The effects of mood on information processing: A diffusion modelling approach

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Exchange Period: August - October 2022

My personal development goal of this exchange was to improve my R programming skills, to learn advanced statistical analysis, as well as computational modelling. While learning these skills, I investigated how the level of the traits of anxiety and depression affect information processing speed in relation to current mood.

In everyday life, we all perform a variety of tasks such as listening to music while cooking or studying, playing a video game, or taking notes in a class. All of these tasks require different levels of attentional control or cognitive functions to maintain the task goals and regulate behaviours. However, patients with psychiatric disorders such as depressive and anxiety disorders sometimes show cognitive impairments (Eysenck et al., 2007; Snyder, 2013). Therefore, it is essential to understand the effects of mood on information processing on the level of the trait of anxiety and depression as cognitive impairment may negatively impact their life. Cognitive impairments in anxious individuals might be caused by imbalance between the top-down and bottom-up systems that are involved in attentional control (Eysenck et al.,2007). The top-down system guides attention towards intentions, whereas the bottom-up processing system guides attention towards salient stimuli (Wolfe, 2021; Wolfe 2007). Anxiety increases attentional focus when a task includes threatening stimuli, and it is decreased in ongoing tasks when there are no threatening stimuli. The latter case is because anxious individuals focus their attention on their internal worries. On the other hand, the cognitive impairment in depressive disorders is still debatable whether it is caused by motor slowing or EF impairment (Snyder, 2013).

Even though these studies provide an understanding about how anxiety and depression levels impair cognitive functions, further studies are required because these studies did not include the effects of moods, which may also play a role in cognitive processing impairments (Eysenck, 2011). Furthermore, these studies compared groups by using reaction time (RT) and accuracy scores separately. That has been criticised because participants might apply different strategies to respond to stimuli (Wagenmakers et al., 2007). Therefore, in this study we applied a computational model - drift diffusion modelling (DDM) (Ratcliff, 1978) - that takes both RTs and responses into account to compare the cognitive ability between groups.

Diffusion modelling enables researchers to understand the underlying mechanism behind a decision making process (Ratcliff, 1978), and it includes parameters that are used for cognitive interpretation. They are starting-point (z), boundary separation (a), drift rate (v), and non-decision time (t). The starting point, for example, is interpreted as a decision bias from the prior knowledge. The boundary separation is the threshold between the two decisions. For example, if a person is very cautious, then the decision threshold would be larger. The drift rate stands for information accumulation time, and the non-decision time includes both the encoding and response processing time (Ratcliff, 1978; Wagenmakers et al., 2007; Voss & Voss, 2007).

Some of our results were in line with previous studies and expectations, whereas other results were not. The results in this study revealed no significant relationship between the level of trait of depression and diffusion model parameters. On the other hand, the results showed a significant negative relationship between the level of trait of anxiety and drift rate, r_s = -.28, *p* = .002, (Figure 1a); and between the level of trait of anxiety and non-decision time (Figure 1b), r_s = -.31, *p* = .012; but not between the anxiety level and boundary separation, *p* = .203. Furthermore, we looked into the effects of the level of stress on the model parameters. The level of stress and non-decision time showed a negative association, r_s = -.34, *p* = .008. On the other hand, the correlation results between mood dimensions and the model parameters were not significant. However, we found interaction effects of mood on the relationship between the levels of the trait of anxiety and depression and the model parameters. The mood discontentment decreased the correlation coefficient between the level of trait of anxiety and non-decision time , b = .001, t(55) = 2.16, *p* = .034. Thus, if people with high levels of anxiety were discontent on the testing day, they had a shorter non-decision time, b = .001, t(55) = 2.16, *p* = .034. Furthermore, a negative interaction effect was found for both discontentment and tension on the trait of stress level.Tension decreased the correlation between stress level and non-decision time, b = -.010, t(57) = -2.126, *p* = .036, and discontentment decreased the drift rate for people with high levels of stress. Thus, people with high levels of stress require even longer time for information accumulation when their level of discontentment is higher, b = -.011 , t(55) = -2.380, *p* = .021.

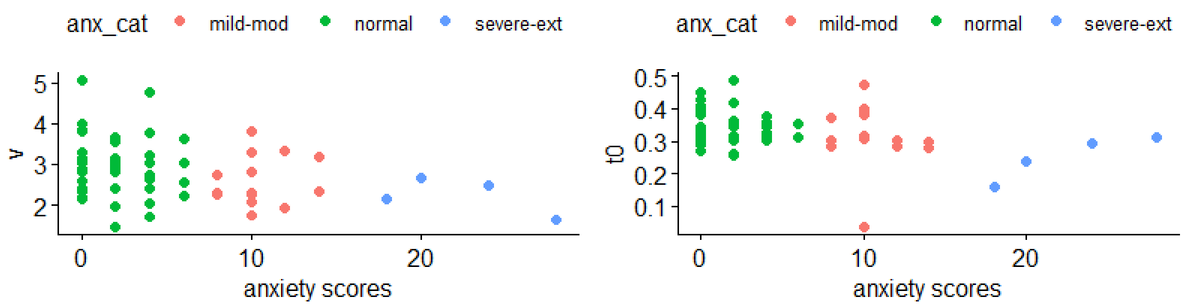
Overall, this study gives further understanding of the attentional control theory (Eysenck et al., 2007), as well as the effects of level of stress on information processing speed. In addition, it provides an understanding of how current mood in relation to the trait of anxiety, depression and stress might affect information processing speed.

The NENS exchange grant gave me the opportunity to learn advanced statistical analysis, as well as computational modelling. During this exchange period, I improved my R programming skills, learned how to work independently, and to pre-process and clean a large scale dataset, transferable skills that I can apply to my research project at my home university. Furthermore, I worked with a great team for data collection, with whom I became friends. I am really grateful to both my host and my home supervisors who supported me throughout my grant application and exchange period, and to the NENS team for enabling me to have this opportunity through their exchange grant programme.

Figure 1

The correlation graphs of the level of the trait of anxiety and the model parameters

a **b**



Note. Anx_cat represents the three severity labels regarding anxiety cut-off scores. Mild -mod stands for mild and moderate. Severe-ext represents severe and extremely severe labels. **a)** The correlation between the level of the trait of anxiety and drift rate (v). **b)** The correlation between the level of the trait of anxiety and non-decision time (t0).

Figure 2

Lab Event - Visiting the Kelham Island Museum

Figure 3

Lab Team Dinner

Figure 4

My Farewell