Abnormalities of Anxiety and Executive Functioning

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Abstract

Anxiety disorders, one of the most common classes of psychological disorders, have been shown to result in a decreased quality of life. Although some research suggests that anxiety disorders are linked to impairments in executive functioning, the inconsistency in the current literature yields an unclear conclusion on the relationship between the two. The current meta-analysis systematically investigated 55 records that compared various groups with anxiety disorders to healthy controls on executive function tasks. Overall, our meta-analysis showed that individuals with anxiety disorders exhibited significant deficits in performance efficiency (reaction times) on executive function tasks. However, we also found that individuals with anxiety disorders may outperform their healthy peers in performance effectiveness (task accuracy) in some conditions. Type of anxiety disorders, domain of executive functions, and mediation use were identified to moderate the overall relations between anxiety disorders and executive functioning. Nevertheless, the results were robust across important demographic and other clinical moderators (e.g., anxiety severity and comorbidity).

Keywords: Anxiety disorder • Executive functions • Attentional control theory • Meta-analysis

Objective

Anxiety disorders, characterised by constant and unsubstantiated fear or worry (American Psychiatric Association, APA), are argued to be one of the most common classes of psychological disorders, with an estimated lifetime prevalence of 28.8% in the United States. The pervasiveness of anxiety disorders is worrying, given their adverse impact on one's quality of life by worsening social functioning, self-esteem, and physical health. Importantly, research suggests that anxiety disorders are associated with deficits in executive functioning a set of higher-order cognitive control processes crucial for goal achievement.

Third, varied emotional salience of task stimuli in different studies may contribute to discrepant findings. According to the attentional control theory, adverse effects of anxiety on task performance caused by task-irrelevant stimuli are greater when stimuli are threat-related rather than neutral. In support of this view, various studies have suggested that groups with anxiety disorders performed worse than controls in cognitive tasks when presented with threatening stimuli as opposed to neutral stimuli. Therefore, we sought to consider the emotional salience of the task stimuli as a moderator in the meta-analysis to investigate this proposition.

Lastly, another factor contributing to the heterogeneity in research findings might be tied to the diversity of the samples used across studies which varied in comorbidity, psychotropic medication use and/or treatment,

severity of anxiety disorder, age, and gender. These demographic variables might account for variances in findings due to their differential relationships with cognitive ability. Specifically, medication use and/or treatment may have different effects on cognitive abilities depending on the type of medication. For example, the use of certain medications, such as benzodiazepines.

Taken together, these inconsistent findings underscore the need for a meta-analytic approach to illuminate the relation between anxiety disorders and impaired EF while accounting for potential moderators of this relation. To this end, we synthesized previous research findings and used meta-analytic methods to test the conflicting hypotheses about the relationship between anxiety disorders and EF. To explore the source of variance in precedent findings, we examined the potential moderating effects of methodological discrepancies (unified/diversified EF, types of measured outcomes, types of anxiety disorders tested, and emotional salience of task stimuli), as well as demographic (age and gender) and clinical (severity of anxiety disorder, use of psychotropic medication/treatment, and comorbidity) variables on effect sizes.

Based on the predictions of attentional control theory, it was hypothesized that anxiety disorders would affect RT, but not accuracy, on EF tasks that assess inhibitory control and task-switching ability. However, anxiety disorders would be less likely to affect RT or accuracy on EF tasks assessing updating ability, since those tasks do not require attentional control. Furthermore, given that the subtypes of anxiety disorders are characterized by distinct diagnoses, specific hypotheses for each type of anxiety disorder and performance on EF tasks were proposed. Generalised anxiety disorder, in particular, is characterized by persistent worry and thoughts on a variety of topics. which may serve as an internal distraction and impair attentional control. In contrast, other forms of anxiety disorders (e.g., social anxiety disorder and specific phobia) are characterized by worry and anxiety in response to specific events and stimuli. For example, individuals with social anxiety disorder have an acute dread of social evaluation, and so their anxiety relates exclusively to social stimuli or circumstances that involve a risk of being evaluated. Likewise, individuals with panic disorder are more biased towards internal and external panic-related stimuli and pay less attention to non-panic-related stimuli.

As a result, attentional control is unlikely to be impaired in individuals with anxiety disorders other than generalised anxiety disorder when they are performing neutral tasks in general situations. Consistent with attentional control theory, which states that anxiety affects processing efficiency but not performance effectiveness, it was hypothesized that generalised anxiety disorder would result in slower response time but a comparable level of accuracy on EF tasks when compared to healthy controls. Individuals suffering from social phobia, panic disorder, specific phobia, or selective mutism, on the other hand, would show no significant difference in RT and accuracy on EF tasks when compared to healthy controls.

The current meta-analysis was not pre-registered. A detailed description of the inclusion and exclusion criteria, documentation of full-text records excluded with their corresponding reasons, as well as R code used for the current meta-analysis, are publicly available on Research Box. Analyses for overall effect size estimates, as well as tests of publication bias, were conducted in R version using the meta-analytic package metaphor version with restricted maximum likelihood estimation.

The search terms were included because acute stress disorder, obsessive-compulsive disorder, and post-traumatic stress disorder have been classified as subtypes of anxiety disorders under DSM-IV, and previous studies often examined different subtypes of anxiety disorders together and compared how the subtypes of anxiety disorders differentially affect neuro-cognition in the same study Therefore, these keywords were included to ensure that studies that examined subtypes of anxiety disorders not classified under DSM-5 and subtypes of anxiety disorders classified under

DSM-5 together were incorporated in the current meta-analysis. In addition, the terms "central executive", "phonological loop" and "visuospatial sketchpad" were included because they represent the different components of working memory as proposed by Baddeley's (1992) model of working memory.

In total, seventeen records were excluded due to missing data while nineteen studies were excluded due to inaccessibility as the original authors did not respond to repeated requests. Fifty-six records were excluded because the constituent studies did not measure performance on EF tasks, twenty-seven records were excluded because the constituent studies did not examine participants with anxiety disorder or participants had an anxiety disorder that was not clinically diagnosed, twelve records were excluded because intrusive measures were used during task performance, ten records were excluded because they did not include a control group free from medication or any current or lifetime psychiatric diagnosis, four records were excluded because they included participants with non-anxiety related disorder as the primary diagnosis, four records were excluded because they involved anxiety-related interventions or manipulations but did not report baseline measures of EF, four records were excluded because they were either review articles or a letter to the editor, three records were excluded because participants in the anxiety group had comorbid disorders, two records were excluded because participants were exposed to electric shocks while working on EF tasks, two records were excluded because another version of the record (i.e., published version and English translated version) was already included in the meta-analysis, and one record was excluded because the constituent study investigated anxiety disorders in participants with brain injury. A more detailed description of the inclusion and exclusion criteria, as well as the documentation of full-text records excluded with their corresponding reasons, is publicly available on ResearchBox.

In terms of measures of EF, the means and standard deviations of scores achieved by both groups (anxiety disorders vs. control) on various tasks assessing EF were recorded whenever available. The task used (e.g., Stroop task) was recorded and categorised into one of the three main components of EF, namely inhibition, shifting, and updating. Common EF tasks used to assess inhibition the ability to suppress automatic responses to irrelevant stimuli include the Stop-signal Task.

Conclusion

In conclusion, our results showed a nuanced relation between anxiety disorder and EF, depending on performance effectiveness and efficiency, type of anxiety disorders, the domain of EF, and mediation use. Our study is valuable in that it provides a comprehensive review of the relationship between anxiety disorders and EF, which was muddled in inconsistent findings derived from past research. Examining each anxiety disorder and its relationship with EF revealed moderated associations, providing clinicians and researchers with a guide for treatment and future research.