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The relationships of need for closure dimensions with psychotic-like experiences and jumping to conclusions. A study of a large cross-population sample

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Summary

Aim. The theoretical affinity between need for closure (NFC) construct and psychotic symptomatology, especially delusionality, has been tested in various studies and brought diverse results. This study tested this relationship on a large sample from the general population using an online survey.

Method. "Preference for Predictability", "Discomfort with Ambiguity" and "Decisiveness" from an abridged NFC scale (NFCS) were used to check for associations with the symptoms of delusion-like ideations and hallucination-like experiences measured with an abridged version of Prodromal Questionnaire (PQ-16). Analyses included both linear and cluster models. Additionally, we examined the associations between jumping to conclusions (JTC) task, full abridged NFCS and psychotic-like symptoms (PLEs) in a smaller sample of individuals who had the highest scores in the online PLEs assessment.

Results. Our study confirmed that NFC is not a homogenous construct. It showed weak associations with psychotic-like symptoms and virtually no associations with JTC results. "Decisiveness" exhibited negative associations with the severity of PLEs.

Conclusions. The NFCS should not be used as a uniform measure and the clinical utility of high NFCS results as an indicator of vulnerability to psychopathology seems questionable. However, being indecisive might be a general sign of struggling with some sort of mental problems.

Key words: delusions, hallucinations, need for closure

Introduction

Certainty what to do or how to react in a given situation begets the comfortable feeling of safety. However, people often have to face various situations in life which, due to their ambiguity, are hard to evaluate and act upon. Being uncertain how to interpret and evaluate a given situation creates discomfort. Webster and Kruglanski [1] theorised that sometimes people are motivated to maintain simplified beliefs about the world which make it more predictable and orderly [2]. They called it 'need for closure' (NFC). Individuals with high NFC have a tendency to form quick judgements about situations and people, which reduces uncertainty and fulfills their need for order and clarity. On the other hand, when considering such phenomena as delusional thinking, this tendency to rely on limited information with certainty seems especially notable. In fact, e.g. meta-cognitive trainings for psychosis aim at lessening the strength of one's convictions and at considering various other explanations [3]. Therefore, it seems intuitively valid to associate the construct of NFC with such motivated processing as, presumably, the one behind delusional thinking in psychosis. This is also in line with the idea of "seizing and freezing" [4], which vividly denotes a tendency to formulate a quick judgement and then to hold on to it disregarding discordant evidence, which is characteristic of high need for cognitive closure.

Although Webster and Kruglanski [1] found a one factor and five sub-factor structure of the tool they developed to assess the construct (NFCS), many following studies did not agree with their model. Specifically, "Decisiveness" was the most discrepant with the remaining sub-factors ("Preference for Predictability", "Discomfort with Ambiguity", "Preference for Order" and "Closed-mindedness"), often showing negative correlations with them. Several other studies confirmed such two-factor model as valid [2, 5]. However, some other reports suggested even three dimensions, with "Preference for Order", "Preference for Predictability", and "Discomfort with Ambiguity" subscales forming one factor, called jointly NFCS-R, whereas "Closed-mindedness" and "Decisiveness" constituted two separate factors [6, 7].

NFC is often hypothesised to be a similar construct to so-called jumping to conclusions (JTC), as both are related to committing to quick judgements with little evidence. Despite the apparent plausibility of the potential associations between delusions, JTC and NFC, the research findings to date have been occasionally (delusions) or often (JTC) at odds with this view. In one study of a general population sample [8], the authors found delusion-prone individuals to score higher on NFCS than their less delusion-prone counterparts. Roets and Soetens [9] confirmed this relationship and extended it to other psychopathological symptoms in another non-clinical sample. A similar difference was also found for patients with persecutory delusions and healthy controls [10]. Furthermore, comparisons between acute or remitted psychotic patients and a control group [11] showed lower NFC scores for the last group, and the difference remained significant after controlling for depressive symptoms. This effect for psychotic patients was confirmed with the NFCS-R measure in a study with

repeated assessment [6]. Interestingly, the authors found the NFCS-R score to be related to trait anxiety in control and generalised anxiety disorder groups, but not in the psychotic one. On the other hand, in another report [12] no correlation was found between NFCS-R or "Decisiveness" and psychotic symptoms after controlling for depressive symptoms, and only "Decisiveness" was slightly negatively associated with hallucinations prior to the control. In an earlier study (2005), Freeman et al. [13] found NFC to have no relationship to virtually generated paranoia. Yet, "Preference for Predictability", "Discomfort with Ambiguity" and "Decisiveness" were associated with social anxiety towards virtual characters.

As regards JTC, it can be shortly described as a tendency to make decisions based on scant evidence and with high subjective certainty. As such, its affinity to the NFC concept seems obvious. However, the research has offered less support. In a previously mentioned study [8], the authors found no association between NFCS score and JTC measures, similarly to the findings of McKay et al. [14] in a non-clinical sample. Freeman et al. [12] found no difference between psychotic individuals exhibiting JTC bias (i.e. making a decision after less than three draws in three variants of the beads task) and those without when compared on the NFCS-R and the "Decisiveness" subscale. Moreover, no significant relationships between measures of NFC and JTC were found among individuals with delusions and among healthy subjects in a study by McKay et al. [10]. Interestingly, those researchers found no difference in draws to decision in the JTC task between both groups and the deluded were less confident in their decisions than healthy participants.

As it turns out, the relationship between JTC and delusional thinking is also not clear, as some studies show a positive correlation [8, 14, 15] while other do not support it [10]. A recent meta-analysis [16] found the correlation between delusional ideation and data gathering to be $rs = -0.10$, which is indeed weak. Yet, another meta-analysis by Dudley et al. [17] indicated that psychotic individuals required significantly less information prior to the decision. Interestingly, Ross et al. [18] conducted a classic beads task involving a non-clinical sample and argued that analytic cognitive style, not delusional ideation, is related to JTC, which is in accord with preliminary findings of Garety et al. [19]. Moreover, when paranoid thoughts and JTC were compared between the induced anxiety and control group, the former had both elevated [20], thus indicating another potential factor affecting both phenomena.

In general, the findings regarding the relationship between need for closure and the tendency towards psychotic-like experiences were observed mostly in clinical samples and their results are inconclusive. Yet, there is a generally accepted view of the health-illness continuum [21] and this in particular includes the dimension of psychoticism, i.e. delusions and hallucinations [22, 23]. Thus, the relationships of interest could be possibly better ascertained in a general population sample, as it comprises a wider spectrum of the phenomena in question. This was the idea behind the analyses presented in this manuscript (Study 1). We decided to test NFC's associations with delusion-like ideations, hallucination-like experiences, as well as the role of

affect (depressive symptoms). What is more, we also ran analyses to confirm the lack of relationship between NFC subscales and JTC tasks in a non-clinical subsample of subjects reporting experiences of psychotic-like symptoms (PLEs; Study 2).

Given the previous research, we suspected NFC subscales would probably not constitute a single, cohesive construct, and considering them separately in analyses might reveal a more informative picture of their associations. Due to the content limitations of Study 1, it was impossible to utilise the full NFC scale, even in its abridged version by Kossowska et al. [2]. Therefore, we chose three subscales, that is "Decisiveness" (NFCdec), "Preference for Predictability" (NFCpred) and "Discomfort with Ambiguity" (NFCamb). Study 2 utilised the complete abridged version, including the remaining two subscales, that is "Preference for Order" (NFCord) and "Closed-mindedness" (NFCmind).

Method

Sample

Adults aged 18-35 were invited by telephone to participate in the study using computer-assisted web interviews (CAWI). Recruitment was made in three Polish cities: Warsaw (1 700 000 inhabitants), Kraków (770 000 inhabitants) and Wrocław (640 000 inhabitants). All participants consented to the study, which was approved by the Ethics Committee of the Medical University of Warsaw. As the aim of this study was to evaluate the overall population sample, psychiatric diagnoses were not an exclusion criterion.

In the first of the two recruitment waves 3514 people participated. They completed an online survey including demographic data and answered questions that included items from the PQ-16, CES-D questionnaires and three subscales of the shortened version of the NFCS. The entire procedure lasted about 20-30 minutes. The data of 85 subjects were excluded from the analyses due to zero variance in the responses in the NFCS subscales (despite two items in the "Decisiveness" subscale with inverted scoring), suggesting carelessness in filling out. The final group in Study 1 therefore included 3429 people (2170 women, 1259 men).

In the second wave of recruitment 3258 people participated in the CAWI survey. From this group, people with the subsequent highest results from the pool of 10% of the highest PQ-16 questionnaire scores were invited by phone to participate in the direct study. The exclusion criteria included a history of diagnosis of psychotic or neurological disorders or taking antipsychotic drugs, as well as the use of psychoactive substances in up to 6 months prior to testing. The recruitment was completed after obtaining consent for direct examination from a group of 112 people, of whom the complete data analysed in Study 2 was collected from 106 people (66 women, 40 men).

The demographic and clinical data for Study 1 and Study 2 groups are presented in Table 1.

Tools

The abridged version of the Need for Closure Scale (NFCS) is a 15-item Polish version prepared by Kossowska et al. [2]. It has five 3-item subscales: (1) "Closed-mindedness", (2) "Preference for Order", (3) "Preference for Predictability", (4) "Discomfort with Ambiguity" and (5) "Decisiveness", of which we employed the last three in the online assessment (Study 1) and all five in the face-to-face procedure (Study 2).

The Prodromal Questionnaire (PQ-16) is a 16-item self-report questionnaire [24], a shortened version of a 92-item tool, used to screen for psychotic-like experiences (PLEs) that may predict psychosis onset. It consists of items that target attenuated positive symptoms except two items targeting anxiety and depression. The original rating scale for experiencing PLEs was binomial (true vs false); however, we modified it to reflect the frequency of PLEs into a 4-point Likert-type scale ('never', 'sometimes', 'often', 'almost always'). The 4-point Likert-type scale for assessing associated distress remained unchanged. We used a Polish version of the questionnaire that was prepared using the back-translation procedure [25].

The Center for Epidemiological Studies-Depression (CES-D) 20-item questionnaire was used to assess depressive symptoms. Respondents indicate how often they experienced the symptoms in the past week. This tool was specifically developed by Radloff [26] to estimate the prevalence of depression in the general population. The Polish version was developed by Jankowski [27]. In the present study, we used 5 items from the scale including: 1. 'I was bothered by things that usually don't bother me'; 3. 'I felt that I could not shake off the blues even with help from my family or friends'; 6. 'I felt depressed'; 7. 'I felt that everything I did was an effort' and 18. 'I felt sad'.

Jumping To Conclusions bias (JTC) was tested using a Fish Task [28, 29], which is a variant of the beads task, described earlier in multiple publications [16, 30]. It presents the subject with two ponds, each containing two types (colours) of fish but in inverse proportions. The task requires the subject to view each subsequent fish caught by an angler from one of the ponds and rate in percentages their confidence that the fish was caught from pond A or B, as well as decide whether they have enough information to tell conclusively which pond the angler catches fish from. This study utilised two tasks with 80/20 and 60/40 ratios of fish in two ponds. People with a tendency to jumping to conclusions would be expected to view few fish before making the final decision.

Statistical analyses

The analyses were performed with IBM SPSS Statistics 25 and with tidyLPA package [31] in R [32]. The significance level in all analyses was alpha = 0.05. Principal Component Analysis was used to assess the consistency of the need for closure construct. We used this method to empirically verify the argument that it is unifactorial. An oblique Promax rotation was adopted to account for the potential correlation between the identified components. The adequacy of the sample for the analysis was

decided based on the KMO measure (Keiser-Meyer-Olkin), the Bartlett test and the value of the correlation matrix determinant. The KMO measure should be at least 0.5, the Bartlett test should be significant, and the determinant of the correlation matrix greater than 0.00001 [33]. Moreover, the better the model reflects reality, the greater the percentage of variance is explained and the higher the factor loadings on one of the factors and the lower on the others for each of the variables.

A linear model in the form of hierarchical regression was used to analyse the relationships between the level of cognitive closure need and the intensity of psychotic-like experiences. This method allows one to evaluate the effect of newly added predictors on the change in the strength and significance of the relationship between the dependent variable and the previously included predictors. In order to investigate whether different levels of the intensity of the need for cognitive closure and the intensity of psychotic-like experiences create clusters of people with similar characteristics, latent profile analysis (LPA) was used. Therefore, this method allows to determine whether the studied group is heterogeneous and consists of homogeneous subgroups with separate distributions [34]. The Bayesian Information Criterion (BIC) was used to select the best model, with lower values indicating a better fit of the model to the data. The significance of the improvement in fit for the more complex models in terms of the degree of parameterisation was assessed using a chi-square test for the difference in log likelihood, whereas the significance of the improvement of the fit in terms of the number of classes was assessed using the bootstrapped likelihood ratio test (BLRT) [35]. The identified profiles are the better distinguished the higher is the probability of a given subgroup of respondents belonging to their own class (profile) and the lower to the other profiles.

The usefulness of the classification is also measured by means of entropy, ranging from 0 to 1 and higher values indicating better accuracy in assigning subjects to classes [34]. To assess the correlations between the subscales of the need for cognitive closure, the results of the jump-to-conclusion task and the intensity of psychotic-like experiences, the Pearson correlation coefficient was used together with the 95% confidence intervals, calculated using the BCa bootstrap method based on 2000 samples in order to reliably determine its significance regardless of normality of the distributions of correlated variables [33].

Results

Demographic and clinical data for Study 1 and 2 groups are presented in Table 1.

Table 1. **Demographic and questionnaire statistics for Study 1 and Study 2 samples**

	Study 1 N=3429		Study 2 N=106	
	n	%	n	%
Sex (women / men)	2170 / 1259	63.3 / 36.7	65 / 41	61.3 / 38.7

table continued on the next page

Education:				
Primary	84	2.4	5	4.7
Vocational	90	2.6	1	0.9
High school	1103	32.2	42	39.6
Bachelor's degree	589	17.2	14	13.2
Master's degree	1563	45.6	44	41.5
Marital status:				
Single	1600	46.7	55	51.9
Informal relationship	966	28.2	37	34.9
Married	818	23.9	13	12.3
Divorced / separated	43	1.3	1	0.9
Widowed	2	0.1	0	0.0
Mental health status:				
Any psychiatric diagnosis	590	17.2	29	27.4
Pharmacotherapy for psychiatric problems	701	20.4	34	32.1
Professional status:				
Student	1303	38.0	49	46.2
Employed	2418	70.5	78	73.6
Social/health benefit	23	0.7	2	1.9
	mean (sd)	range	mean (sd)	range
Age	26.3 (4.7)	18 – 35	25.6 (4.6)	18-36
PQ-16 total score	9.9 (6.2)	0 – 48	22.4 (3.6)	15-34
NFCpred (Study 1)	10.7 (2.8)	3 – 18	-	-
NFCamb (Study 1)	11.3 (1.9)	3 – 18	-	-
NFCdec (Study 1)	10.3 (3.0)	3 – 18	-	-
PQ-16 total score (Study 2)	-	-	14.8 (6.2)	2-29
NFC total score (Study 2)	-	-	55.4 (7.7)	26-71
NFCord (Study 2)	-	-	12.3 (3.3)	3-18
NFCpred (Study 2)	-	-	11.8 (3.3)	4-18
NFCamb (Study 2)	-	-	14.0 (2.6)	5-18
NFCmind (Study 2)	-	-	7.9 (2.7)	3-16
NFCdec (Study 2)	-	-	9.4 (3.6)	3-18

Study 1

In the first step, a principal component analysis with Promax rotation was run on the nine NFCS items to investigate their structure. The KMO measure equaled 0.811 and Bartlett's test was significant ($p < 0.001$), all individual measures of sampling adequacy were higher than 0.650 and the determinant of correlation matrix equaled 0.128. However, the percentage of residuals above 0.05 was 55%. Both scree plot and Horn's parallel analysis indicated two components, incidentally the same number as did Kaiser's criterion. Total variance explained by these two components equaled 52.5%. The items grouped into a joint component for "Preference for Predictability" (NFCpred) and "Discomfort with Ambiguity" (NFCamb) (loadings' range: 0.573; 0.785), hereafter jointly referred to as NFCcore, and "Decisiveness" (NFCdec ; loadings' range: 0.649; 0.833). The correlation between both components was $r = – 0.30$. Cronbach's alpha for the first component was 0.762 and 0.665 for the second.

Table 2. **Results of a principal component analysis (PCA) of the 9 items of the abridged NFCS comprising "Decisiveness", "Preference for Predictability" and "Discomfort with Ambiguity" (original item numbering). Pattern matrix**

	Components	
	1	2
NFC 10. I don't like to be with people who are capable of unexpected actions.	0.785	0.210
NFC 15. I dislike unpredictable situations.	0.739	0.067
NFC 13. I feel uncomfortable when someone's meaning or intention is unclear to me.	0.722	-0.074
NFC 2. I don't like situations that are uncertain.	0.613	0.063
NFC 4. I feel uncomfortable when I don't understand the reason why an event occurred in my life.	0.585	-0.131
NFC 5. I don't like to go into a situation without knowing what I can expect from it.	0.573	-0.200
NFC 6. I usually make important decisions quickly and confidently.	0.246	0.833
NFC 7. I would describe myself as indecisive.	-0.041	0.790
NFC 8. I tend to struggle with most decisions.	-0.278	0.649

PCA, Promax rotation with Kaiser's normalization. Convergence reached in 3 iterations.

Next, we intended to check whether there is a relationship between NFC subscales and hallucination and delusion-like symptomatology as PQ-16 has items with symptoms from both domains [24]. Analysing the content of the items we have identified the items referring to hallucination-like experiences as: 2, 3, 4, 5, 6, 8, 9, 12, 13, whereas referring to delusional-like ideations as: 10, 11, 14, 15, 16. Hierarchical regressions were run twice, first for the NFC subscales grouped according to PCA (i.e. NFCcore and NFCdec) and, second, for three separate NFC subscales. In the first step the models included additionally age and sex. In the second step CES-D-5 score was added, to

check the supposition that inclusion of affect renders the relation between NFC scales and symptoms insignificant. The results are presented in Tables 3 and 4.

Table 3. **Hierarchical regression models for hallucination-like experiences and delusion-like ideations – NFCS subscales grouped according to PCA results**

	Model		B	Std. Error	Beta	t	p-level	95% C.I. for B	
								lower bound	upper bound
Dependent variable: hallucination-like experiences	1 R^2= 0.042 adj.R^2= 0.041 F= 37.967 p= < 0.001	(constant)	6.891	0.509		13.549	0.000	5.894	7.888
		sex	0.366	0.123	0.050	2.970	0.003	0.124	0.608
		age	-0.067	0.013	-0.090	-5.296	0.000	-0.092	-0.042
		NFCcore	0.051	0.015	0.057	3.359	0.001	0.021	0.081
		NFCdec	-0.194	0.020	-0.165	-9.614	0.000	-0.233	-0.154
	2 R^2= 0.177 adj.R^2= 0.176 F= 147.663 p= < 0.001	(constant)	1.159	0.530		2.187	0.029	0.120	2.198
		sex	0.595	0.115	0.082	5.188	0.000	0.370	0.820
		age	-0.029	0.012	-0.040	-2.488	0.013	-0.052	-0.006
		NFCcore	0.009	0.014	0.009	0.602	0.547	-0.019	0.036
		NFCdec	-0.028	0.020	-0.024	-1.410	0.159	-0.067	0.011
		Ces-D total	0.384	0.016	0.406	23.698	0.000	0.352	0.415
Dependent variable: delusion-like ideations	1 R^2= 0.089 adj.R^2= 0.088 F= 83.794 p= < 0.001	(constant)	4.692	0.347		13.534	0.000	4.013	5.372
		sex	0.365	0.084	0.072	4.344	0.000	0.200	0.530
		age	-0.048	0.009	-0.092	-5.573	0.000	-0.065	-0.031
		NFCcore	0.061	0.010	0.097	5.888	0.000	0.041	0.081
		NFCdec	-0.208	0.014	-0.254	-15.158	0.000	-0.235	-0.181
	2 R^2= 0.260 adj.R^2= 0.259 F= 240.868 p= < 0.001	(constant)	0.181	0.351		0.516	0.606	-0.507	0.870
		sex	0.545	0.076	0.108	7.173	0.000	0.396	0.694
		age	-0.018	0.008	-0.036	-2.359	0.018	-0.034	-0.003
		NFCcore	0.028	0.009	0.044	2.928	0.003	0.009	0.046
		NFCdec	-0.078	0.013	-0.095	-5.893	0.000	-0.104	-0.052
		Ces-D total	0.302	0.011	0.458	28.138	0.000	0.281	0.323

Table 4. **Hierarchical regression models for hallucination-like experiences and delusion-like ideations – separate NFCS subscales**

	Model		B	Std. Error	Beta	t	p-level	95% C.I. for B	
								lower bound	upper bound
Dependent variable: hallucination-like experiences	1 R^2= 0.046 adj.R^2= 0.045 F= 32.967 p= < 0.001	(constant)	7.247	0.518		14.000	0.000	6.232	8.262
		sex	0.302	0.124	0.042	2.430	0.015	0.058	0.546
		age	-0.068	0.013	-0.092	-5.405	0.000	-0.093	-0.043
		NFCdec	-0.157	0.023	-0.134	-6.921	0.000	-0.201	-0.112
		NFCpred	0.116	0.024	0.094	4.863	0.000	0.069	0.163
		NFCamb	-0.064	0.036	-0.034	-1.787	0.074	-0.135	0.006
	2 R^2= 0.179 adj.R^2= 0.178 F= 124.587 p= < 0.001	(constant)	1.449	0.539		2.685	0.007	0.391	2.506
		sex	0.547	0.116	0.075	4.722	0.000	0.320	0.774
		age	-0.030	0.012	-0.041	-2.585	0.010	-0.054	-0.007
		NFCdec	-0.002	0.022	-0.002	-0.090	0.928	-0.045	0.041
		NFCpred	0.056	0.022	0.046	2.528	0.012	0.013	0.100
		NFCamb	-0.076	0.033	-0.041	-2.266	0.024	-0.141	-0.010
		Ces-D total	0.382	0.016	0.404	23.579	0.000	0.350	0.413
Dependent variable: delusion-like ideations	1 R^2= 0.091 adj.R^2= 0.089 F= 68.172 p= < 0.001	(constant)	4.850	0.353		13.730	0.000	4.158	5.543
		sex	0.337	0.085	0.066	3.967	0.000	0.170	0.503
		age	-0.049	0.009	-0.093	-5.641	0.000	-0.065	-0.032
		NFCdec	-0.192	0.015	-0.234	-12.406	0.000	-0.222	-0.161
		NFCpred	0.090	0.016	0.104	5.521	0.000	0.058	0.122
		NFCamb	0.010	0.025	0.007	0.396	0.692	-0.038	0.058
	2 R^2= 0.261 adj.R^2= 0.259 F= 201.064 p= < 0.001	(constant)	0.273	0.358		0.763	0.445	-0.429	0.975
		sex	0.530	0.077	0.105	6.896	0.000	0.379	0.681
		age	-0.019	0.008	-0.036	-2.404	0.016	-0.034	-0.003
		NFCdec	-0.070	0.015	-0.085	-4.763	0.000	-0.098	-0.041
		NFCpred	0.043	0.015	0.050	2.893	0.004	0.014	0.072
		NFCamb	0.001	0.022	0.001	0.035	0.972	-0.043	0.044
		Ces-D total	0.301	0.011	0.457	28.058	0.000	0.280	0.322

To assess whether individual scores on NFCdec, NFCpred and NFCamb tend to form clusters with scores on the delusional and hallucinatory spectrum assessed with PQ-16 a latent profile analysis (LPA) was conducted. The sample was randomly split

into two similar size subsamples (n = 1715 and n = 1714), as utilising the total sample resulted in unstable outcomes, which may have been due to convergence issues.

Table 5. **Descriptive statistics and correlations among NFC and PQ scores for the subsamples n = 1715 and n = 1714**

		NFCdec	NFCpred	NFCamb	PQhal	PQdel
n = 1715	min	3	3	3	0	0
	max	18	18	18	21	14
	mean	10.36	10.68	11.32	4.73	3.11
	sd	3.00	2.82	1.89	3.47	2.46
	skewness	-0.12	-0.14	-0.03	1.23	1.01
	kurtosis	10.36	10.68	11.32	4.73	3.11
n = 1714	min	3	3	3	0	0
	max	18	18	17	27	15
	mean	10.33	10.68	11.33	4.77	3.13
	sd	2.97	2.86	1.85	3.53	2.43
	skewness	-0.06	-0.16	-0.13	1.50	1.01
	kurtosis	-0.13	-0.01	0.48	3.49	1.16
	Pearson correlation coefficients between NFC and PQ scores included in LPA for subsample n = 1715 (above diagonal) and subsample n = 1714 (below diagonal)					
		NFCdec	NFCpred	NFCamb	PQhal	PQdel
	NFCdec		-0.249	0.267	-0.183	-0.276
	NFCpred	-0.293		0.315	0.122	0.17
	NFCamb	0.232	0.348		-0.054	-0.036
	PQhal	-0.165	0.104	-0.042		0.693
	PQdel	-0.249	0.157	-0.023	0.705	

The LPA analyses tested models with 1 to 7 profiles (classes) with varying variances and with covariances either fixed to zero or also varying. These models were formed based on the data including NFCdec, NFCpred, NFCamb and the PQdel (delusion-like ideations) and PQhal (hallucination-like experiences) scores. The best solutions in both subsamples, according to BIC and tested for significance with chi-square and BLRT tests, consisted of 3 latent classes with varying variances and covariances, presented in Fig. 1. The entropy for the n = 1715 subsample equaled 0.53, whereas for the n = 1714 subsample it was 0.58.

The resulting means for the extracted three classes in both subgroups are presented in Table 6 along with average posterior probabilities associated with each class.

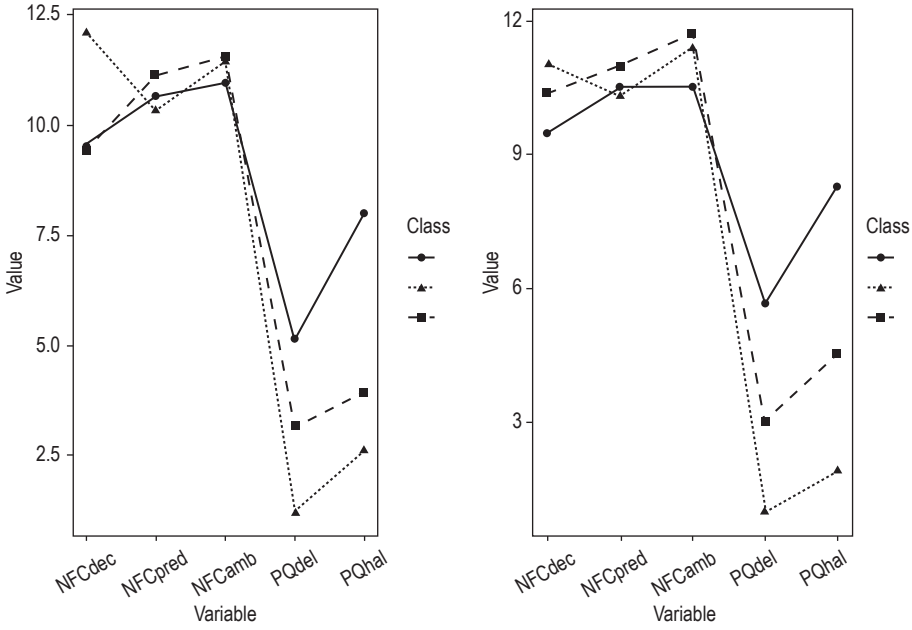

Figure 1. **LPA results for psychotic-like experiences and NFC dimensions in the subsample *n* = 1715 (left) and *n* = 1714 (right)**

Table 6. **Means and average posterior probabilities of class affiliation for LPA models with NFC subscales, delusion-like ideations and hallucination-like experiences**

Subsample	Class	n	Means for scores in classes					Average posterior probabilities associated with class:		
			NFCdec	NFCpred	NFCamb	PQdel	PQhal	1	2	3
n = 1715	1	461	9.52	10.64	10.97	5.13	7.99	0.867	0.028	0.105
	2	647	12.08	10.29	11.44	1.19	2.61	0.062	0.780	0.158
	3	607	9.41	11.11	11.53	3.17	3.89	0.159	0.112	0.729
n = 1714	1	373	9.48	10.54	10.52	5.66	8.27	0.865	0.007	0.128
	2	521	11.03	10.29	11.41	0.96	1.89	0.023	0.773	0.204
	3	820	10.39	10.98	11.73	3.00	4.52	0.124	0.067	0.809

Study 2

The second study was conducted on a subsample of 106 individuals participating in face-to-face assessment. It employed the complete abridged NFCS [2] as well as a JTC task (fish task) and the assessments of delusion-like ideations and hallucination-like

experiences with PQ-16, performed both during the online measurement and during the face-to-face meeting. The correlations between NFCS subscales and JTC results are presented in Table 7. The correlations of NFCS subscales and JTC results with PQ scores are shown in Table 8. To avoid inflation of correlation coefficients due to distributions diverging from normal, the bootstrap method (2000 samples) was utilised to calculate 95% BCa confidence intervals for the assessed parameters. Nonetheless, significance based on normal distribution was indicated with asterisks.

Table 7. **Pearson's correlation coefficients and their bootstrapped 95% BCa confidence intervals for NFCS subscales and JTC results (significant correlations are bolded)**

	NFCord	NFCpred	NFCamb	NFCmind	NFCdec	NFCtotal
NFCord		**0.521** [0.355; 0.655]**	**0.500** [0.297; 0.665]**	**-0.232* [-0.417; – 0.020]**	-0.020 [-0.239; 0.187]	**0.743** [0.632; 0.824]**
NFCpred			**0.571** [0.407; 0.698]**	-0.115 [-0.325; 0.094]	-0.191 [-0.363; – 0.001]	**0.725** [0.621; 0.804]**
NFCamb				-0.088 [-0.260; 0.092]	**-0.302** [-0.492; – 0.085]**	**0.637** [0.490; 0.752]**
NFCmind					-0.116 [-0.325; 0.090]	0.112 [-0.112; 0.338]
NFCdec						**0.230* [0.062; 0.387]**
JTC task 80/20 -draws to decision	0.025 [-0.174; 0.237]	0.152 [-0.038; 0.335]	0.184 [-0.045; 0.369]	-0.074 [-0.268; 0.108]	-0.060 [-0.258; 0.144]	0.086 [-0.138; 0.283]
JTC task 80/20 -confidence %	0.042 [-0.178; 0.275]	-0.004 [-0.203; 0.214]	-0.063 [-0.236; 0.146]	0.121 [-0.098; 0.312]	0.097 [-0.061; 0.259]	0.082 [-0.100; 0.287]
JTC task 60/40 -draws to decision	0.064 [-0.128; 0.256]	0.180 [-0.003; 0.344]	**0.286** [0.055; 0.477]**	0.004 [-0.179; 0.196]	-0.062 [-0.290; 0.175]	0.176 [-0.005; 0.342]
JTC task 60/40 -confidence %	-0.014 [-0.252; 0.233]	-0.042 [-0.256; 0.188]	-0.062 [-0.248; 0.155]	0.021 [-0.157; 0.177]	-0.005 [-0.215; 0.195]	-0.041 [-0.261; 0.210]

Indicators of significance based on normal distribution: * correlation is significant at the 0.05 level (2-tailed); ** correlation is significant at the 0.01 level (2-tailed)

Table 8. **Pearson's correlation coefficients and their bootstrapped 95% BCa confidence intervals between PLEs and NFCS subscales and JTC results (significant correlations are bolded)**

	PQhal.1	PQdel.1	PQhal.2	PQdel.2
NFCord	-0.127 [-0.284; 0.037]	-0.178 [-0.332; 0.005]	0.046 [-0.128; 0.217]	0.049 [-0.120; 0.231]
NFCpred	-0.158 [-0.345; 0.032]	-0.141 [-0.326; 0.065]	-0.016 [-0.233; 0.187]	0.074 [-0.133; 0.283]
NFCamb	**-0.219* [-0.398; – 0.018]**	-0.135 [-0.307; 0.048]	0.030 [-0.171; 0.221]	-0.069 [-0.268; 0.129]
NFCmind	-0.038 [-0.257; 0.173]	-0.032 [-0.222; 0.153]	-0.018 [-0.217; 0.195]	0.073 [-0.100; 0.249]
NFCdec	0.064 [-0.145; 0.262]	-0.117 [-0.291; 0.060]	-0.185 [-0.365; 0.011]	-0.151 [-0.351; 0.054]
NFC total score	-0.182 [-0.344; 0.003]	**-0.250** [-0.415; – 0.049]**	-0.068 [-0.258; 0.121]	-0.016 [-0.204; 0.182]
JTC task 80/20 -draws to decision	0.048 [-0.126; 0.222]	-0.061 [-0.266; 0.143]	-0.130 [-0.323; 0.064]	-0.155 [-0.322; 0.017]
JTC task 80/20 -confidence %	**-0.161 [-0.331; – 0.004]**	-0.025 [-0.224; 0.154]	-0.027 [-0.167; 0.107]	0.009 [-0.144; 0.160]
JTC task 60/40 -draws to decision	-0.081 [-0.271; 0.093]	0.010 [-0.189; 0.217]	-0.002 [-0.179; 0.191]	0.052 [-0.134; 0.239]
JTC task 60/40 -confidence %	0.062 [-0.110; 0.229]	-0.045 [-0.240; 0.136]	-0.044 [-0.219; 0.126]	-0.086 [-0.308; 0.140]

PQhal.1 / PQdel.1 – hallucination-like experiences / delusion-like ideations measured online; PQhal.2 / PQdel.2 – hallucination-like experiences / delusion-like ideations measured during face-to-face interviews; indicators of significance based on normal distribution: * correlation is significant at the 0.05 level (2-tailed); ** correlation is significant at the 0.01 level (2-tailed)

Discussion

The NFC construct seems theoretically related to the concept of delusion formation and to jumping to conclusions. This could have additional clinical value in identifying individuals at risk of psychosis. Yet the studies so far have brought in mixed results as regards these associations. The purpose of this study was to firstly investigate the selected NFC subscales' relationships to delusion and hallucination-like experiences in a large population-based sample (Study 1). Secondly, it aimed to check NFCS's associations with JTC, which was performed in a sample of individuals exhibiting the highest scores in the online assessment of PLEs (Study 2). We also assessed the

uniformity of the NFC construct itself, as it has been a long-debated subject. Our results support the notion that NFC does seem to be an amalgam of several related but distinct constructs, with "Decisiveness" and "Closed-mindedness" especially diverging from the remaining three subscales. Second, NFC subscales show some weak relationship to psychotic-like symptoms and affect seems to explain part of that relationship. Third, we found no indication that people with higher NFC scores tend to jump to conclusions.

Analyses of the three NFCS subscales using PCA revealed two components, with "Preference for Predictability" and "Discomfort with Ambiguity" items forming the first one and "Decisiveness" items the second. This agrees with previous findings [6, 7] on the full NFCS, according to which the above subscales forming the first component along with "Preference for Order" items comprising the so-called NFCS-R, whereas "Decisiveness" and "Closed-mindedness" constituting separate constructs. The correlations found for the five subscales in Study 2 agree well with this finding of Neuberg et al. [7]. Therefore, this strengthens the notion that NFCS should not be used as a unidimensional scale as this may be misinformative when trying to assess the need for closure. Interestingly, a short NFCS version proposed by Roets and Van Hiel [36] has completely rewritten "Decisiveness" subscale items, to tap the need instead of ability to form quick decisions, which, as the authors argue, was the weakness of the original NFCS. However, their method for selecting 15 items for the abridged version was based on a forced 1-component PCA solution on the full NFC scale including altered "Decisiveness" items. The selected items were then checked for unidimensionality which was confirmed. Noteworthy, the selection differed partly from the items used in this study.

The relationships of NFC subscales with psychotic subclinical symptoms assessed with PQ-16 were confirmed in our study, although the regression model showed low strength of associations. Initially, we grouped three NFC subscales according to PCA results, that is "Decisiveness" as a single score and "Preference for Predictability" coupled with "Discomfort with Ambiguity" as another score. This in part resembled the division into NFC-R and separate subscales of "Decisiveness" and "Closed-mindedness" utilised previously [12]. The results of the regression analyses showed that both in the case of hallucination-like experiences and delusion-like ideations NFC constructs are significantly associated with them. The inclusion of depressive symptoms rendered NFC scores insignificant in the case of hallucination-like experiences, whereas for delusion-like ideations they remained significant, although the relationships weakened. Therefore, NFC seems to have a more specific relationship with the latter. The results fall in the middle ground between those of Bentall and Swarbrick [11] and Freeman et al. [12] and show that depressive symptoms have a diminishing effect on the strength of the relationship between NFC and psychotic-like symptoms. Notably, in both cases "Decisiveness" correlated negatively with symptoms, showing that individuals scoring higher on both symptomatic measures considered themselves indecisive. This corresponds with the findings of Freeman

et al. [12] regarding delusions and stands in opposition to the idea that hasty decisions contribute to their development.

Next, we changed the regression models to include separate NFC subscales instead of NFCcore construct. For delusion-like ideations the results were similar to the above, except that "Discomfort with Ambiguity" turned out to be insignificant prior and after inclusion of depressive symptoms. However, in the case of hallucination-like experiences, their association with "Discomfort with Ambiguity" turned out to be negative and became significant after inclusion of affect in the model. This surprising result suggests that individuals acknowledging hallucination-like symptoms have a higher tolerance for situations or people's intentions which are unclear to them. Yet, it has to be noted that the significance level is relatively poor and the association itself weak, which may indicate this is a chance finding. Nevertheless, the relationship of NFC with delusion-like symptoms seems more stable and clear than that with hallucination-like experiences.

Lastly, it should be noted that NFC subscales in Study 1, along with age and sex as additional predictors, explain quite a small proportion of variance in regression models for both dependent variables. If high NFC was a significant factor in the development of delusions it should affect the variability more prominently. However, the factual relationship between these variables may be obscured by the assumption of linearity. Therefore, this study also tested the relationships between NFCS subscales and hallucination and delusion-like symptoms without assuming linearity, that is, analysing the data for latent profiles or clusters grouping the studied individuals. To the best of our knowledge this is a novel approach in relation to the construct of need for closure. The best solutions revealed three profiles in both tested groups. These profiles show that "Preference for Predictability" and "Discomfort with Ambiguity" may have non-linear relationships with delusion-like ideations and hallucination-like experiences. However, in both solutions the highest mean "Decisiveness" score is found for cluster two and it is associated with the lowest cluster scores for both types of psychotic-like symptoms. Moreover, the relationship between "Decisiveness" and symptoms is indeed inverse in the second subsample, while in the first the other two clusters (one and three) score similarly low in "Decisiveness". This is akin to the results of the linear regression models and points to the potential value of assessing "Decisiveness" in relation to psychotic, especially delusional, symptoms. Interestingly, indecisiveness had already been found to be positively related to delusion-proneness by McKay et al. [14] and Freeman et al. [12], as well as to a whole set of other psychopathologic symptoms [9]. Finally, it should be noted that the entropy for both LPA models is somewhat above fifty percent which indicates that the separation of classes is moderate. However, the entropy may decrease due to large sample size and other factors [37] and at the same time the average posterior probabilities of class affiliation are satisfactory.

The results of our study do not lend support to using NFCS as a uniform scale, where high results could potentially indicate individuals at greater risk of develop-

ing psychotic symptoms. However, they indicate that "Decisiveness", as measured by NFCS, may have an inverse relationship with a tendency toward experiencing psychotic-like symptoms. Along the lines of discussion by Freeman et al. [12], emotional distress associated with having such symptoms, possibly including also anxiety, may increase the subjective experience of indecision. Besides, one additional point should be made here. The sample in Study 1, which was conducted over the internet, comprised a wide spectrum of members of the general public, including those with psychiatric diagnoses. However, it probably did not include patients with acute delusional symptoms. It may be the case that, while in stable, remitted individuals with delusion-like ideations "Decisiveness" is lower than in healthy subjects, it might spike in the acute delusional phase. Incidentally, the study by Bentall and Swarbrick [11] found "Decisiveness" higher in acute patients. Otherwise, both regression and LPA analyses suggest that individuals experiencing delusion-like ideations, at least declaratively, show that making decisions is not easy for them.

The second part of our analyses, Study 2, was performed on individuals with high scores on psychotic-like experiences measured with PQ-16 in the internet-based evaluation. As mentioned, the analyses of intercorrelations between NFC subscales presented similar patterns as those found by Neuberg and colleagues [7], that is, "Decisiveness" and "Closed-mindedness" were weakly related to the remaining three subscales, which formed a more cohesive construct. Neuberg et al. [7] recommended using those two subscales separately from the remaining three, called jointly NFCS-R. Our results support this conclusion. Further studies confirmed especially the distinction of "Decisiveness" [2]. The virtual lack of relationships between NFC subscales and the jumping to conclusion task, i.e. "fish task", also corroborated some previous findings [8, 10, 12, 14]. We found no significant associations except for one low positive correlation of draws to decision in 60/40 fish task with "Discomfort with Ambiguity". At most, these correlations may suggest an opposite trend to the one expected, which would be high NFC being linked with high tendency to jump to conclusions, i.e. deciding after fewer fish. The key point to consider here is that the former is a subjective and declarative measure, whereas the latter involves actual decision making in a probabilistic context, but possibly, with low ecological validity [38, 39]. Thus, both have specific limitations and either one might miss the actual tendency in real life situations.

Importantly, the correlation analyses of NFC and JTC with delusional and hallucinatory-like symptomatology showed almost no significant associations within our sample. The three significant correlations (including one for total NFC score) are low and are negative, as opposed to the expected associations between the symptoms and the measures of NFC and JTC. Moreover, they are not replicated in the second assessment with PQ-16 taken during face-to-face interviews, which may suggest they are chance findings. As PQ-16 scores were used to select the group, their variability was possibly lowered due to this fact, even though the second assessment was made. This may obscure the existence of a relationship, especially if

it is not very salient, as may be the case here. Nevertheless, both NFC and JTC do not seem to have clearly evident associations with neither delusion-like ideations nor hallucination-like experiences.

Conclusions

Summing up, our study confirmed that NFC, as assessed by an abridged version of NFCS, is not a homogenous construct, thus it should not be used in this manner. Moreover, the clinical utility of high NFCS scores as an indicator associated with vulnerability to psychopathology is questionable. NFC is weakly related to delusion and hallucination-like symptoms, but shares variability with affect. It also remains unrelated to JTC performance measures. An additional finding is the association between lack of decisiveness, as measured by the "Decisiveness" subscale of NFCS, and higher severity of psychotic-like symptoms. This was found using both regression and latent profile analysis and is supportive of previous findings [9]. Possibly, being indecisive is a general sign of struggling with some sort of mental problems.

Limitations

We need to once again point to several limitations of this study. First, in Study 1 we did not utilise the abridged NFCS tool in full. The findings allow to conclude that the measure is not unidimensional and should not be used as such; however, the inclusion of the remaining two subscales would provide the complete picture. The large sample that was successfully recruited for the CAWI study is characterised by a relatively higher proportion of female respondents and with higher education as compared to their share in the Polish population. A potential factor that could influence this was the area of recruitment, i.e. university cities, along with the adopted age restrictions, and the profile of respondents participating in opinion polls. Therefore, caution should be exercised in generalising the obtained results to the general population. Moreover, our study groups did not include individuals with acute delusional or hallucinatory symptoms, which could be especially valuable in terms of latent profile analyses.

There are of course also limitations imposed by the tools used to evaluate the studied phenomena, especially self-report questionnaires. This type of assessment is vulnerable to both intentional and unintentional distortions of the phenomenon that is measured. Hopefully, the utilisation of a big sample aided in elimination of some sources of such errors.

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