40 completed by one friend and Tangney, Baumeister, and Boone's scale was relatively high ($r = .58, p < .001$). In the case of NEO-FFI, we obtained a weak correlation between NAS-40 and Conscientiousness ($r = .31, p < .001$), and no correlations for other subscales.

Thus, it appeared that self-reported self-control was rather weakly correlated with self-control assessed by other people. Therefore, we suggest that both versions should be administered in order to obtain a more thorough examination. The results of both versions can be interpreted separately, or they can be compiled using an averaged index or creating a latent variable obtained on the basis of all the data. Weak concordance between third-person descriptions is a cause of concern, but it does not necessarily reflect badly on the tool itself – perhaps it just indicates that we do not have a good knowledge of other people, when it comes to the assessment of their important individual traits. It may also suggest that our self-knowledge concerning control functions is inadequate (Nęcka, Lech, Sobczyk, & Śmieja, 2012). However, the third-person NAS-40 scores were related to personality traits assessed by NEO-FFI in theoretically expected way. We noted a positive relationship between NAS-40 and Conscientiousness, and lack of correlation with Neuroticism.

At first glance, the lack of correlation between NAS-40 score and Neuroticism seem unexpected in the light of the negative correlation between NAS-50 and Neuroticism, reported in the previous section. However, we can explain this differential pattern of correlations by the 'self-other knowledge asymmetry' (SOKA) model, proposed by Vazire (2010). The SOKA model aims at accounting for the differences in accuracy between self- and informant ratings across traits. According to this model, all personality traits can be characterized in terms of two factors: their observability from behavior and evaluativeness (i.e., desirability). Traits that are low in observability can be measured more accurately by means of self-ratings, whereas traits that are readily observable are measured more accurately by observant-ratings. In contrast, due to motivational factors, traits that are high in evaluativeness are better assessed by others. With respect to neuroticism, the SOKA model predicts that self-ratings of neuroticism will have higher validity than informant ratings due to low observability of this trait. Thus, it suggests that the differential pattern of the relationships between self- and other-ratings of self-control and neuroticism observed in

the current study can be accounted for by the SOKA model (Vazire, 2010) as reflecting the relationship between source-specific trait information and self-control. This conclusion can be supported by the study by Kurtz et al. (2012), showing that self-ratings of neuroticism had higher correlations with emotional adjustment than with the informant ratings.

Summary and conclusions

The results of the reliability analyses of NAS-50 scale indicated at least a good level of its internal consistency, as measured by Cronbach's alpha. The obtained reliability indices were particularly satisfactory in the case of the overall score and slightly weaker in the case of the individual subscales, which should not be surprising given that the subscales consisted of 10 items each. The lowest reliability indexes obtained for the PC subscale were oscillating between 0.65 and 0.70, which is acceptable. It may suggest, however, that the analysis of individual subscales should be performed with due caution. Furthermore, the current study also revealed good indicators of divergent and convergent validity of NAS-50, suggesting that the scale has satisfactory construct validity. As to the stability, NAS-50 appears very stable in test-retest analysis. The ICC for overall NAS-50 score exceeds .9, which is very high. The ICCs for subscales of NAS-50 are a little bit lower (over .8), but still very satisfying. In sum, it can be concluded that NAS-50 is a sufficiently good psychometric tool for evaluating individual level of self-control understood as a personal trait.

The second important component of the proposed tool is NAS-40 – a third-person version intended to allow evaluation of self-control by informants who have knowledge about the rated person's behavior. The results provide preliminary evidence of the measurement utility of NAS-40. Specifically, as revealed, NAS-40 showed the acceptable level of internal reliability and high level of stability as well. Moreover, NAS-40 showed moderate correlations with NAS-50. The correlation between independent self- and observer-assessments increased if NAS-40 questionnaire was completed by two independent informants. Moreover, the results of the divergent and convergent validity analysis of NAS-40 revealed that the patterns of correlations between NAS-40 with other theoretically grounded constructs were acceptable and analogical to those between NAS-50 and the respective constructs. In sum, current results suggest that NAS-50 and NAS-40 – as two different sources of information (self- and other-ratings) about the level of someone's self-control – may provide differential predictions and, in practice, they may be used in parallel.

References

- Arrington, C. M. & Logan, G. D. (2005). Voluntary task switching: Chasing the elusive homunculus. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31, 683–702.
- Ball, D., Hill, L., Freeman, B., Eley, T. C., Strelau, J., Riemann, R., Spinath, F. M., Angleitner, A., & Plomin, R. (1997). The serotonin transporter gene and peer-rated neuroticism. *NeuroReport*, 8, 1301–1304.

- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, *74*, 1252–1265.
- Baumeister, R. F. & Tierney, J. (2011). *Willpower: Rediscovering the greatest human strength*. New York: Penguin Books. Polish edition: *Sila woli*. Poznań: Media Rodzina.
- Braver, T. S., Gray, J. R., & Burgess, G. C. (2007). Explaining the many varieties of working memory variation: Dual mechanisms of cognitive control. In A. R. A. Conway, C. Jarrold, M. J. Kane, A. Miyake & J. N. Towse (Eds.), *Variation in Working Memory* (pp. 76–106). Oxford: Oxford University Press.
- Casey, B. J., Somerville, L. H., Gotlib, I. H., Ayduk, O., Franklin, N. T., Askren, M. K., Jonides, J., Berman, M. G., Wilson, N. L., Teslovich, T., Glover, G., Zayas, V., Mischel, W., & Shoda, Y. (2011). Behavioral and neural correlates of delay of gratification 40 years later. *PNAS*, *108*(36), 14998–15003.
- Clark, L. A., Vittengl, J., Kraft, D., & Jarrett, R. B. (2003). Separate personality traits from states to predict depression. *Journal of Personality Disorders*, *17*, 152–172.
- Chapman, B. P., & Goldberg, L. R. (2011). Replicability and 40-year predictive power of childhood ARC types. *Journal of Personality and Social Psychology*, *101*(3), 593–606. doi: 10.1037/a0024289
- Chapple, C. L., Vaske, J., & Hopec, T. L. (2010). Sex differences in the causes of self-control: An examination of mediation, moderation, and gendered etiologies. *Journal of Criminal Justice*, *38*(6), 1122–1131. doi: 10.1016/j.jcrimjus.2010.08.004
- Chen, L. S., Tu, H. H., & Wang, E. S. (2008). Personality traits and life satisfaction among online game players. *CyberPsychology & Behavior*, *11*, 145–9.
- Chevalier, N., Martis, S. B., Curran, T., & Munakata, Y. (2015). Metacognitive processes in executive control development: The case of reactive and proactive control. *Journal of Cognitive Neuroscience*, *27*(6), 1125–1136. doi: 10.1162/jocn_a_00782.
- Choynowski, M. (1967). *Test znajomości słów*. [The Word Knowledge Test] Warszawa: Pracownia Psychometryczna PAN.
- Chuderski, A. (2010). Samokontrola: własności, funkcje, mechanizmy i ograniczenia. [Self-control: properties, functions, mechanisms, and limits]. *Studia z Kognitywistyki i Filozofii Umysłu*, *4*, 27–51.
- Costa, P. T., Jr., & McCrae, R. R. (1992). Four ways five factors are basic. *Personality and Individual Differences*, *13*, 653–665.
- Criaud, M., Wardak, C., Ben Hamed, S., Ballanger, B., & Boulinguez, P. (2012). Proactive inhibitory control of response as the default state of executive control. *Frontiers in Psychology*, *3*:59. doi: 10.3389/fpsyg.2012.00059.
- Elfhag, K. & Morey, L. C. (2008). Personality traits and eating behavior in the obese: Poor self-control in emotional and external eating but personality assets in restrained eating. *Eating Behaviors*, *9*, 285–293.
- Higgins, G. E. (2004). Gender and self-control theory: Are there differences in the measures and the theory's causal model? *Criminal Justice Studies: A Critical Journal of Crime, Law and Society*, *17*(1), 33–55. http://doi.org/10.1080/0888431042000204961
- Jaworowska, A., & Szustrowa, T. (2010). *Test Matrycy Ravena w wersji standard. Formy: klasyczna, równoległa, plus*. [Raven's Matrices Test in the standard version. Forms regular, parallel, and plus]. Warszawa, PL: Pracownia Testów Psychologicznych PTP.
- Judge, T. A., Erez, A., Bono, J. E., & Thoresen, C. J. (2002). Are measures of self-esteem, neuroticism, locus of control, and generalized self-efficacy indicators of a common core construct? *Journal of Personality and Social Psychology*, *83*(3), 693–710. http://doi.org/10.1037//0022-3514.83.3.693.
- Kotabe, H. P., & Hofmann, W. (2015). On integrating the components of self-control. *Perspectives on Psychological Science*, *10*(5), 618–638.
- Krug, M. K., Carter, C. S. (2011). Anterior Cingulate Cortex contributions to cognitive and emotional processing: A general purpose mechanism for cognitive control and self-control. In R. R. Hassin, K. N. Ochsner & Y. Trope (Eds.), *Self-control in society, mind, and brain* (pp. 3–26). Oxford, UK: Oxford University Press.
- Kurtz, J. E., Puher, M. A., & Cross, N. A. (2012). Prospective prediction of college adjustment using self- and informant-rated personality traits. *Journal of Personality Assessment*, *94*(6), 630–637. http://doi.org/10.1080/00223891.2012.672506
- McCrae, R. R., Martin, T. A., & Costa, Jr., P. T. (2005). Age trends and age norms for the NEO Personality Inventory-3 in adolescents and adults. *Assessment*, *12*, 363–373. http://doi.org/10.1177/10731911052797240.
- Mehroof, & Griffiths (2010). Online Gaming Addiction: The Role of Sensation Seeking, Self-Control, Neuroticism, Aggression, State Anxiety, and Trait Anxiety. *Cyberpsychology, Behavior, and Social Networking*, *13*(3), 313–316.
- Mischel, W. (1974). Processes in delay of gratification. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 7, pp. 249–292). New York: Academic Press.
- Mischel, W., Shoda, Y., & Peake, P. (1988). The nature of adolescent competencies predicted by preschool delay of gratification. *Journal of Personality and Social Psychology*, *54*, 687–696.
- Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science*, *244*, 933–938.
- Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., Houts, R., Poulton, R., Roberts, B. W., Ross, S., Sears, M. R., Thomson, W. M., & Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *PNAS*, *108*, 2693–2698.
- Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*, *126*, 247–259.
- Norman, D. A. & Shallice, T. (1986). Attention to action: Willed and automatic control of behavior. In R. J. Davidson, G. E. Schwartz, & D. Shapiro (red.), *Consciousness and self-regulation. Advances in research and theory* (pp. 1–18). New-York: Plenum Press.
- Raven, J. C., Court, J. H., & Raven, J. (1983). *Manual for Raven's progressive matrices and vocabulary scales: Advanced Progressive Matrices Sets I and II*. London: H. K. Lewis.
- Schnabel, K., Asendorpf, J. B., & Ostendorf, F., (2002). Replicable types and subtypes of personality: German NEO-PI-R versus NEO-FFI. *European Journal of Personality*, *16*, S7–S24. doi: 10.1002/per.445
- Sandson, J. & Albert, M. L. (1984). Varieties of perseveration. *Neuropsychologia*, *22*, 715–732.
- Slabosz, A., Lewis, S. J., Śmigasiewicz, K., Szymura, B., Barker, R. A., & Owen, A. M. (2006). The role of learned irrelevance in attentional set-shifting impairments in Parkinson's disease. *Neuropsychology*, *20*, 578–588.
- Soubelet, A., & Salthouse, T. A. (2011). Personality–cognition relations across adulthood. *Developmental Psychology*, *47*(2), 303–310. http://doi.org/10.1037/a0021816
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Terracciano, A., McCrae, R. R., Brant, L. J., & Costa, P. T., Jr. (2005). Hierarchical linear modeling analyses of the NEO-PI-R scales in the Baltimore Longitudinal Study of Aging. *Psychology and Aging*, *20*, 493–506. http://doi.org/10.1037/0882-7974.20.3.493
- Vazire, S. (2010). Who knows what about a person? The self–other knowledge asymmetry (SOKA) model. *Journal of Personality and Social Psychology*, *98*(2), 281–300. http://doi.org/10.1037/a0017908
- Zawadzki, B., Strelau, J., Szczepaniak, P., Śliwińska, M. (1998). *Inwentarz osobowości NEO-FFI Costy i McCrae. Adaptacja polska. Podręcznik* [NEO-FFI Personality Inventory by Costa and McCrae. Polish adaptation. A manual]. Warszawa: Pracownia Testów Psychologicznych PTP.