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Araştırma Makalesi ● Research Article

Perceived Stress in Cognitive Performance of Easy and Difficult Task in High and Low Neurotics

Nevrotik Bireylerde Kolay ve Zor Testler Sırasında Algılanan Stres Seviyesi ve Bilişsel Performans

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ÖZ

Bu araştırmanın amacı, kolay ve zor olarak düzenlenmiş testlerin uygulanması sırasında yüksek ve düşük nevrotik seviyedeki iki gurubun algılanan stres seviyesini incelemektedir. Bunu test etmek için, 21 maddeden oluşan Eysenk kişilik testi kullanilarak 400 kişi arasindan nevrotik seviyesi yüksek ve düşük olan 22'şer kişilik iki grup olustruldu. Bu katılımcılar kolay ve zor olarak adlandırılan testlere tabii tutulduktan sonra, testler sırasında algılanan stres seviyeleri ölçüldü. İki grup arasında, kolay ve zor testler ve stres seviyesi arasındaki etkileşimi öğrenmek için ANOVA testi kullanıldı. Sonuçlar, kolay testler sırasında, iki grup test perfromansı ve algılanan stress açısından benzer iken, zor test uygulaması sırasında, yüksek seviyede nevrotik olan bireyler, düşük seviyede nevrotik olanlara göre daha düşük performans ve yüksek stres seviyesine sahip oldukları bulunmuştur.

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ABSTRACT

The current study aims at investigating stress related differences during processing of easy and difficult tasks in high and low neurotics. To examine this, 22 high and 22 low neurotic participants were selected among 400 screened people based on 21 item Eysenck Personality Questionnaire (EPQ). They performed single and dual tasks and subsequently filled self-designed perceived stress survey. An analyses of variance (ANOVA) tests with repeated measures were conducted to analyse the results. The results showed that while high and low neurotics did not differ on easy tasks regarding performance and perceived stress level, high neurotics were considerably slower with greater perceived stress level than low neurotics on difficult tasks.

1. Introduction

Neuroticism is defined as the inclination to negative affectivity and psychologic disorders such as anxiety and depression. This leads to higher level of worry and stress which disrupt cognitive processing (Eysenck and Eysenck, 1986; 1978). Behavioral studies in the field of cognitive psychology have shown that neuroticism impairs cognitive performance generally in difficult tasks, but not so much in easier tasks (Corr, 2003; Studer-Luethi et al., 2012; Szymura and Wodniecka, 2003) because in difficult task performance, arousal level easily increase which in turn leads elevated stress and then cognitive impairments in high neurotics (Eysenck, 1967). Although the cognitive impairment in high neurotics is well investigated, the research about the stress related cognitive impairment is sparse. Thus, in the present study aims to investigate perceived stress level during

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processing of easy and difficult tasks in high and low neurotics.

Eysenck (1967) proposed arousal-based theory (ABT) to explain physiological correlates of neuroticism regarding cognitive processing. He indicates while high and low neurotics perform similarly on easy tasks which are perceived not stressful, high neurotics have a considerable cognitive impairment on difficult tasks as compared to low neurotics which is evident by their slower reactions. The reason for such greater cognitive impairments in high neurotics is stress because it leads to elevated arousal level which in turn influences cognitive performance (Eysenck and Eysenck, 1986; Eysenck, 1967). Interpreting this assumption in terms of experimental tasks, it means that high neuroticism level has no detrimental effect on easy tasks, because it results in low levels of stress (Eysenck and Eysenck, 1986; Eysenck, 1967; Studer-Luethi et al., 2012). Therefore, high and low neurotics do not differ in their association between stress and task performance (Szameitat et al., 2016). However, regarding difficult task performance, high neurotic individuals exhibit elevated stress level, that constrain their performance, while low neurotics show an optimal performance due to their moderate stress level (Eysenck and Eysenck, 1986; Eysenck, 1967; Szameitat, et al., 2016).

Furthermore, Eysenck (1967) suggests that in difficult task performance, high neurotics have greater higher stress level and greater cardiovascular activities than in low neurotics. This results in perceiving more difficulty in difficult task performance. This physiological difference could be investigated by using subjective measures (Eysenck and Eysenck, 1986; Eysenck, 1967). In this context, if performance of high and low neurotics is measured on easy and difficult tasks and subsequently they fill a perceived stress survey which asks to score their stress level, the relationship between stress and performance should be observed. In this view, while high and low neurotics do not differ on easy tasks regarding both behavioral performance and perceived stress level, high neurotics should have lower performance with higher perceived stress level in difficult tasks as compared to low neurotics (Eysenck and Eysenck, 1986; Poposki et al., 2009).

In line with the theory, previous investigations on dual tasking has found that high levels of neuroticism negatively influence dual task processing whereas high and low neurotics perform similarly on single-task performance (Corr, 2003; Osorio et al., 2003; Poposki et al., 2009; Studer-Luethi et al., 2012; Szymura and Wodniecka, 2003). However, these studies did not provide evidence on whether the real cause of this impairment is stress. One study was found to have probed effect of stress on two distinct personality traits which were neuroticism and extraversion (i.e. being social, and talkative) (Poposki et al., 2009). In this study, four tasks were presented simultaneously, and the participants performed the tasks one by one. When the task performance was completed, subsequently the participants were given a perceived stress survey to be filled out. In the survey the participants were asked how stressed they were during the task performance. The results showed that high neurotics had lower performance and higher perceived stress level as compared to extraverts. However, in the study of Poposki et al. (2009), two distinct personality traits were compared which were unable to show any difference between high and low neurotics. Moreover, in the study, all tasks were working memory tasks (WM: storing, monitoring and manipulation of information) so that the difference between easy and difficult task regarding stress in high and low neurotics was not clear. Therefore, the interaction regarding stress level between easy and difficult tasks was not demonstrated.

One paradigm that could allow to see the effects of stress on easy and difficult task is the psychological refractory period (PRP paradigm), that refers to the simultaneous performance of two tasks (Response 1 and Response 2) when two tasks are performed simultaneously or with an interval between two tasks (stimulus onset asynchrony [SOA]) (Pashler, 1994; Logan and Gordon, 2001). The processing of the second task will be delayed until the processing of the first task has been completed (Pashler, 1994; Logan and Gordon 2001). The delay in the second task depends on SOA, if the SOA is short or set up to zero then the task becomes more difficult which leads to longer delays. If the SOA is longer, for example 1000 ms, then the task become easier than dual task with shorter SOA but will still be more difficult than single tasks and so the delay is shorter (De Jong, 1995; Luria and Meiran, 2003; Meyer and Kieras, 1997). Previous studies have shown that task processing in a single task is easy and is not associated with WM whereas a dual task that requires extensive use of WM (De Jong, 1995; Logan and Gordon, 2001; Luria and Meiran, 2003; Szameitat et al., 2016; Szameitat and Vanloo et al., 2016). A comparison between single and dual tasks performance will show the effect of task difficulty.

Recently, Szameitat et al. (2016), conducted a very similar study to test performance of high and low neurotics on easy and difficult task by employing an experiment of PRP. They were able showed that while high and low neurotics did not differ on single tasks, high neurotics were considerably slower on dual task which is quite difficult as compared to single task. The conclude that the major reason of such cognitive impairment in high neurotics might be stress because it may restrict employment of cognitive resources in the brain. However, in this study, the authors did not used any measures to see whether the cause of this impairments is stress. Their interpretation was based on assumption of ABT. To find out whether the real cause of task impairment in high neurotics is stress, indeed, one needs to employ a measure of stress to prove this.

In the present study, we investigate perceived stress level in high and low neurotics during easy (single task) and difficult tasks (dual task) performance. First, high and low neurotic participants were selected based on Eysenck Personality Questionnaire (EPQ) that consisted of 21 items. Further, the participants performed single and dual tasks and subsequently they filled a self-report perceived stress questionnaire. In more detail, we used PRP paradigm to set up dual task experiment. In PRP dual task, the simultaneous performance of two tasks (Response 1 and Response 2) which is consisted of two stimuli that are demonstrated concurrently (Logan and Gordon, 2001; Meyer and Kieras, 1997; Pashler, 1993). Generally, in dual tasks, the response of the second stimulus is prolonged compared to the response of a single task. Recently, it has been shown that high neurotics had lower performance than low neurotics on PRP

dual task and this associates with decreased brain activations in prefrontal regions (Szameitat et al., 2016). The present study explores whether this performance decrement associates with perceived stress in high neurotics by employing a perceived stress questionnaire just after dual task performance. In this context, the hypothesis to be tested is that cognitive impairment and perceived stress level in high neurotics will increase as the task difficulty increases compared to low neurotics.

It is important to investigate this because although theoretically it has been assumed that major reason of task impairment in high neurotics is stress, it hasn't been proved yet. In this context, this investigation will confirm theoretical assumption of ABT. Moreover, as most of psychological disorders leads impairments on cognitive task performance, the result of current study will allow to deep insights into the cognitive system in high and low neurotics. This may facilitate to find out the cause of the psychological problems that is triggered by neuroticism in clinical researches.

2. Method

To create extreme groups of high neuroticisms (high-N) and low neuroticism (low-N) 400 people were screened and filled out the EPQ questionnaire. Generally, individuals who scored over 12 supposed to be neurotics and who scores below 12 supposed to be low neurotics (Eysenck, 1975). In more detail, in this study, highly neurotics and very low neurotics were selected. Therefore, people who scored over 15 were taken as high neurotics and people who scored below six were taken as low neurotics. In this context, from the screened sample, 44 people took part in the final experiment: Twenty 22 (11 women) were in the high-N group (H: mean EPQ score=18, range=16–24) and 22 (10 women) in the low-N group (L: mean EPQ score= 3.89, range=0–6). The two groups were matched for age (21.36 and 23.50) and gender. These samples were selected based on previous studies which has confirmed to show sufficient difference between high and low neurotics (Szameitat, et al., 2016; Chan, Harmer, Goodwin, and Norbury, 2008). All participants were recruited from Brunel University campus and they were either British or English speakers for ten years. Prior to the experiment, screening procedures were used to determine eligibility for the study. Participants read and give an informed consent form before the study. The participants received £10 for one-hour participation. Ethical approval was given from Department of Life Sciences ethics committee at Brunel University.

3. Tasks and procedure

Participants performed an auditory and a visual two-choice reaction task either separately as single tasks or concurrently as dual tasks (DT). In the single tasks, the participants were presented with the visual and auditory single tasks. While the visual stimuli consisted of two shapes either square or triangle, the auditory condition consisted of beep tone either high or low tones. Participants were required to decide whether the shape is square or triangle in the visual condition and whether the beep tone was high or low in the auditory condition. A trial in the single task condition started with a blank grey screen for 300ms, followed by a fixation period of 300ms. The stimuli were presented for 300ms. In visual condition, the participants had to respond with the right index finger to the square by pressing the N button, and with the right middle finger to the triangle by pressing the M button on the keyboard for the two choice visual reaction tasks. In auditory condition they had to respond with the left index finger to the high beep tone by pressing the X button, and with the left middle finger to the low beep tone by pressing the Z button on the keyboard for the two choice tasks. Thus, the trial duration depended on the response speed of the participant. For incorrect responses, an error feedback ("Error") was displayed on the screen. For the correct responses, a fixation cross is displayed. In the dual task (DT) condition, both the visual and auditory tasks were presented either simultaneously (with 0 SOA) or in a rapid succession (with 1000 ms SOA). In this context, task difficulty increased gradually from single to dual task with 1000ms to 0ms SOAs in separate conditions.

After completion of the experiment, the participants scored the stressfulness and difficulty of each task by marking it from 1 (very easy) to 9 (very difficult) on a paper sheet. For example, if the tasks were perceived as very easy the participant marked 1, 2 or 3 and if the task was moderately difficult then the participant marked it 4, 5 or 6. On the other hand if the task was very difficult, then the participants marked it 7, 8 or 9 for each task. At the end of the study, all the participants were given a debriefing form. Overall the experiment took one hour for each participant to complete the study.

4. Findings

The results were calculated either by one way or mixed ANOVA. In all Anova tests *Levene's test* for equality of variances were considered. The results regarding *Levene's test* were not significant in the current study All pairwise comparisons were non-significant for task variables: [all F (1,43) < (largest: 3.36/ lowest: .74), all p > (largest: .40/ lowest .07)]. In this context, the results were reported with ANOVA tests because *Levene's tests* for equality of variances were not significant (all p> .05).

Table 1. The Mean and Standard Deviations (SD) in High and Low Neurotics across Tasks in High and Low Neurotics

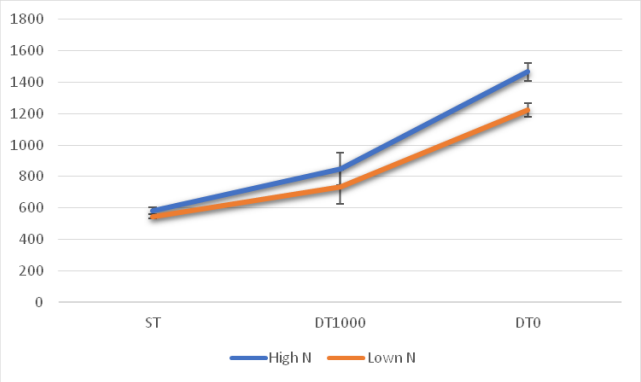
Descriptive Statistics				
	Groups	RT Mean	Std. Deviation	N
Single Task	High N	552	91	22
	Low N	520	69	22
DT Long SOA (1000ms)	High N	840	240	22
	Low N	724	190	22
DT Short SOA (0ms)	High N	1450	303	22
	Low N	1130	217	22

For the analyses of single tasks (easy tasks) one-way Anova was calculated. The variables for testing was single task conditions and the grouping variables was high and low neuroticism. The testing variables were the task conditions. The results showed that high and low neurotics did not differ on single tasks performance [F (1, 43) = 1.55; p> .05].

Regarding difficult tasks, interaction effects across two forms of dual task (DT) and neuroticism levels were explored by employing 2x2 factorial ANOVA. The response times of the second tasks were preferred as majority of the dual task studies suggest that the most sensitive measure of dual task is RT 2 (Pashler, 1993; Pashler, 1994). The

between subject factor was groups (high vs low neurotics) and the within-subject factor was dual tasks (dual tasks with 1000ms SOA vs dual tasks with 0ms SOA). The results showed that high neurotics were slower than low neurotics [neuroticism main effect, F (1, 43) = 7.70; p< .05]. Furthermore, all participants were slower in their reaction time as the task difficulty increase from DT 1000ms to DT 0ms respectively [Task difficulty main effect, F (1, 43) = 43.95; p < .01]. Finally, high neurotics were becoming slower as the task difficulty increase from DT 1000ms SOA to DT 0ms SOA than low neurotics, this was evident from the interaction between the groups and manipulation in task difficulty [F (1, 43) = 4.80; p < .05]. Taken together, as demonstrated in the graph (Fig. 1), while high and low neurotics did not significantly differ, high neurotics became slower as task difficulty increase.

Fig. 1. The Single and Dual Task Performance in High and Low Neurotics



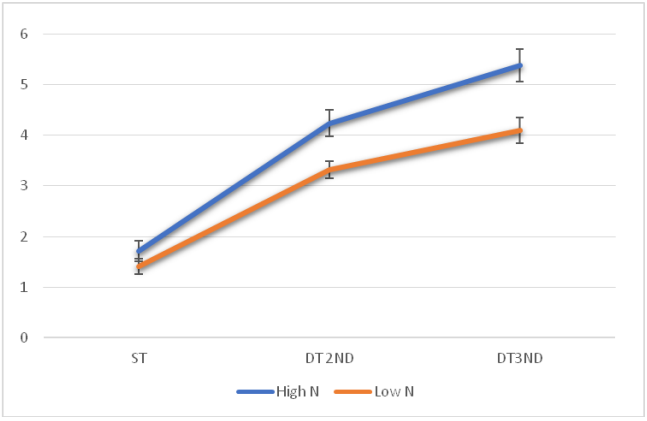
Similar analyses were run for the effect of neuroticism on perceived stress level along the tasks. First, the results regarding perceived stress level on easy tasks show high and low neurotics have similar perceived stress level F (1, 43) = 1.15; p> .05]. Also, regarding difficult tasks, interaction effects across perceived stress level in two forms of dual task and neuroticism levels were explored by employing 2x2 factorial ANOVA. The between subject factor was groups (high vs low neurotics) and the within-subject factor was perceived stress level in single and dual tasks (DT1000ms SOA vs DT 0ms SOA).

Table 2. The Mean and SD in Scores of Perceived Stress Level Across the Tasks in High and Low Neurotics

Descriptive Statistics				
	Groups	Mean	Std. Deviation	N
Single Task	High N	1.62	1.03	22
	Low N	1.41	0.63	22
DT Long SOA (1000 ms)	High N	4.33	1.22	22
	Low N	3.27	0.77	22
DT Short SOA (0ms)	High N	5.48	1.75	22
	Low N	4.20	1.63	22

The results demonstrate high neurotics perceived higher stress compared to the low neurotics [neuroticism main effect, F (1, 43) = 7.85; p< .01]. Further, all participants perceived stress level increased as difficulty increased [Perceived stress level main effect, F (1, 43) = 60.11; p < 0.01]. Finally, high neurotics perceived greater stress as task difficulty increased as evident by significant interaction between the groups and perceived stress level along the tasks [F (1, 43) = 8.42; p < .01].

Fig. 2. The Perceived Stress Level in High and Low Neurotics in Single (Easy) and Dual Task (Difficult)



5. Conclusion and Discussion

In the present manuscript, performance of high and low neurotics was compared on easy (single tasks), and difficult tasks (DT 1000ms SOA and DT with 0 SOA). Following that, perceived stress level in the participants were measured via a self-report questionnaire. Accordingly, the results demonstrated that high neurotics dramatically slowed down as difficulty increased on DT performance whereas high and low neurotics did not statistically differ on single tasks performance. Further, high neurotics had greater perceived stress level as compared to low neurotics as task difficulty increase from easy to difficult tasks. Taken together, the current findings indicate that greater cognitive impairment in high neurotics as compared to low neurotics may be mediated by the stress.

ABT proposed that cognitive impairment in high neurotics would be greater due to elevated stress in high neurotics whereas high and low neurotics do not differ on easy tasks because both groups have decreased stress level on the easy tasks. It has been proposed that neuroticism like traits are inclined to higher level of stress. Therefore, high neurotics need to spend more effort to achieve a task as compared to low neurotics because stress related activities interfere with cognitive activities which consume mental resources and limits task performance (Eysenck and Eysenck, 1986; Eysenck, 1967; Eysenck et al., 2007; Eysenck and Derakshan, 2011). Further, Eysenck (1967) proposed that changes in the stress level on the easy and difficult tasks can be observed by employing subjective measures such as a self-designed perceived stress survey as in the current study. The current results confirm ABT by showing a clear elevated stress level accompanied with greater cognitive impairment as the difficulty increase along the tasks.

The results are in line with previous empirical findings and add a new contribution (Dornic, 1977; Poposki et al., 2009). In more detail, the previous studies which showed greater stress level on multitasking or other cognitive tasks in high neurotics often used complicated tasks, therefore, the interaction between task difficulty (easy/difficult) and neuroticism (high and low) is not observed. In this regard, our findings show significant interaction effects between neuroticism levels and perceived stress level along the easy and difficult tasks. In other words, the current results showed that high neurotics do not have a significant impaired performance and increased stress level in simple task

whereas high neurotics considerably slowing down as task difficulty increase and this accompanied with greater stress level in high neurotics. To our knowledge, this is the first study investigating neuroticism related perceived stress level in PRP dual task paradigm.

In conclusion, while performance and perceived stress level is similar in high and low neurotics, high neurotics perform worse than low neurotics with higher perceived stress level as task difficulty increases. The results domenstrate that neuroticism related cognitive impairments in processing of difficult tasks appear to be mediated by an increased stress level. In the current study, a subjective method was used to measure stress level. It is important that future studies use objective measures such as cortisol level, electrodermal or cardiovascular activities to explore neuroticism related stress level in difficult task performance. This may help to alleviate the psychological problems that is precipitated by neuroticism in clinical researches.

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