Statistical Consulting

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September 2023

Chapter 1

Introduction

Social anxiety disorder (SAD) is a chronic and difficult-to-cure psychiatric condition that presents as a persistent, disproportional fear of observation and judgment in social settings or social performance situations (**national˙collaborating˙centre˙for˙mental˙hea colonnesi˙social˙2017**); in some contexts, symptoms can extend beyond anxiety around how an individual's behavior reflects on them-self to include anxiety around how their behavior may reflect on other people (**jefferies˙social˙2020**). SAD can develop at any time in a person's life, but it typically emerges during childhood or early adolescence (**national˙collaborating˙centre˙for˙mental˙health˙uk˙social˙201** and is thought to be caused by a combination of genetic and environmental factors (XX). People experiencing SAD may feel shame, anxiety, and discomfort around interpersonal engagement, fearing humiliation or rejection by their peers (XX).
Categorizing how other traits slot into the disease profile is less straightforward. For example, while psychophysiological symptoms such as heart rate variability (HRV)) or meta-cognitive processes (here: "monitoring of one's own cognitive processes" **folz˙facial˙2023**), such as "worry, rumination, threat-monitoring and self-focused processing" (**nordahl˙metacognition˙2022**) may occur in response to anxiety-inducing stimuli, anxiety around these psychophysiological or metacognitive responses may itself engender the disorder. That is, while people living with SAD may experience altered heartrate variability or meta-cognitive processes as symptoms of anxiety, anxiety around others noticing and evaluating these responses can also inform an individual's anticipatory posture towards social interaction. The consequences of SAD can be debilitating and far-reaching, with sufferers experiencing distress in social settings and engaging in avoidance behaviors (XX). In the long term, SAD affects education, professional, and health outcomes (XX).

Much research on the role played by psychophysiology and meta-cognition has focused on adult sufferers of SAD, and the extent to which these findings extend to adolescents remains poorly understood. Existing research on therapeutic interventions suggests that early intervention is necessary to prevent the most far-reaching negative outcomes later in life in areas such as education (**vilaplana-perez˙much˙2021**). These findings are particularly salient given that young people are disproportionately at risk of developing SAD (**jefferies˙social˙2020**), and as such, recent years have seen an uptick in research on SAD in children and adolescents. However, these small studies have at times produced conflicting results, and the presence of moderators such as age, clinical level of SAD, and measurement tool have made comparison between findings difficult.

The present research seeks to bring these results together via a meta-analysis of 90 relevant studies with the aim of shedding light on the relationship between meta-cognition, psychophysiology, and SAD. It is our hope that cohesive analysis of study outcomes will support early assessment and intervention for children and adolescents struggling with SAD. To this end, three main Research Questions have been developed:

1. Do specific metacognitive processes and psychophysiological patterns contribute to the development of social anxiety disorder in children and adolescents

2. Does interaction between meta-cognition and psychophysiological phenomena contribute to the development of social anxiety disorder in children and adolescents?

3. To what degree do moderators like age, clinical level, and measurement tool play a role in the development of SAD?

4. Do the relationships uncovered by the analysis conform to theoretical cognitive-affective model of social anxiety?

Chapter 2

Methodology

Search Criteria

The data in meta-analyses originate from existing studies. For this meta-analysis, researchers first compiled a body of relevant, existing literature from four databases (psycINFO, Medline, EMBASE, and Web of Science Core Collection; conducted March 13, 2023) by considering research on either social phobia (SAD) and meta-cognition or social phobia and HRV. After duplicates were removed from the pool of papers, two raters screened titles and abstracts for inclusion and exclusion criteria. Inclusion criteria consist of: studies with a socially anxious patient population, papers that specifically mention one of the instruments used to measure meta-cognition or HRV, and studies with patient populations under the age of 24. Papers that include co-morbid disorders or where social anxiety is not considered separately in the results section were excluded. After the remaining papers were screened by a second rater, 34 papers were retained for meta-cognition, and 54 papers were retained for HRV. Of these, two additional raters independently screened 30 (meta-cognition) and 50 (HRV) papers for inclusion, with raters largely in agreement on paper inclusion or exclusion (Kappa inter-reliability: Meta-cognition = 0.902; HRV = 0.913).
For this initial meta-analysis, we restrict the scope of the study by considering only the literature on meta-cognition. These papers were then carefully read and relevant data extracted.

Data Information

The data set compiled for the meta-analysis contains 26 variables that characterize each of the 54 papers included in this study. The variables included in the data set fall into 5 different categories: **Paper information**, **Participant information**, **Social anxiety data**, and **Metacognition methodology**. The **Paper information** variables contain the information necessary for identifying the paper, such as the authors, year of publication, and the study's country of origin. The **Participant information** category is composed of variables that describe the sample included in each study, such as sample size, gender and ethnic composition, and participant age. The **Social anxiety data** variables capture data on the type of study conducted (correlational or group comparison), the type of instrument used to measure social anxiety (e.g. self-reported, clinician assessed) and recruitment measure (e.g. referred by therapists). The **Meta-cognition methodology** category includes variables related to the type of Meta-cognition measure used in a study (trait or state) and information on the meta-cognition measurement instrument used (the number of questions included in it). Finally, the **Results** variables include the results obtained from each study, giving information about the statistical analysis performed, the effect size, the type of measure used (effect size: d-measures or correlation: r-measures), and the significance of the results. The 95% confidence interval and the variance of the effect size estimates are also included.

Statistical Analysis

A random-effects meta-analysis was performed to estimate the overall effect size of the relationship between meta-cognition and social anxiety. Initially, the data set was cleaned by removing papers with missing information on the effect size. Moreover, it was necessary to uniform the different effect size estimates type into a single one, since both means differences with standard deviations (d effect size) and correlations (r effect size) were included in the data set. Therefore, the correlation coefficients were transformed into the corresponding effect size estimate and standard deviations using the following formulas reported by **mathur˙simple˙2020**:

$$d = \frac{2r}{\sqrt{1 - r^2}}$$

$$\hat{SE}(d) = \frac{2}{(N-1)(1-r^2)}$$

With r being the correlational coefficient and N being the number of individuals included. Finally it was possible to perform the random-effects meta-analysis using the converted dataset as described in the previous steps. The entire analysis were performed using the `metafor` package in `R`.