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Neuroticism and the mental noise hypothesis: Relationships to lapses of attention and slips of action in everyday life

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Abstract

We investigated the relationship between neuroticism and cognitive failure liability in everyday-life situations. Previous research (e.g., Robinson & Tamir, 2005; Robinson, Wilkowski & Meier, 2006) reported a positive association between the trait of neuroticism (N) and fluctuations in mental efficiency when performing elementary cognitive operations. High-N individuals were proposed to be characterized by increased noise within information processing from perception to action. To further examine this relationship, we collected self-report data from 222 individuals, measuring N via the Eysenck Personality Questionnaire and the related construct of Behavioural Inhibition System sensitivity via the BIS/BAS scales, and assessing cognitive failure liability via the Cognitive Failures Questionnaire (CFQ). The results revealed positive correlations between N and general cognitive failure liability, providing further support for the mental noise hypothesis. A more detailed investigation of CFQ subscales (Meiran et al., 1994) yielded a specific pattern, with the strongest correlation between N and the CFQ–Unintended Activation subscale ($r = .40$; $p < .01$). This suggests that high-N individuals preferably commit cognitive failures due to intrusions of task-irrelevant cognitions from associative memory.

Key words: neuroticism; mental noise; cognitive failure liability; attention

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The personality dimension labelled "neuroticism" is one of the empirically most robust and best replicated traits in various theories of personality. Originally the concept was introduced by Eysenck (1947), for whom neuroticism was a dimension ranging from emotional lability to stability. Cattell (1965) conceptualized neuroticism as anxiety, Guilford (1959) as emotionality, and Tellegen (1982) as negative emotionality. Some facets of neuroticism are identical with Strelau and Sawadzki's (1993) concept of reactive emotionality. Individuals high in neuroticism are assumed to be generally less adaptive in response to novel situations and less effective in regulating emotion and behaviour (Cattell & Scheier, 1961; Eysenck, 1947). They are generally characterized as anxious and easily aroused with regard to the autonomous system (Germain, Buysse, Ombao, Kupfer, & Hall, 2003). Neuroticistic individuals are reported to be emotionally labile with a tendency to experience negative emotion and mood (Eid & Diener, 1999), and to be sensitive to punishment cues from their physical and social environment (Derryberry & Reed, 1994). Further, they are regarded to be less tolerant to stress factors and to frequently experience worry and discomfort when faced with difficult task demands (Bolger & Zuckerman, 1995; Moskowitz & Zuroff, 2004). Moreover, several studies reported high neuroticism to be associated with low self-esteem, problems in social interactions, and unhappiness with the individual's present situation (Brown & Moskowitz, 1997).

The most salient feature of neuroticism (N) is state instability. As mentioned before, the ends of the dimension are often termed *stability* (low N) versus *instability* (high N). There are numerous studies that concordantly support the idea that high N reflects a ubiquitous tendency towards instability in emotion, cognition, and behaviour (e.g., Eid & Diener, 1999; Eysenck & Eysenck, 1985; Moskowitz & Zuroff, 2004; Westhoff, 1975). In pursuing goals, high-N individuals tend to be inflexible and less adaptive when faced with task demands that are constantly changing (Robinson, Wilkowski, Kirkeby, & Meier, 2006). Studies suggest that these individuals are more reactive to stressors (Bolger & Zuckerman, 1995; Carver & White, 1994; Patterson & Newman, 1993), which consequently trigger reactivity processes that produce variability in emotional and motivational states (Fiske & Rice, 1955). For example, high-N compared to low-N individuals have been shown to respond with increased effort to enhanced task demands, which, in turn, brings about an increased risk of energy depletion and mental exhaustion (Muraven & Baumeister, 2000). Therefore, high-N individuals may get tired more easily when performing cognitive activity over prolonged time periods. High N has also been found to be associated with strong behavioural inhibition after committing errors or receiving negative feedback (Boksem, Tops, Wester, Meijman, & Lorist, 2006; Pailing & Segalowitz, 2004), which has lead to the notion that some aspects of neuroticism can be conceptualized as sensitivity to punishment (Smilie & Jackson, 2006).

The nature of neuroticism-related individual differences in cognitive processing and performance has attracted many researchers long since (Cattell & Scheier, 1961, pp. 86-91), and a multitude of chronometric paradigms has been examined. Recently, Robinson and Tamir (2005) reported a positive correlation between neuroticism and reaction time (RT) variability in chronometric tasks: although high-N individuals did not differ from lower-N individuals in their mean RT performance, they appeared to be more inconsistent in their performance than low-N individuals. Since increased RT variability usually arises from an increased frequency of very long RTs, which are deemed to reflect attentional lapses or "mental blockings" (e.g., Bills, 1931; Flehmig, Steinborn, Langner, Scholz, & Westhoff, 2007; Ulrich & Miller, 1994, p. 34; Weissman, Roberts, Visscher, & Woldorff, 2006), Robinson and

Tamir's results indicate that high-N individuals can be characterized as having an increased tendency to commit lapses of attention during RT tasks.

In subsequent research, Robinson and colleagues replicated their findings in other chronometric paradigms (Robinson, Wilkowski, Kirkeby et al., 2006; Robinson, Wilkowski, & Meier, 2006). They argued that instability of elementary cognitive operations is a general and task-independent characteristic of high-N individuals. Furthermore, they suggested that neuroticism reflects system noise in the brain's control circuits. By referring to the concept of mental noise (Laming, 1968; Luce, 1986, pp. 253-268), Robinson and colleagues argued that a significant characteristic of high N can be labelled inconsistency of elementary cognitive operations within the processing stream from stimulus perception to the motor response. Mental noise is assumed to be caused by two main sources, mental preoccupations and reactivity processes (Robinson & Tamir, 2005, p. 107-108). Preoccupations refer to the processing of task-irrelevant cognitive information, such as intrusions of current worries, negative mood, or somatosensory input. Reactivity processes refer to increased effort investment when unexpectedly faced with difficult task demands, oftentimes resulting in increased energy depletion and fatigue.

Research Plan

The mental noise hypothesis predicts that high-N individuals should perform more inconsistently than low-N individuals, since they are less effective in regulating cognition and behaviour in all kinds of everyday-life situations. However, this proposal has not been exhaustively examined yet. To investigate neuroticism-related cognitive performance instability in a more natural way, a study based on self-reported behavioural phenomena in everyday life seemed to be a promising approach. Various kinds of questionnaires have been developed to assess people's self-estimated attention and memory abilities in natural circumstances (Herrmann, 1982). Among them, the best-known and most widely used one is the Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, Fitzgerald, & Parkes, 1982).

The CFQ is a 25-item questionnaire that assesses the efficiency of a person's everyday attentional and memory performance, especially under stressful conditions. It requires subjects to report (on a 5-point Likert scale) the frequency of everyday slips and lapses during the last six months. The CFQ has been shown to have high retest reliability and internal consistency (Klumb, 1995). High CFQ-scorers had deficits in sustained attention and concentration over prolonged time periods (Flehmig, Steinborn, Langner, & Westhoff, 2007), and in the ability to flexibly adjust their attentional focus in response to changing environmental demands (Meiran, Israeli, Levi, & Grafi, 1994). Further, the CFQ has been found to be positively correlated with accident frequency (e.g., Larson & Merritt, 1991; Simpson, Wadsworth, Moss, & Smith, 2005) and dysfunctions of everyday attention and memory (e.g., Michiels, de Gucht, Cluydts, & Fischler, 1999; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997; Sher, Mann, & Frost, 1984). Several authors argued that the CFQ measures not only aspects of attention and memory ability but also stress reactivity (e.g. Mahoney, Dalby, & King, 1998; Wells & Matthews, 1994).

The CFQ was developed to measure everyday-life cognitive failure liability, which was originally considered a unidimensional concept (Broadbent et al., 1982). Several subsequent studies attempted to ascertain the dimensionality of the construct, each with slightly different results (Larson, Alderton, Neideffer, & Underhill, 1997; Matthews, Coyle, & Craig, 1990; Meiran et al., 1994; Pollina, Greene, Tunick, & Puckett, 1992; Wallace, 2004).

The account of Meiran et al. (1994) is of special importance here: they separated the CFQ items into four subcategories of cognitive failures, labelled as (1) "loss of activation", (2) "false triggering", (3) "failure to trigger", and (4) "unintended activation". This classification has a clear theoretical motivation and is closely related to Norman's (1981) taxonomy of action slips. Further, it builds upon the theory of action control by Norman and Shallice (1986).

Meiran et al.'s (1994) classification discriminates between slips and lapses (Reason, 1984), both of which can be evoked either by endogenous or exogenous factors. Slips are commission errors and refer to an action that is not intended but is automatically executed. This category includes both verbal and psychomotor action slips, which are triggered either by factors in the external environment (e.g., confusion of action sequences), or internally by ongoing mental preoccupations (e.g., Freudian slips). Lapses are omission errors and refer to an action that is intended but is not executed. This can be due to either a retrieval failure from prospective memory (see, Goschke & Kuhl, 1993) or a failure to attend to task-relevant features. Precisely, lapses are thought to occur either because the activation of an intention decays or because of insufficient situational awareness for relevant stimulus features (Botvinick & Bylsma, 2005). A summary of Meiran et al.'s (1994) classification is shown in Table 1.

In the present study, we examined the question whether neuroticism is related to cognitive failure liability in everyday-life situations and whether there is a specific pattern of N–CFQ relations. To this end, we conducted a self-report study, in which we assessed extraversion, neuroticism, and psychoticism as major personality dimensions (Eysenck, 1947; Eysenck & Eysenck, 1985), and cognitive failure liability in everyday-life situations (Broadbent et al., 1982; Klumb, 1995). In addition, we assessed punishment and reward sensitivity (via the Behavioural Inhibition/Activation System [BIS/BAS] scales), since research indicated that punishment sensitivity as measured by the BIS scale comprises a special aspect of neuroticism. Reward sensitivity served as a control variable. Starting from the theoretical account of Robinson and colleagues (Robinson & Tamir, 2005; Robinson, Wilkowski, Kirkeby et al., 2006; Robinson, Wilkowski, & Meier, 2006), we predicted a positive relationship between neuroticism and cognitive failure liability. That is, individuals high in N should report an increased tendency to commit everyday lapses of attention and memory failure as well as slips of action, compared to individuals low in N. To obtain a more detailed picture of the proposed N–CFQ relationship, we examined the four subscales of the CFQ according to Meiran et al. (1994). Finally, a positive correlation between CFQ and punishment sensitivity (BIS scale) and no correlation between CFQ and reward sensitivity (BAS scale) was expected.

Table 1:
Classification of Cognitive Failures into Four Subscales of the CFQ
(According to Meiran et al., 1994)

	Types of Cognitive Failures	
	Slips (commission errors)	**Lapses (omission errors)**
	An action is carried out but was not intended	An action was intended but is not carried out
endogenously driven	*CFQ-UA (Unintended Activation)* - slips triggered by associative memory - intrusion of task-irrelevant cognition failure source: relevance of memory content *Example item:* Do you start doing one thing at home and get distract into doing something else? (item 21)	*CFQ-AL (Activation Loss)* - lapses of (prospective) memory - forgetting of task-relevant memory content failure source: fatigue and cognitive overload *Example item:* Do you forget items to buy at the shop? (item 23)
exogenously driven	*CFQ-FT (Faulty Triggering)* - slips triggered by environmental stimuli - stimulus features trigger inappropriate action failure source: similarity of trigger stimuli *Example item:* Do you find you confusing right and left when giving directions? (item 4)	*CFQ-FTT (Failure to Trigger)* - lapses of attention - relevant stimulus features are not detected failure source: mental preoccupation *Example item:* Do you bump into people? (item 5)

Note. Examples are taken from the English version of the CFQ (see Appendix 1).

Method

Participants

222 German individuals (87 male, 135 female) participated in the study. Their mean age was 31.4 (SD = 15.5) years and all of them reported to be in good health. The majority of the participants (63 %) reported to have high school graduation, the rest reported to have secondary school graduation. The sample was recruited via advertisements in a local newspaper and on the campus of the Dresden University of Technology and the RWTH Aachen University.

Questionnaires

Eysenck Personality Questionnaire–Revised. The German short version of the EPQ–Revised (EPQ-RK) was used (Ruch, 1999). The EPQ-RK is a 50-item self-report inventory and assesses three major personality dimensions of personality (Eysenck & Eysenck, 1985): extraversion (E), neuroticism (N), and psychoticism (P). It is considered an up-to-date instrument with very good psychometric properties (retest reliability: $r = .84$ for N; $r = .88$ for E, $r = .85$ for P; internal consistency of the scales between $r = .81$ and .88). The scales of the German version have been shown to be equivalent to the English version, including gender and age differences. The EPQ-RK is widely used in current personality research (e.g., Abraham, Windmann, Daum & Güntürkün, 2005; Beauducel, Brocke & Leue, 2006; Chavanon, Wacker, Leue & Stemmler, 2007; Stahl & Rammsayer, 2007). Therefore, the EPQ-RK can be favourably compared with alternative instruments that assess N, such as the NEO-PI-R (Ostendorf & Angleitner, 2004) and the EPP-D (Bulheller & Häcker, 1998; Moosbrugger, Fischbach & Schermelleh-Engel, 1998).

Cognitive Failures Questionnaire. The German version of the Cognitive Failures Questionnaire (Klumb, 1995) was used. The CFQ is a 25-item self-report inventory that inquires about minor attentional lapses and action slips in everyday-life situations. The German version of the CFQ has been shown to have good internal consistency (Cronbach's $\alpha = .78$). The items of the CFQ are displayed in Appendix 1.

Behavioural Inhibition System/Behavioural Activation System Scales. The German version of the short BIS/BAS scales was used (Strobel, Beauducel, Debener, & Brocke, 2001). The BIS/BAS scales are a 24-item self-report inventory that assesses individual differences in punishment and reward sensitivity. The scales are based on the biobehavioural personality theory of Gray (1982) and were originally developed by Carver and White (1994). The BIS scale includes items which refer to responses to the anticipation of punishment, whereas the BAS scale includes items which refer to responses to the anticipation of reward. There are three BAS subscales. The BAS Drive scale includes items pertaining to the persistent pursuit of desired goals. The BAS Fun Seeking scale includes items reflecting both a desire for new rewarding events and a willingness to approach a potentially rewarding event on the spur of the moment. The BAS Reward Responsiveness scale includes items that focus on positive responses to the occurrence or anticipation of reward.

Procedure and Analytical Design

Participants first reported demographic information, then completed the relevant questionnaires (CFQ, BIS/BAS, EPQ). To obtain more detailed information about cognitive failure liability, Meiran et al.'s (1994) four CFQ subscales were computed: (1) CFQ-AL (Activation Loss), (2) CFQ-FT (False Triggering), (3) CFQ-FTT (Failure to Trigger), and (4) CFQ-UA (Unintentional Activation). The assignment of items to the subscales is reported in Appendix 1. The CFQ scores were then related to neuroticism using Pearson's correlation coefficient. As we pursued a rather exploratory approach, we only asked whether or not there is a positive relationship between N and cognitive failure liability (i.e., H_0: $p = 0$ versus H_1: $p \neq 0$), and we had no specific hypothesis regarding the strength of the relationship (see Kubinger, Rasch, & Šimečkova, 2007; Rasch, Kubinger, Schmidtke & Häusler, 2004). For a more in-depth examination of the N–CFQ relationship, additional post-hoc group analyses were performed: individuals were classified into four groups according to their N score, such that individuals with the lowest N scores were classified into Group 1 (G1) and those with the highest N scores classified into Group 4 (i.e., G1: EPQ-RK N-subscale score = 0-3; G2: 4-6; G3: 7-9; G4: 10-12). Analyses of variance (ANOVA) were performed to test for differences in cognitive failure liability as a function of group level. Beyond the correlational analysis, a statistical group comparison should allow us to examine in more detail, whether the relationship is continuous in nature or whether it solely results from individuals with extreme high levels of neuroticism.

Results

Preanalysis. Mean scores, standard deviation, and range of scores are displayed in Table 2, correlations are displayed in Table 3. Descriptive analyses revealed that the relevant traits (i.e., neuroticism and cognitive failure liability) showed a unimodal and symmetric distribution in the sample. Neuroticism was uncorrelated with age (r = -.06) and gender (r = .11, ns), and uncorrelated with both extraversion and psychoticism, and was also uncorrelated with the overall BAS, BAS Drive and BAS Fun Seeking. Further, there was an unexpected positive correlation with BAS Reward Responsiveness (*r* = .23), indicating that higher neuroticism scores correspond to higher reward sensitivity. As expected, a positive correlation was observed with the BIS score (*r* = .39), indicating that there is some communality between the

Table 2:
Descriptive Statistics for the Cognitive Failures Questionnaire (CFQ), the Eysenck Personality Questionnaire (EPQ), and the Behavioural Inhibition/Activation System (BIS/BAS) Scales

	Scales	**Parameters**			**Items**
		M	*SD*	*Range*	*n*
1	*EPQ Neuroticism*	5.2	2.9	0-12	12
2	*EPQ Extraversion*	6.9	3.3	0-12	12
3	*EPQ Psychoticism*	3.3	2.5	0-14	14
4	*CFQ*	1.34	0.45	0.04-2.64	25
5	*CFQ-AL (Activation Loss)*	1.57	0.60	0.00-3.57	7
6	*CFQ-FT (False Triggering)*	1.03	0.58	0.00-2.75	4
7	*CFQ-FTT (Failure to Trigger)*	1.22	0.47	0.09-2.64	11
8	*CFQ-UA (Unintended Activation)*	1.63	0.70	0.00-4.00	3
9	*BIS (Behavioural Inhibition Scale)*	2.8	0.3	1.9-3.7	7
10	*BAS (Behavioural Activation Scale)*	3.0	0.3	2.2-3.9	13
11	*BAS Drive*	2.9	0.5	1.5-4.0	4
12	*BAS Fun Seeking*	2.9	0.5	1.5-4.0	4
13	*BAS Reward Responsiveness*	3.2	0.4	2.2-4.0	5

Note. The subscores of the CFQ have been computed according to Meiran et al. (1994).

concepts of punishment sensitivity and neuroticism. CFQ was uncorrelated with gender (r = .01) and only slightly correlated with age (r = .-16). However, partial correlation analyses clearly revealed that age and gender had no influence on the predicted N–CFQ relationship.

Main analysis. As predicted, correlational analyses (Table 3) revealed significant positive correlations of neuroticism with the overall CFQ score ($r = .26$) and the CFQ subscores except False Triggering ($r = .18$ for AL; $r = .09$ for FT; $r = .20$ for FTT; $r = .40$ for UA). The observed relationships generally remained stable after controlling for extraversion, psychoticism, BAS and the BAS subscales, by partial correlation. Only the correlation between N and the CFQ-AL subscale decreased from $r = .18$ to $r = .10$ when controlling for BIS sensitivity.

In a second step, we examined the relationship between N and cognitive failures by separating participants into four groups according their level of N, as described above. Figure 1 displays cognitive failure liability as a function of N at group level. A multivariate ANOVA revealed a significant effect of N on the overall CFQ score [$F(3,218) = 5.5$; $p < .01$] as well as a significant effect on CFQ-AL [$F(3,218) = 3.5$; $p < .05$], CFQ-FTT [$F(3,218) = 3.4$; $p < .05$], and CFQ-UA [$F(3,218) = 14.7$; $p < .01$], but not on CFQ-FT [$F(3,218) = 0.8$; n.s.]. As shown in Figure 1, the largest group differences were observed for the subscale CFQ-UA, indicating that unintended activation of task-irrelevant cognitions from associative memory seems to be the kind of cognitive failure being most affected by neuroticism. Importantly,

Table 3:

Intercorrelation of Self-Report Measures: Cognitive Failures Questionnaire (CFQ), Eysenck Personality Questionnaire (EPQ-RK), and Behavioural Inhibition/Activation System (BIS/BAS) Scales

	EPQ-RK			CFQ (CFQ-total and –subscores)					BIS/BAS				
	N	**E**	**P**	**CFQ**	**AL**	**FT**	**FTT**	**UA**	**BIS**	**BAS**	**D**	**FS**	**R**
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
1	-	-.04	.07	**.26**	**.18**	.09	**.20**	**.40**	**.39**	.11	-.03	.00	**.23**
2		-	.08	.03	-.04	.05	.05	.04	-.10	**.35**	**.24**	**.31**	**.19**
3			-	**.27**	.13	**.20**	**.28**	**.25**	**-.25**	.07	-.15	**.43**	-.11
4				-	**.83**	**.67**	**.91**	**.67**	**.20**	.05	-.12	**.19**	.04
5					-	**.40**	**.63**	**.44**	**.23**	.04	-.04	.09	.04
6						-	**.54**	**.34**	.11	.09	.01	.16	.03
7							-	**.53**	.14	.00	**-.19**	**.18**	.00
8								-	.12	.11	-.09	**.22**	.09
9									-	**.19**	.07	-.07	**.38**
10										-	**.72**	**.63**	**.77**
11											-	.14	**.39**
12												-	**.21**
13													-

Note. n = 222; EPQ-RK scores: N = Neuroticism; E = Extraversion; P = Psychoticism; CFQ-scores: CFQ = overall score; AL = Activation Loss; FT = False Triggering; FTT = Failure to Trigger; UA = Unintended Activation. BIS/BAS scores: BIS = Behavioural Inhibition; BAS = Behavioural Activation; D = BAS-drive; FS = BAS-funseeking; R = BAS-reward; Correlations are denoted if $r \geq .18$ ($p < .01$).

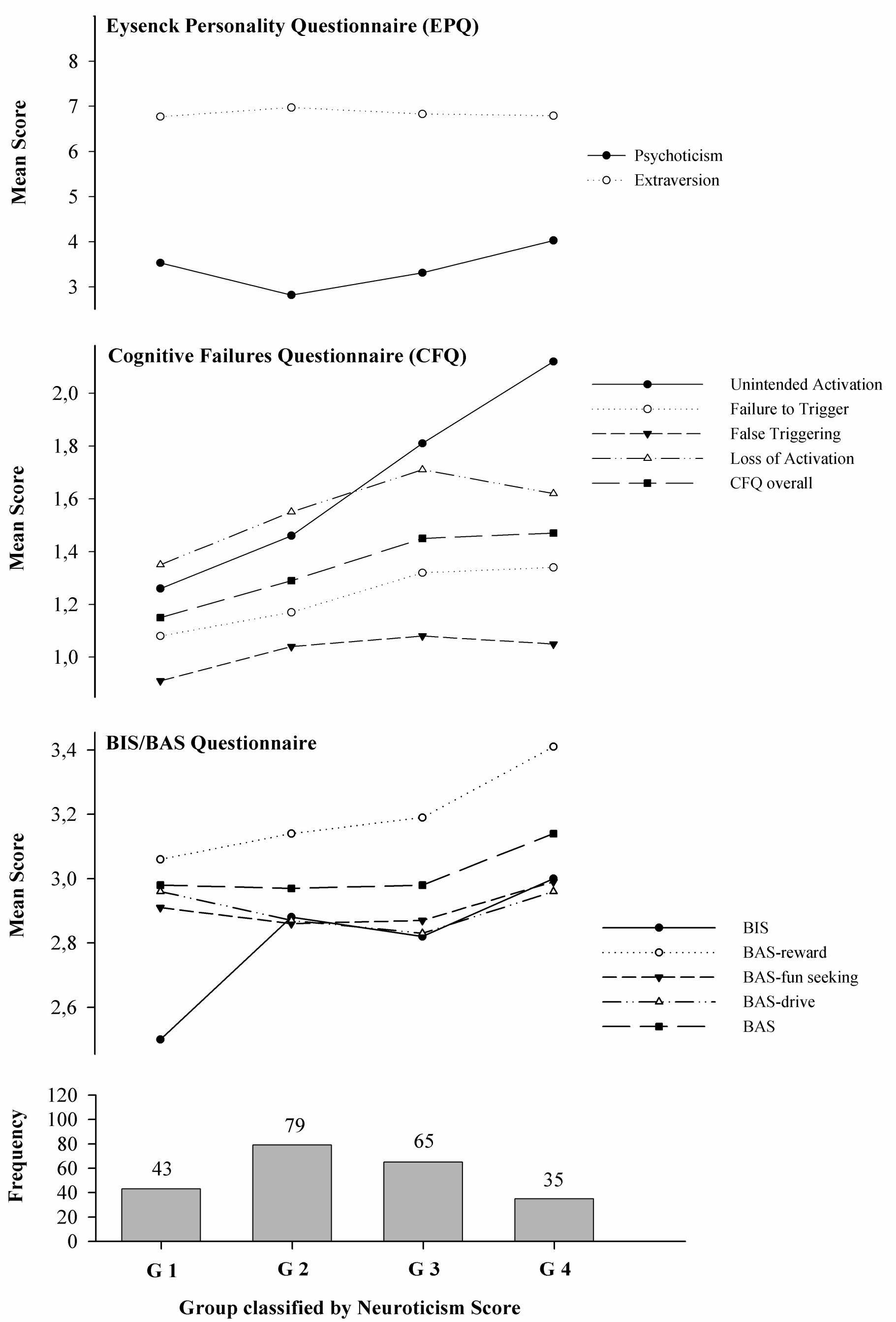

Figure 1:
Personality and Cognitive Failure Liability as a Function of the Level of Neuroticism

the observed effect was not restricted to individuals with extreme (i.e., the highest) N scores but appeared to increase continuously as a function of group level (i.e., from G1 to G4).

Finally, linear regression analysis was performed to estimate the individual contribution of each of the four CFQ subscores on the N–CFQ relationship. The regression model contained the four CFQ subscores as predictors and the N score as dependent variable. As a result, 15 % common variance could be explained by only one predictor: unintended activation (CFQ-UA); the other three predictors (CFQ-AL, -FT, and -FTT) provided only redundant information, already contained in CFQ-UA. Similarly, in a stepwise regression approach, only the CFQ-UA subscore was retained in the model, explaining 16 % of the variance of N. Compared to the overall CFQ score, which explained only 7 % variance of N, CFQ-UA is substantially more predictive. Considering that the CFQ-UA scale contains much less items than the overall CFQ scale, this finding is highly interesting, since it indicates that the proposed N–CFQ relationship is highly specific in nature.

Discussion

In the present study, we investigated the relationship between neuroticism (N) and cognitive failure liability in everyday-life situations. The results can be summarized as follows: **(1)** In general, high-N individuals reported to commit significantly more everyday cognitive failures than low-N individuals, as evidenced by positive N–CFQ relationship (r = .26). Of note, the size of the correlation is relatively small. **(2)** The most interesting finding is the correlation between N and the CFQ-UA subscale (Unintended Activation, r = .40), indicating that high-N individuals preferably commit those slips that are triggered endogenously, i.e., from associative memory. This subscale of cognitive failures includes intrusions of task-irrelevant cognitions, which presumably lead to interference with ongoing task-related information processing. **(3)** Slips triggered from stimulus features of the external environment (CFQ-FT) are not related to the trait of neuroticism. **(4)** High-N individuals also commit more lapses of memory and suffer more from prospective memory failures than low-N individuals (CFQ-AL; r = .18). That is, they reported to have an increased tendency to forget task-relevant memory contents and current goal intentions. However, the relationship is small in size, and further seems to be a special characteristic of those individuals who are both high in neuroticism and high in BIS (punishment) sensitivity: when BIS sensitivity is removed by partial correlation, the relationship declines substantially (r = .10, n. s.). **(5)** High-N individuals also reported to commit more lapses of attention to environmental stimuli as evidenced by a small N - CFQ-FTT relationship (r = .20). **(6)** The overall pattern of the relationship between neuroticism and cognitive failure liability remained stable when controlling for age and gender but also when controlling for other personality traits (e.g., extraversion, psychoticism, BIS, BAS).

From a theoretical point of view, the present study examined the mental noise hypothesis of neuroticism, as recently proposed by Robinson and colleagues (Robinson & Tamir, 2005; Robinson, Wilkowski, Kirkeby et al., 2006; Robinson, Wilkowski, & Meier, 2006). This hypothesis considers the trait of neuroticism as reflecting system noise within the individual's information processing system: high-N individuals are proposed to suffer more from mental noise than low-N individuals, as indicated by fluctuations of elementary cognitive operations during attention- and concentration-demanding tasks. In contrast to Robinson and colleagues, our investigation concerned the relationship between neuroticism and self-reported cognitive failures in everyday life. High-N individuals reported to have an increased liability for committing lapses of attention and memory failure in everyday-life situations compared to individuals low in neuroticism.

Of note, the correlations between N and the CFQ scores are relatively small (except the relation with CFQ-UA) and should not be overestimated by the reader. Although these findings provide substantial evidence that some aspects of neuroticism can indeed be explained by cognitive variables, the small size of the correlations, on the other hand, show that cognitive aspects of behaviour such as attention failure are not the "primary characteristics" of the neuroticism trait. With this regard, the medium correlation between N and the CFQ-UA subscale is highly interesting, since it revealed that the N-CFQ relationship is highly specific in nature, precisely that action slips triggered endogenously by associative memory (i.e., due to intrusions of task-irrelevant cognition) are the most characteristic feature of neuroticism-related cognitive failure liability. Hence, our results are consistent with the predictions derived from the mental noise hypothesis: high-N individuals can be characterized to be less effective in regulating attentional capacity, prospective memory, and overt behaviour. As a consequence, they suffer more from cognitive failures in everyday behaviours than low-N individuals.

A recently proposed metaphor for neuroticism is instability of elementary cognitive operations (Robinson & Tamir, 2005). We tested the idea that this instability is not only reflected in performance characteristics in laboratory experiments but also in everyday-life behavioural phenomena (i.e., action slips and lapses). This prediction was confirmed in the present study. By means of a self-report approach, we sought to further examine the generality of the mental noise hypothesis. Our results provide a further line of evidence in support of this hypothesis and, hence, contribute to the already existing body of research showing that higher levels in neuroticism are associated with a greater tendency towards committing cognitive failures.

Two other points add to the value of the present findings. First, the pattern of relations cannot be due to other confounding variables such as age, gender, or influences from other trait variables (i.e., extraversion, psychoticism, BAS sensitivity), since partial correlation analyses showed that these variables do not have any significant influence on the main pattern of results. Second, the theoretical concept behind the CFQ is not regarded to have conceptual overlap with neuroticism. That is, the CFQ is not considered to be any measure of neuroticism. Instead, high CFQ-scorers are assumed to have deficits in everyday attention and concentration (Tipper & Baylis, 1987) and in their ability to flexibly adjust mental capacity in response to changing task demands (Meiran et al., 1994). These assumptions are supported by studies showing that the CFQ is positively correlated with a variety of attention-related variables, such as accident proneness (Larson & Merritt, 1991; Simpson et al., 2005) and everyday attention/memory dysfunctions (Michiels et al., 1999; Robertson et al., 1997; Sher et al., 1984), even though some studies have found some relations to stress reactivity (Mahoney et al., 1998; Wells & Matthews, 1994). Thus, our data support the mental noise hypothesis (Robinson & Tamir, 2005) and extend our understanding of the individual-difference correlates of neuroticism and cognitive instability to everyday-life situations.

An important goal for future research will be to explore the causes of individual differences in neuroticism and cognitive failure liability via the experimental method. The well-known virtue of the experimental method is the tight control of situational variables (Cronbach, 1956). With this regard, Pauli (1938) stated that the relation between personality and cognitive efficiency can only be studied when situational variables that evoke fluctuations in cognitive performance, such as workload, stress, or mental fatigue, are experimentally manipulated. Therefore, a promising albeit costly experimental method to analyse individual differences in cognitive efficiency is to directly manipulate the energetical state of an individual, comparing performance in the "beneficial" and in the "detrimental" condition (see also Manly, Robertson, Galloway, & Hawkins, 1999; Pailing & Segalowitz, 2004; Smit & Van der Ven, 1995; Westhoff & Dewald, 1990; Westhoff & Graubner, 2003; Westhoff & Kluck, 1984). Therefore, subsequent research should consider new paradigms to study effects of energetical variables on cognitive performance. Recently, efforts in this direction have been made concerning effects on cognitive performance of mental fatigue and circadian rhythm (e.g., Bratzke, Rolke, Ulrich, & Peters, 2007; Monk & Carrier, 1997; Steinborn et al., 2007), psychopharmacological treatments (e.g., Rammsayer, 1995; Rammsayer & Stahl, 2006), and incentives (e.g., Pailing & Segalowitz, 2004). These experimental manipulations appear to be appropriate to study the interplay between personality factors and cognitive processes.

In sum, this study provides further support for the idea that neuroticism and cognitive instability are related to each other. We were able to show that this relationship is not restricted to laboratory task performance but is a ubiquitous characteristic of high-N individuals reflected in daily-life behaviour. Specifically, the trait of neuroticism correlated positively with everyday cognitive failures despite the fact that neuroticism is quite independent of other aspects of cognitive ability. On the basis of our results we offer a more differentiated perspective on neuroticism that may help to explain why individuals high in neuroticism are less stable and more error-prone in managing their life. Our findings suggest that proneness to cognitive failures in everyday life is an aspect of personality that might be seen as one building block of a psychological trait like cognitive self-regulation ability.

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Appendix 1

Items of the Cognitive Failures Questionnaire

	English Version	German Version	SS
1	Read something and find you haven't been thinking about it?	Lesen Sie etwas und stellen fest, dass Sie nicht darüber nachgedacht haben und es noch einmal lesen müssen?	AL
2	Do you find you forget why you went from one part of the house to another?	Stellen Sie fest, dass Sie vergessen haben, warum Sie von einem Teil Ihrer Wohnung in einen anderen gegangen sind?	AL
3	Do you fail to notice signpost on the road?	Übersehen Sie Wegweiser an der Straße?	FTT
4	Do you find you confusing right and left when giving directions?	Verwechseln Sie rechts und links, wenn Sie die Richtung angeben?	FT
5	Do you bump into people?	Stoßen Sie unabsichtlich gegen andere Personen?	FTT
6	Forget whether you've turned off a light or a fire or locked the door?	Stellen Sie fest, dass Sie vergessen, ob Sie eine Lampe oder den Herd ausgemacht haben oder die Türe abgeschlossen haben?	AL
7	Fail to listen to people's names?	Überhören Sie die Namen von Leuten, wenn Sie diese treffen?	AL
8	Say something and realize afterwards that it might be taken as insulting?	Sagen Sie etwas und erkennen anschließend, dass dies als beleidigend aufgefasst werden könnte?	FT
9	Fail to hear people speaking to you when you are doing something else?	Überhören Sie Leute, die zu Ihnen sprechen, wenn Sie gerade dabei sind, etwas anderes zu tun?	FTT
10	Do you lose your temper and regret it?	Geraten Sie in Wut und bereuen es?	UA
11	Leave letters unanswered for days?	Lassen Sie versehentlich Briefe tagelang liegen, die umgehend beantwortet werden müssten?	FTT
12	Do you find you forget which way to turn on a road you know well but rarely use?	Vergessen Sie, welche Richtung Sie einschlagen müssen auf einem Weg, den Sie gut kennen, aber selten benutzen?	FTT
13	Fail to see what you want in a supermarket?	Übersehen Sie das, was Sie in einem Supermarkt wollen, obwohl es da ist?	FTT
14	Wonder if you've used a word correctly?	Fragen Sie sich plötzlich, ob Sie ein Wort richtig gebraucht haben?	FT
15	Do you have trouble making up your mind?	Fällt es Ihnen schwer, Entscheidungen zu treffen?	FTT
16	Do you find you forget appointments?	Vergessen Sie Verabredungen?	FTT
17	Forget where you put something?	Vergessen Sie, wo Sie etwas hingelegt haben wie zum Beispiel eine Zeitung oder ein Buch?	AL

continued

	English Version	German Version	SS
18	Throw away the thing you want and keep what you meant to throw away?	Werfen Sie unbeabsichtigt etwas weg, das Sie behalten wollten, und behalten das, was Sie eigentlich wegwerfen wollten?	FT
19	Daydream when you ought to be listening to something?	Träumen Sie vor sich hin, wenn Sie eigentlich etwas anderem zuhören sollten?	UA
20	Forget peoples names.	Vergessen Sie die Namen von Leuten?	AL
21	Do you start doing one thing at home and get distract into doing something else?	Beginnen Sie mit der Erledigung einer Sache, und Sie machen auf einmal ohne Absicht etwas ganz anderes?	UA
22	Can't quite remember something although it's "on the tip of your tongue"?	Fällt Ihnen etwas nicht ein, obwohl es Ihnen auf der Zunge liegt?	FTT
23	Forget items to by at the shop?	Vergessen Sie, was Sie in Geschäften einkaufen wollten?	AL
24	Do you drop things?	Lassen Sie Gegenstände fallen?	FTT
25	Can't think of anything to say?	Beobachten Sie, dass Sie etwas sagen wollen, aber nicht mehr wissen, was es war?	FTT

Note. SS = Subscales; AL = Activation Loss; FT = False Triggering; FTT = Failure to Trigger; UA = Unintended Activation.