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Why Children Develop Anxiety Problems: A Study of Risk Factors

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Abstract

Anxiety disorders are the most common psychiatric problems faced by children across the world. Without intervention, the lives of anxiety disordered children often unfold with less opportunity and more hardship than their peers. Many will go on to face chronic mental health difficulties in adulthood with worse outcomes in physical health and education. Happily, efforts to detect children at risk of anxiety disorder and intervene during childhood may change this trajectory. Such efforts depend upon a scientific understanding not only of which factors determine risk of anxiety disorders among children, but also how such risk factors may interact. Given the aggregation of anxiety disorders within families and evidence to suggest that intergenerational transmission of anxiety disorders is not genetically mediated, parenting behaviours have become the focus of much research. While parenting behaviours – such as overly controlling parenting and overprotective parenting – have shown modest but robust associations with child anxiety, limited experimental research in this field leaves questions about causality and directionality unanswered. Furthermore, fathers remain completely absent from the available experimental literature on anxiogenic parenting behaviour, and effects have yet to be observed in physiological measures of child anxiety. Previous meta-analyses have synthesised evidence on single risk factors for child anxiety, but have not provided explored whether the presence of more than one risk factor amounts to a greater risk of anxiety disorders in children compared to single factors alone.

To expand upon this growing evidence base, the present thesis project will synthesise evidence on combined and individual risk factors for child anxiety and contribute a piece of novel empirical research, both of which emanate from a joint project between two clinical psychology doctoral trainees. In the first chapter, key differences between the joint projects will be delineated and the unique contributions in the present thesis will be justified. In the second, a systematic review and meta-analysis will synthesise evidence from 38 studies on associations between risk factors (parent anxiety disorder, behavioural inhibition and anxiogenic parenting behaviour) and child anxiety, comparing individual risk factor effects with combined risk factor effects. In the third and final chapter, a novel experimental study exploring the causal relationship between the overly controlling parenting behaviour of fathers and anxiety symptoms in their children, including child-reported measures of anxious cognitions and affect along with heartrate variability.

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Research Thesis: Declaration of Authorship

Print name: Dave Burniston

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I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before

Signature: Date:

Acknowledgements

Firstly, I would like to thank every father and child who participated in our experimental research. For children, agreeing to deliver a speech to strangers required courage and often meant sacrificing playtime. With minimal protest, these children were happy to give us their time, often with little more encouragement than a printed A4 “well done” certificate and the knowledge that they were about to play some small part in “doing some science to help other children feel confident.” Though many of the fathers who participated lived busy lives, they invited us into their homes and gave us their time. While the A4 paper *they* received provided them with a £30 voucher code, it was clear from our conversations with them that the possibility of playing some part in securing happiness and confidence within the children of strangers was a greater motivator to them.

I would like to thank my supervisors – Drs Alessio Bellato, Tessel Bazelmans and Pete Lawrence. Without their expertise, wisdom and patience this project would not have been possible. And to Kashmala, my fellow researcher in this joint project, I owe an enormous debt of gratitude. While conducting this research project within the participant’s own homes meant travelling around two-thousand miles and spending almost 75 hours collecting data for both of us, I am mindful that for you this also meant stepping into the homes of countless cats and dogs – had you not faced your own fear of animals, we may have understood a little less about the fears of young children. I don’t know how (or if) I would have reached this point without your intelligence and your good humour, and it has been a pleasure to be the Robin to your Batman.

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Definitions and Abbreviations

HRV ..... Heart rate variability

BI ..... Behavioural inhibition

RMSSD ..... Root mean square of successive differences

RDoC ..... Research Domain Criteria

DSM-IV ..... Diagnostic Statistical Manual 5th edition

ICD-11 ..... The International Classification of Diseases 11th edition

WHO ..... World Health Organisation

ADHD ..... Attention deficit hyperactivity disorder

PRISMA ..... Preferred Reporting Items for Systematic Reviews and Meta-Analyses

REML ..... Restricted maximum likelihood

RoB2 ..... Cochrane Risk of Bias Tool

NOS ..... Newcastle-Ottawa Sale

JBI ..... Joanna Briggs Instituite Critical Appraisal Checklist

MOA ..... Method of anxiety assessment

ECG ..... Electrocardiogram

BPM ..... Beats per minute

PNS ..... Parasympathetic nervous system

RMS ..... Root mean square

M ..... Mean

SD ..... Standard deviation

SE ..... Standard error

CI ..... Confidence interval

LMM ..... Linear mixed effects model

VIF ..... Variance inflation factors

Chapter 1 Introductory Chapter

This doctoral thesis aims to examine the intergenerational transmission of anxiety from parent to child, focusing particularly on the role of anxiogenic parenting behaviour. This project, comprising a synthesis of existing evidence as well as a novel piece of empirical research, is part of a joint piece of work conducted with a fellow student of the Doctorate in Clinical Psychology. In this opening chapter, I will clarify the unique contributions made within the present meta-analysis and empirical project, drawing distinctions between my colleague's counterpart project and my own, and establishing the justification for the differences within my own project. Specifically, these are i) a focus in my meta-analysis on continuous assessment of child anxiety symptom severity (rather than categorical or diagnostic assessment), and, ii) in my empirical project, a focus on the use of heartrate variability as a biomarker of autonomic nervous system dysregulation (rather than behavioural observation of child anxiety).

1.1. Child anxiety as a continuous outcome

The first distinction between projects is that my colleague's meta-analysis synthesised studies measuring child anxiety as a categorical outcome (i.e. anxiety disorder versus no anxiety disorder) whereas mine, by contrast, included only studies using a continuous measure of child anxiety symptoms.

Contemporary models of psychopathology increasingly emphasise dimensional approaches to understanding anxiety, in which symptoms are conceptualised as existing along a continuum, rather than being categorically present or absent (Cuthbert & Insel, 2013). This approach is reflected in frameworks such as the Research Domain Criteria (RDoC), which conceptualise anxiety as a graded construct influenced by multiple interacting biological, psychological, and environmental factors (Casey, Oliveri, & Insel, 2014). From a research perspective, treating child anxiety as a continuous outcome rather than a binary diagnosis allows for more precise modelling of how risk factors—including parenting behaviours, parental anxiety, and child temperament—contribute incrementally to anxiety symptomatology. As Rapee, Schniering and Hudson (2009) argue, such an approach is particularly important in developmental research, where risk factors are likely to exert gradual, cumulative effects that shape anxiety over time, rather than acting as discrete triggers of diagnosable disorders.

Brooks and Kutcher (2004) found in their review of 200 studies of adolescent anxiety between 1994 and 2001 that more than 20% of studies reporting child anxiety diagnosis did not report the use of developmentally appropriate diagnostic instruments. This is significant, as anxiety symptoms may manifest differently in children compared to adults and may shift

through the child's development (Weems, 2008). In their critical review of epidemiology and aetiology of anxiety disorders among children and adolescents, Beesdo, Knappe and Pine (2009) note a number of issues in using diagnostic systems such as the Diagnostic Statistical Manual, 5th edition (DSM-IV; American Psychiatric Association, 2013), that fail to sufficiently differentiate childhood anxiety disorders from those presenting in adulthood. Specifically, they argue that diagnostic tools for anxiety disorders may i) fail to distinguish fears that may be normative and transient during childhood from those that may be pathological; ii) fail to account for differences between adults and children in their ability to articulate internal experiences, resulting in potential under-reporting among children and; iii) fail to account for differences in age of onset between disorders. For example, while specific phobias may emerge in early childhood (Becker et al., 2007), social anxiety disorder typically emerges during or after adolescence (Beesdo et al., 2007).

Furthermore, the DSM-IV criterion for "clinical significance" raises particular questions regarding how "impairment" and "significant distress" may be interpreted with regards to children. Wakefield and First (2003) have argued that transitions typical in childhood – such as starting school – are likely to evoke periods of temporary distress that do not reflect pathology. Equally, they argue that a child's apparent impairment while learning how to function in novel contexts is incomparable to persisting functional impairment seen in adults for whom a reasonable degree of adjustment to such social contexts as the workplace can reasonably be expected. This issue is accentuated by evidence that differences in both informant (e.g. teacher, parent or clinician) and context (e.g. school, home or clinic) can produce significant differences in ratings of child impairment (Beesdo, 2009).

Wakefield and First (2003) make the argument that the ICD-10 may be more appropriately used among children, due to its inclusion of codes unique to childhood anxiety and recognition of fears that may be normative to childhood, yet in their categorical (disordered or not disordered) approach are likely to fail to capture the dimensional nature of anxiety disorders in children. The International Classification of Diseases (11th ed.; ICD-11; World Health Organisation [WHO], 2019) offers some modest improvements, specifically with the inclusion of integrated developmentally specific variations into each disorder category, allowing clinicians to make some distinctions between anxiety disorders presenting in children from those in adults. These changes, however, still fail to address many limitations of categorical systems of anxiety disorder diagnosis among children, and much of the research included in the meta-analysis presented within this thesis were conducted prior to the release of the ICD-11.

Previous meta-analyses have also highlighted issues in using categorical classifications of child anxiety disorder. For example, McLeod, Wood and Weisz (2007) argue that effect sizes in

studies using categorical measures of child anxiety are likely inflated, with those using continuous measures reporting smaller but likely more accurate effect sizes for the association between anxiogenic parenting behaviour and child anxiety. This is, they argue, because children meeting threshold for anxiety disorder diagnosis more often comprise clinical samples, whereas continuous scores of child anxiety are more often collected through wider, non-clinical samples inclusive of a wider range of anxiety symptoms not formally meeting threshold for diagnosis. Similarly, Wood et al. (2003) caution that research limited to diagnosed children may fail to generalise to community populations, underestimating the influence of parent and child risk factors that may operate below diagnostic thresholds. Taken together, these findings support the use of dimensional anxiety measures, particularly in studies aiming to model developmental trajectories or identify emerging risk factors for anxiety across childhood.

Van der Bruggen, Stams, and Bögels (2008) highlight similar issues in their meta-analysis, adding that, by collapsing the continuum of anxiety symptoms into a "disordered" and "not-disordered" binary, moderator analyses are limited. For example, specific developmental patterns of child anxiety in relation to parenting behaviour – such as the age-related effects of overcontrolling parenting on child anxiety found by McLeod et al. (2007) – may be obscured when synthesising studies using categorical measures that reduce anxiety symptoms to a simple binary. Furthermore, Rapee, Schniering and Hudson highlight in their 2009 literature review the value of continuous child anxiety symptom measures in tracking the developmental trajectories of child anxiety and identifying patterns of associations between risk factors and child anxiety symptoms before such symptoms reach clinical threshold.

1.2. The use of heartrate variability as a biomarker of autonomic nervous system dysregulation

In these collaborative thesis projects, both authors sought to build upon the experimental work of Thirwall and Creswell (2010) in partially replicating their experimental design to examine the causal effects of paternal overcontrolling behaviour on young children. Both projects build upon the original authors' work by being the first to experimentally study the effects of *fathers'* overcontrolling parenting behaviour on child anxiety. Our projects are distinct in the methods of measurement used to capture child outcomes. While my colleague's project replicates the combination of observer ratings and self-report, my project attempts to address the limitation identified by Thirwall and Creswell (2010) in the conclusion of their paper: the need for a physiological child outcome measure.

While self-report measures offer crucial insight into the subjective experience of the individual, such measures face a number of limitations, especially among children. One such limitation is that children may lack the intellectual capacity to introspect and communicate internal anxious states, with many common child-report measures lacking sensitivity to the child's developmental level (Schniering et al., 2000). The 5-point Likert "feelings scale" originally used in Thirwall and Creswell's (2010) study may have been sufficiently simple for children aged 4-6 years to interpret, yet limitations on the scale's validity remain. One such limitation is that the scale still requires the child to determine what is meant by a "scared" feeling, and requires the researcher to interpret said feelings. One might assume that a child reporting 'scared' feelings prior to an unwanted experience might also report similar feelings while waiting to board a rollercoaster. It may be reasonable to assume, therefore, that perceptions of 'scaredness' or 'fear' provide insufficient detail to determine that which is adaptive from that which is maladaptive, or that which is pathological from that which is not pathological or, even, is desirable. Furthermore, child-reported anxiety may be vulnerable to response biases. Children may be influenced by a perceived social desirability (for example, a perception that fearlessness is desired), particularly when a trusted adult is present (De Los Reyes & Kazdin, 2005; van Roy et al., 2010).

To complement child-reported anxiety symptoms, Thirwall and Creswell (2010) also included observer-rated child anxiety symptoms using a coding scheme for anxious symptoms in children. Combined with child self-report, this measure offers greater insight into experiences of anxiety among the child sample, though several limitations are inherent. One such limitation is that the measure fails to capture manifestations of anxious symptoms that are inherently unobservable. Children may, for example, experience anxiety-related cognitive or physiological patterns that are not visible to the observer (Kendall & Pimentel, 2003; Rapee et al., 2009). Equally, observers may misattribute behaviours – such as fidgeting or avoidance caused by boredom – to symptoms of anxiety (Hudson et al., 2009).

Heart rate variability (HRV) is recognised as a physiological index in the study of anxiety, offering unique advantages that complement and extend the scope of self-report and observer-based assessments alone. HRV refers to the variation in time intervals between consecutive heartbeats, and reflects the dynamic balance of sympathetic and parasympathetic nervous system activity—often interpreted as a measure of autonomic flexibility or regulatory capacity (Porges, 2007; Appelhans & Luecken, 2006). Specifically, parasympathetic-mediated HRV, indexed by measures such as the root mean square of successive differences (RMSSD), captures how effectively an individual's autonomic nervous system can adapt to environmental demands, including stress or threat. It has been validated across numerous experimental

paradigms involving children, including social stress tasks such as public speaking, peer interaction, or performance evaluation (e.g., Gentzler et al., 2009; Smiley et al., 2020). Importantly, HRV can be reliably measured in short time segments, making it suitable for child-friendly, time-limited procedures commonly used in developmental research (Laborde et al., 2017).

Crucially, HRV does not merely indicate the presence of anxiety, but offers nuanced insight into regulatory processes. Low baseline HRV or larger HRV reductions in response to stress may reflect autonomic dysregulation, a pattern linked to elevated state anxiety, and to vulnerabilities in emotion regulation, inhibitory control, and flexibility under stress (Beauchaine & Thayer, 2015). This makes HRV particularly valuable in identifying children at risk for persistent or maladaptive anxiety profiles, even when subjective distress is not reported. While self-report and observer report measures could be said to capture the child's anxiety, HRV is unique in offering some insight into the child's internal relationship with anxious feelings during the experiment.

1.3. Clinician's observations

While only anecdotal, I would like to address an observation made by myself while conducting our experimental study. I observed a number of children who appeared to extend exhalations during five-minute echocardiograph baseline measurements which were later calculated to indicate exceptionally high HRV. In one case, the child's RMSSD score (117.2) during a baseline measurement was more than double the median RMSSD score (58) found in a sample of 465 five-year-old children (Seppälä et al., 2014). When speaking with the child's parent following our experimental procedure the parent stated that both he and his child frequently feel anxious, before turning to his child and saying "but we know what to do, don't we? Nice big breaths."

Such patterns of breathing are sometimes considered to be a source of noise, obscuring autonomic patterns of reactivity that researchers aim to isolate (e.g. Kircher et al., 2015). In the context of the present study, however, treating respiration as a source of noise may neglect a significant biobehavioural index of emotion regulation in children. Children who are better able to self-regulate may naturally adopt slower, more adaptive breathing patterns during stress, leading to higher HRV. Conversely, dysregulated children may exhibit anxious breathing patterns—rapid, shallow breaths—resulting in lower HRV. Thus, how a child breathes under stress may be part of the regulatory response, rather than an artefact to be removed (Porges, 2007; Laborde et al., 2017).

1.4. References

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). American Psychiatric Publishing.

Appelhans, B. M., & Luecken, L. J. (2006). Heart rate variability as an index of regulated emotional responding. Review of General Psychology, 10(3), 229–240. https://doi.org/10.1037/1089-2680.10.3.229

Beauchaine, T. P., & Thayer, J. F. (2015). Heart rate variability as a transdiagnostic biomarker of psychopathology. International Journal of Psychophysiology, 98(2), 338–350. https://doi.org/10.1016/j.ijpsycho.2015.08.004Becker, E. S., Rinck, M., Türke, V., Kause, P., Goodwin, R., Neumer, S., & Margraf, J. (2007). Epidemiology of specific phobia subtypes: Findings from the Dresden Mental Health Study. European psychiatry, 22(2), 69-74. https://doi.org/10.1016/j.eurpsy.2006.09.006

Beesdo, K., Bittner, A., Pine, D. S., Stein, M. B., Höfler, M., Lieb, R., & Wittchen, H.-U. (2007). Incidence of Social Anxiety Disorder and the Consistent Risk for Secondary Depression in the First Three Decades of Life. Archives of General Psychiatry, 64(8), 903-912. https://doi.org/10.1001/archpsyc.64.8.903

Beesdo, K., Knappe, S., & Pine, D. S. (2009). Anxiety and anxiety disorders in children and adolescents: developmental issues and implications for DSM-V. Psychiatr Clin North Am, 32(3), 483-524. https://doi.org/10.1016/j.psc.2009.06.002

Casey, B. J., Oliveri, M. E., & Insel, T. (2014). A neurodevelopmental perspective on the Research Domain Criteria (RDoC) framework. Biological Psychiatry, 76(5), 350–353. https://doi.org/10.1016/j.biopsych.2014.01.006

Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: The seven pillars of RDoC. BMC Medicine, 11(1), 126.

De Los Reyes, A., & Kazdin, A. E. (2005). Informant discrepancies in the assessment of childhood psychopathology: a critical review, theoretical framework, and recommendations for further study. Psychol Bull, 131(4), 483-509. https://doi.org/10.1037/0033-2909.131.4.483

Hudson, J. L., Dodd, H. F., & Bovopoulos, N. (2009). Temperament and family environment as predictors of anxiety in preschool children. Journal of Abnormal Child Psychology, 37(3), 393–406. https://doi.org/10.1007/s10802-008-9283-2

Kendall, P. C., & Pimentel, S. S. (2003). On the self-report of worry in children. Child & Family Behavior Therapy, 25(2), 17–40. https://doi.org/10.1300/J019v25n02_02

Kircher, M., Lenis, G., & Dössel, O. (2015). Separating the effect of respiration from the heart rate variability for cases of constant harmonic breathing. Current Directions in Biomedical Engineering, 1(1), 46-49. https://doi.org/doi:10.1515/cdbme-2015-0012

Laborde, S., Mosley, E., & Thayer, J. F. (2017). Heart rate variability and cardiac vagal tone in psychophysiological research–Recommendations for experiment planning, data analysis, and data reporting. Frontiers in Psychology, 8, 213. https://doi.org/10.3389/fpsyg.2017.00213

McLeod, B. D., Wood, J. J., & Weisz, J. R. (2007). Examining the association between parenting and childhood anxiety: A meta-analysis. Clinical Psychology Review, 27(2), 155–172.

Porges, S. W., Doussard-Roosevelt, J. A., & Maiti, A. K. (1994). VAGAL TONE AND THE PHYSIOLOGICAL REGULATION OF EMOTION. Monographs of the Society for Research in Child Development, 59(2-3), 167-186. https://doi.org/https://doi.org/10.1111/j.1540-5834.1994.tb01283.x

Porges, S. W. (2007). The polyvagal perspective. Biological Psychology, 74(2), 116–143. https://doi.org/10.1016/j.biopsycho.2006.06.009

Rapee, R. M., Schniering, C. A., & Hudson, J. L. (2009). Anxiety Disorders During Childhood and Adolescence: Origins and Treatment. Annual review of clinical psychology, 5(Volume 5, 2009), 311-341. https://doi.org/https://doi.org/10.1146/annurev.clinpsy.032408.153628

Schniering, C. A., Hudson, J. L., & Rapee, R. M. (2000). Issues in the diagnosis and assessment of anxiety disorders in children and adolescents. Clinical Psychology Review, 20(4), 453-478. https://doi.org/10.1016/S0272-7358(99)00037-9

Seppälä, E. M., Nitschke, J. B., Tudorascu, D. L., Hayes, A., Goldstein, M. R., Nguyen, D. T., Perlman, D., & Davidson, R. J. (2014). Breathing-based meditation decreases posttraumatic stress disorder symptoms in U.S. military veterans: a randomized controlled longitudinal study. J Trauma Stress, 27(4), 397-405. https://doi.org/10.1002/jts.21936

Seppälä, S., Laitinen, T., Tarvainen, M. P., Tompuri, T., Veijalainen, A., Savonen, K., & Lakka, T. (2014). Normal values for heart rate variability parameters in children 6–8 years of age: the PANIC Study. Clinical Physiology and Functional Imaging, 34(4), 290-296. https://doi.org/https://doi.org/10.1111/cpf.12096

Smiley, P. A., Schriber, R. A., Preuss, L. J., & Guyer, A. E. (2020). Autonomy-restrictive parenting, resting RSA, and anxiety in children. Child Development, 91(4), e833–e850. https://doi.org/10.1111/cdev.13313

Van der Bruggen, C. O., Stams, G. J. J. M., & Bögels, S. M. (2008). Research review: The relation between child and parent anxiety and parental control: A meta-analytic review. Journal of Child Psychology and Psychiatry, 49(12), 1257–1269.

Van Roy, B., Groholt, B., Heyerdahl, S., & Clench-Aas, J. (2010). Understanding discrepancies in parent-child reporting of emotional and behavioural problems: Effects of relational and socio-demographic factors. BMC psychiatry, 10(1), 56. https://doi.org/10.1186/1471-244X-10-56

Visted, E., Sørensen, L., Osnes, B., Svendsen, J. L., Binder, P.-E., & Schanche, E. (2017). The Association between Self-Reported Difficulties in Emotion Regulation and Heart Rate Variability: The Salient Role of Not Accepting Negative Emotions [Original Research]. Frontiers in Psychology, Volume 8 - 2017. https://doi.org/10.3389/fpsyg.2017.00328

Wakefield, J. C., & First, M. B. (2003). Clarifying the distinction between disorder and nondisorder: Confronting the overdiagnosis (False-positives) problem in DSM-V. In Advancing DSM: Dilemmas in psychiatric diagnosis. (pp. 23-55). American Psychiatric Association.

Weems, C. F. (2008). Developmental trajectories of childhood anxiety: Identifying continuity and change in anxious emotion. Developmental Review, 28(4), 488-502. https://doi.org/https://doi.org/10.1016/j.dr.2008.01.001

Wood, J. J., McLeod, B. D., Sigman, M., Hwang, W.-C., & Chu, B. C. (2003). Parenting and childhood anxiety: theory, empirical findings, and future directions. Journal of child psychology and psychiatry, 44(1), 134-151. https://doi.org/https://doi.org/10.1111/1469-7610.00106

World Health Organization. (2019). International classification of diseases for mortality and morbidity statistics (11th ed.). https://icd.who.int/

Chapter 2 Systematic review and meta-analysis of individual and combined risk factors for the development of anxiety symptoms in children

This chapter is written for the Journal of Child Psychology and Psychiatry. The author guidance states review articles should not exceed 5000 words, (including title page and abstract, excluding references, tables, figures). For detailed author guidelines Author Guidelines - Journal of Child Psychology and Psychiatry - Wiley Online Library

Chapter 1 word count: 4996 (excluding tables, figures and references)

2.1. Abstract

This meta-analysis synthesised evidence from 38 studies to examine how three key risk factors—behavioural inhibition (BI), parent anxiety, and anxiogenic parenting behaviours—are associated with child anxiety symptoms. All three factors showed significant positive associations with child anxiety, with BI emerging as the most robust individual predictor. Anxiogenic parenting behaviours and parent anxiety were also meaningfully linked to elevated anxiety in children. A central aim was to determine whether combinations of these risk factors confer greater risk than individual factors alone. Contrary to expectations, no significant difference was found between combined and individual risk effects, although only a small number of studies reported the necessary multivariate data to test this question fully. Moderator analyses revealed that these associations were consistent across child age, gender, method of anxiety assessment, and country of data collection, suggesting these effects are relatively robust across developmental and cultural contexts. No evidence of publication bias was found. These findings support early screening for behavioural inhibition and parenting-focused interventions, while also highlighting gaps in the literature regarding cumulative risk processes and the need for more integrative, multivariate research designs.

2.2. Introduction

Anxiety disorders are prevalent and harmful, with an estimated worldwide prevalence of 6.5% (Polanczyk et al., 2015), potentially increasing during the COVID-19 pandemic (est. prevalence 20.5%; Racine et al., 2021) with a similar trend seen in the preceding decade (Bitsko et al. 2022). Though prevalence estimates are varied there is strong evidence that anxiety disorders are the most prevalent psychiatric diagnoses among children, exceeding diagnoses of ADHD and depressive disorders (WHO, 2021; Polanczyk et al., 2015). Compared with non-anxious children, children with anxiety disorders may experience worse outcomes achievement in education (Van Ameringen et al., 2003), social relationships (Greco & Morris, 2005), long-term immune system dysregulation (Kiecolt-Glaser et al., 2010), chronic pain (Noel et al., 2016), gastrointestinal disorders (Drossman & Hasler, 2016), cardiovascular disease (Piepoli et al. ,2016), premature mortality (Copeland et al., 2014) and reduced quality of life (Essau et al., 2014). Without successful intervention, childhood anxiety disorders often develop into substance misuse and co-occurring mental health conditions such as depression (Beesdo et al., 2009). Wider negative consequences are also found in family functioning (Senaratne et al., 2010) as well as a significant economic burden (Pollard et al., 2023).

Children are nearly twice as likely to develop an anxiety disorder if their parents have one (Lawrence et al., 2019). As parents contribute both genetic and early socialisation during childhood, they have been the focus of much research. While there is evidence to suggest that the transmission of anxiety disorders from parent to child is not mediated by genetic factors (Eley et al., 2015), parenting behaviours have emerged as a significant factor of interest in many studies. There are numerous anxiogenic parenting behaviours identified in the literature, including: i) overcontrolling parenting (diminishing self-efficacy and autonomy by excessively intervening to control the child; Affrunti & Ginsburg, 2012); ii) overprotective parenting (limiting exposure to appropriate challenges, fostering avoidance and promoting dependence; Chorpita et al., 1998); iii) intrusive parenting (excessive verbal or physical behaviours that limit the child's

autonomy; Grolnick & Pomerantz, 2009); and parental rejection (signalling criticism or a lack of warmth towards the child with excessively negative parenting; Rohner, 2004). Empirical evidence finds modest effect sizes for overcontrolling (Thirwall & Creswell, 2010), overprotective (Coplan et al., 2004; Edwards et al., 2010), overinvolvement (De Vente et al., 2011) and rejection (Akün, 2017) parenting behaviours, though the differential application of terms and unclear conceptual definitions make evidence synthesis difficult. For example, in their systematic review and meta-analysis of 55 studies, Jiang et al. (2023) identify 10 separate terms relating to intrusive parenting (such as overinvolvement, overprotection and psychological control). In their 2016 meta-analysis of 40 studies, Möller et al. attempted to aggregate terms relating to overprotection, overcontrol and intrusiveness as subdomains of 'overinvolvement,' but called for caution in doing so after findings suggested differential associations for anxiogenic parenting subdomains with some domains more associated with child anxiety than others, depending on factors such as gender and ethnicity. Parental rejection appears to be distinct from overinvolved behaviours (McLeod et al., 2007). Defined by excessive criticism, dismissiveness or a lack of warmth, parental rejection is thought to undermine the child's emotional security, threaten attachment and enhance social fears and is associated with child anxiety across cultures (Khaleque & Rohner, 2002).

Behavioural inhibition (BI), a stable trait observable from infancy (Kagan et al., 1984; 1988) characterised by aversion and fearful response to novel stimuli, has emerged as the most robust risk factor for child anxiety. A 2020 meta-analysis of 27 studies by Sandstrom et al. found strong positive associations between BI and anxiety, with children high in BI 2.8 times as likely to develop an anxiety disorder, though heterogeneity between specific anxiety disorders included in each study may have influenced their calculation of overall risk for any disorder. They found that children were 5.84 times more likely to develop social anxiety disorder specifically, though they were unable to find sufficient studies to examine effects of BI on panic disorder.

Traditional models of childhood anxiety have focused on single main effects (e.g. Gottman et al., 2013; Maccoby, 1994), yet such models only account for a fraction of the

variance in childhood anxiety For example, parenting behaviour and BI are both associated with child anxiety, yet neither account for most of the variability in child anxiety symptoms (Möller et al., 2016). Limitations of single-factor models have inspired attempts to understand the development of childhood anxiety as a complex, multidetermined process, though the evidence for dynamic models remains unclear. For example, Hudson and Dodd (2012) found that both child BI and parenting behaviours predict worse anxiety outcomes in children, but did not find interactive effects between the two factors whereas Lewis-Morrarty et al. (2012) found that overprotective parenting strengthened the association between BI and child anxiety and in their experimental study, Thirwall and Creswell (2010) found that overcontrolling maternal parenting was significantly associated with child anxiety only when BI was included as a moderator. One potential difficulty in synthesising evidence on anxiogenic parenting and child anxiety is the degree of heterogeneity between studies, with a variety of child anxiety assessment methods (such as self-report, parent report or clinical interview), data collection in different countries and at different stages in the child's development. These details are crucial as methods of child anxiety measurement often produce different scores (Bögels & Melick, 2004), the influence of parenting behaviours may depend on cultural parenting norms (Aaron et al., 2023) and the salience of particular parenting behaviours may depend upon the child's age, with children potentially more vulnerable to excessive parental control when later childhood demands of independence and exploration become more salient (Samdan et al., 2020).

One significant issue for evidence synthesis that remains untested is whether children with multiple risk factors face a greater risk of developing anxiety disorders compared to those with only one. Answering this question may be important in developing models that comprehensively explain the potentially complex and dynamic factors that predict child anxiety. Furthermore, this evidence will inform those seeking to identify at-risk children and those developing strategies for prevention.

The present meta-analysis seeks to answer this question as part of a joint project. As symptoms of anxiety problems are likely to develop in children before they reach diagnostic

threshold (Beesdo et al., 2009), extraneous factors (such as access to diagnostic services) are likely to influence rates of diagnosis, and continuous anxiety measures are likely to be more sensitive to anxiety differences (Murray et al., 2009), the present study will explore continuous measures of anxiety symptoms, with its sister study exploring anxiety diagnoses. Building on previous meta-analyses, we will review and synthesise evidence from studies using validated measures of child anxiety and reporting effect sizes for individual effects of risk factors (BI, parent anxiety and anxiogenic parenting behaviour) and also studies reporting effect sizes for combinations of the above factors. Comparison between the two will provide a summary of existing evidence and attempt to identify whether additive or multiplicative effects exist among combined risk factors. Based on existing theory and evidence within current literature, we predict that the meta-analysis will reveal effect sizes that are larger for combined risk factors than for individual factors.

2.3. Methods

2020 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Page et al., 2021) were adhered to in reporting the present systematic review and meta-analysis. The PRISMA checklist in reported in appendix A and the protocol was pre-registered on PROSPERO (CRD42024588579).

2.3.1 Search strategy

The PRISMA flowchart for selection process (depicted in figure 2.1) began with a search of CINHAL, PsycINFO (via EBSCO), Embase (via Ovid), Web of Science and Medline databases on 1st October 2024. Search terms were structured using Boolean operators capturing parent anxiety, behavioural inhibition and parenting behaviour including wildcards to capture alternative phrasing and spelling (i.e. inhibited temperament and BI). Boolean logic (AND/OR) was used to structure queries to combine child anxiety symptom outcomes with risk factors. Terms were refined by a librarian at the University of Southampton. The full search terms can be found in Appendix B.

2.3.2. Selection criteria

Criteria for inclusion were: a) human participants aged 0-18 years; b) published since 1980 in a peer-reviewed journal; c) published in English; d) reported no fewer than two risk factors for child anxiety (limited to parent anxiety disorder, child Behavioural Inhibition and anxiogenic parenting behaviours); e) studies using a validated measure of BI when BI is reported; f) a validated continuous measure of childhood anxiety symptoms. As obsessive-compulsive disorder and post-traumatic stress disorder are no longer categorised as anxiety disorders in the DSM-5 (American Psychiatric Association, 2013), effect sizes drawn from measures exclusive to or inclusive of these disorders were omitted. Given the potential for unique development trajectories for anxiety among populations with neurodevelopmental conditions, physical health diagnoses or intellectual disabilities, studies exclusively reporting on these populations were excluded to reduce confounds and minimise between-study variance. Domain specific anxieties (such as maths or dental anxiety) were also excluded to preserve heterogeneity between studies.

2.3.3. Data selection, extraction and coding

Identified studies were exported to Rayyan software (Ouzzani et al., 2016) to remove duplicates and perform initial title and abstract screening, which was independently screened by the present author (DB) and KS (a third-year doctoral trainee cooperating on the project). Full-text screening was conducted independently by the same KS and DB, using COVIDENCE software. Conflicting decisions were resolved by screeners until consensus was reached. The same two researchers extracted, for each study, i) author name(s), ii) year of publication, iii) sample size, iv) child age (years), v) child gender (% female), vi) parent gender (% female), viii) measure(s) of risk factor used, ix) country of data collection, x) measure(s) of child anxiety symptoms. Statistical results of regression analyses for associations between risk factors and child anxiety symptoms were extracted, with combined regression models from studies reporting combined risk effects. When published data was not sufficient to extract desired

individual or combined effect sizes (i.e. when combined models included risk factors unrelated to our research question), necessary data was requested from authors, with these effect sizes excluded when authors failed to respond before a four-week deadline. The study selection process is depicted in Figure 2.1.

2.3.4. Quality assessment

Quality and bias assessment were independently conducted by two researchers using Cochrane Risk of Bias Tool (RoB2; Sterne et al., 2019) for randomised controlled trials, Newcastle-Ottawa Scale (NOS; Wells et al., 2013) for case-control studies and the Joanna Briggs Institute Critical Appraisal Checklist for cross-sectional studies (JBI; Barker et al., 2024). Disagreements between researchers were discussed until consensus could be reached.

2.3.5. Data synthesis and analysis

Three-level meta-analyses were conducted to establish i) the overall effect of all risk factors on child anxiety across all studies; ii) the overall effect of all individual risk factors and; iii) the overall effect of all combined risk factor effects. Sub-domains of anxiogenic parenting behaviours (such as overinvolvement and overprotection) were coded, as this factor is significantly heterogeneous in previous research (e.g. Moller et al., 2016) to warrant further distinction by behaviour subtype. Age (in years), gender (% female), method of child anxiety measurement (parent-report, child report or clinical interview) and country of data collection were coded as potential moderators.

All data analysis was conducted using R-Studio (version 4.2.; R Core Team, 2024). Published regressions were converted to Fisher's Z before analysis using the 'esc.' function. Multilevel random-effects meta-analyses were conducted with restricted maximum likelihood (REML) estimation to account for dependency where multiple effect sizes are nested in single studies (Cheung, 2014). The three-level structure modelled i) sampling error, ii) within-study variance and, iii) between-study variance using the *rma.mv* function within the *metafor* package in R (Viechtbauer, 2010).

Moderator analyses were conducted to examine whether effect sizes varied by child age, gender (% female), country, and method of anxiety assessment (MOA). Moderators were tested both individually and in combination. Heterogeneity was assessed using Cochran's Q and the I^2 statistic. Heterogeneity was assessed using I^2 partitioned across each level of the 3-level model.

To check for publication bias in the three-level meta-analyses, we used the sensitivity analysis approach developed by Rodgers and Pustejovsky (2021). This method estimates how likely studies are to be included based on the significance of their results and shows how the overall findings might shift under different assumptions about selective reporting. We also applied the Duval and Tweedie (2000) trim-and-fill method to estimate how many studies might be missing and how that could affect the results. Funnel plots were created for each risk factor when enough studies were available, and we re-ran the bias checks on residuals from the moderator models to see if the findings held up. Forest plots were used to display the range of effect sizes and their confidence intervals. All effect sizes are reported as Fisher's z scores, along with 95% confidence intervals and p-values.

2.4. Results

2.4.1. Study characteristics

The search strategy returned a total of 38 studies published between 2006 and 2024 reporting a total of 135 effect sizes. Of these, 6 studies reported 6 effect sizes for combinations of risk factors and 32 studies reported a total of 129 effect sizes for individual risk factors. All studies measure continuous anxiety symptoms in children (% female *M*= 49.95, SD= 9.91) aged from 2.03 to 15.09 years (*M*= 8.41, *SD*= 3.53). Anxiety symptoms were measured predominantly by child-report or parent-report measures (e.g. Spence Children's Anxiety Scale; SCAS-PR; Spence, 1999), with some studies using structured clinical interviews. See figure 2.1 for the PRISMA flowchart and table 2.1 for additional descriptive details.

Figure 2.1. PRISMA flowchart.

A

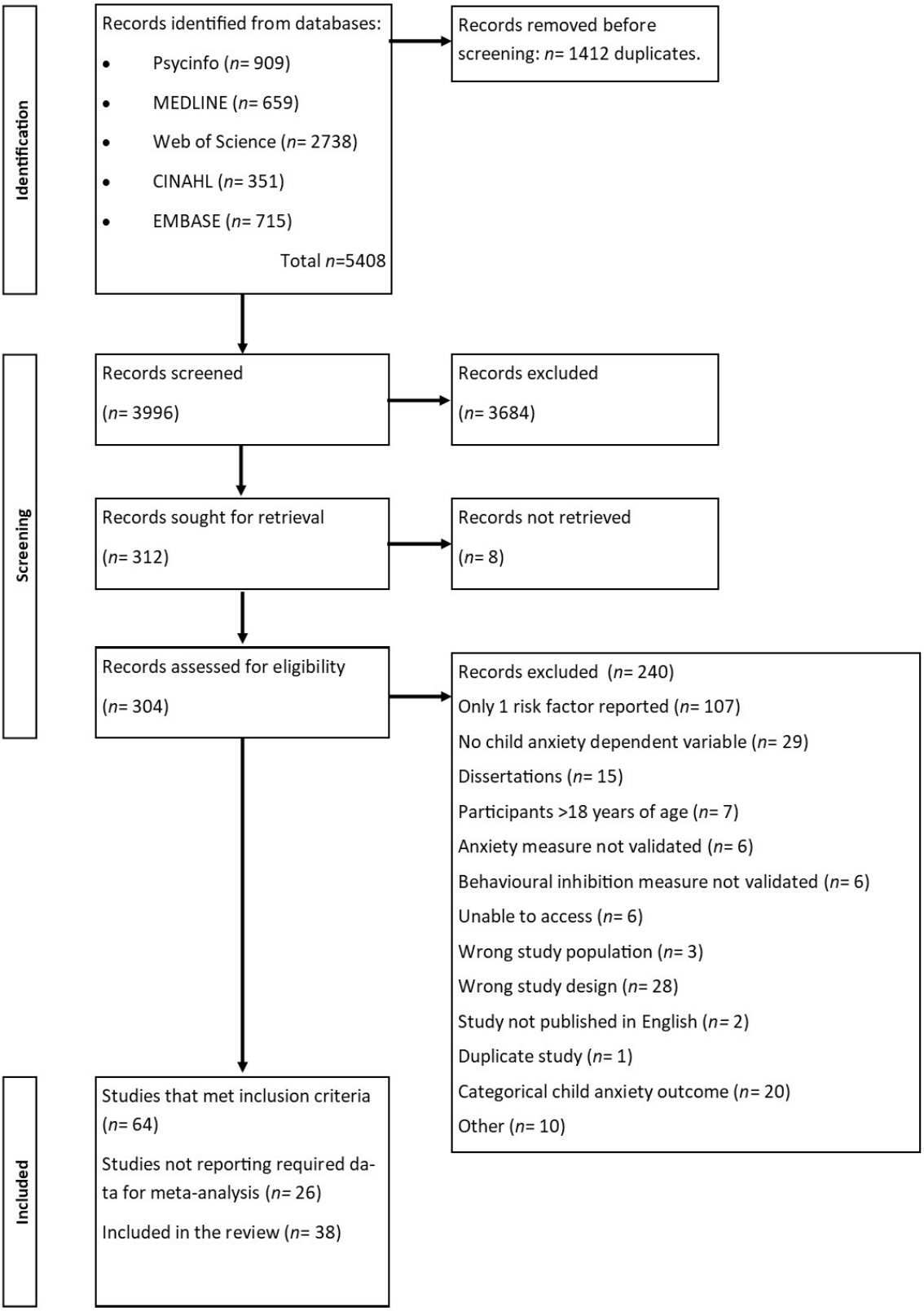

Identification
Records identified from databases:
Psycinfo (n= 909)
MEDLINE (n= 659)
Web of Science (n= 2738)
CINAHL (n= 351)
EMBASE (n= 715)
Total n=5408
Records removed before screening: n= 1412 duplicates.
Screening
Records screened (n= 3996)
Records excluded (n= 3684)
Records sought for retrieval (n= 312)
Records not retrieved (n= 8)
Records assessed for eligibility (n= 304)
Records excluded (n= 240)
Only 1 risk factor reported (n= 107)
No child anxiety dependent variable (n= 29)
Dissertations (n= 15)
Participants >18 years of age (n= 7)
Anxiety measure not validated (n= 6)
Behavioural inhibition measure not validated (n= 6)
Unable to access (n= 6)
Wrong study population (n= 3)
Wrong study design (n= 28)
Study not published in English (n= 2)
Duplicate study (n= 1)
Categorical child anxiety outcome (n= 20)
Other (n= 10)
Included
Studies that met inclusion criteria (n= 64)
Studies not reporting required data for meta-analysis (n= 26)
Included in the review (n= 38)

Table 2.1. Individual study details.

Study	*N*	Mean Child Age (years)	Child Gender (% female)	Parent gender (% female)	Mean Parent Age (years)	Risk Factor(s) included	Risk Factor Measure(s) used	Child Anxiety Measure(s) used	Country of Origin	Study Design	Method of Assessment	Quality Assessment (tool used)
Affrunti & Ginsburg (2012)	74	8.86	52.1	82.7	40.75	Parent anxiety PB (overcontrol)	STAI EMBU-C	SCARED	USA	Cross-sectio	Child report	High (JBI)
Bahtiyar-Saygan & Berument (2022)	100	2.22	46	100	32.62	Behavioural inhibition PB (overcontrol)	ECBQ BIQ	CBCL BITSEA	Turkey	Cross-sectio	Parent report	High (JBI)
Becker et al. (2010)	75	9.03	52	100	39.91	Parent anxiety		SCARED	USA	Cross-sectio	Parent report Child report	High (JBI)
Bogels (2004)	75	10.3	45.3	50	43.2	Parent anxiety	SCARED-A	SCARED-C	Netherlands	Cross-sectio	Parent report Child report	Moderate (JBI)
Borelli et al. (2015)	102	11.31	40	50	39.73	PB (overcontrol)	USC-POS	STAIC	USA	Longitudinal	Child report	Moderate (NOS)
Buss et al. (2021)	166	2.04	50.6	100		Parent anxiety PB (overcontrol)		HBQ	USA	Longitudinal	Parent report	Moderate (NOS)
de Vente et al. (2022)	113	7.5	55	52.2	40.1	Parent anxiety	SPAI-18(SF)	PAT SCARED	Netherlands	Cross-sectio	Parent report Child report	Moderate (JBI)
Edwards et al. (2010)	638	3.95	49.7	71.73	36.95	PB (overprotection) Behavioural inhibition	BIQ	PAS-R	Australia	Longitudinal	Parent report	High (NOS)
Emerson et al. (2019)	85	9.83	55.3	85.9		Parent anxiety	STAI	SCAS-P	UK	Cross-sectio	Parent report	Moderate (JBI)
Fernandes et al. (2023)	33	4.05	49.1	54.81	37.01	Behavioural inhibition Parent anxiety	BIQ	PAS	Portugal	Cross-sectio	Child report	Moderate (JBI)
Festa & Ginsburg (2011)	63	9.62	48	92	40.67	PB (overprotection) PB (rejection) Parent anxiety	STAI EMBU-C FMST	SCARED-C ADIS-C	USA	Cross-sectio	Clinical interview Child report	High (JBI)
Fliek et al. (2014)	202	4.27	41.9	51.99	36.59	Parent anxiety PB (overprotection)	STAI	PAS-R	Netherlands	Cross-sectio	Parent report	High (JBI)
Francis & Manley (2022)	119	15.09	47.9	48.7	47.24	Parent anxiety PB (overprotection)	RBQ-C RBQ-P	RCADS-25	USA	Cross-sectio	Parent report Child report	High (JBI)
Goldsmith et al (2022)	1,735	13.16		94.3		Parent anxiety Behavioural inhibition PB (overprotection)	CIDI	DISC-IV MASC	USA	Longitudinal	Parent report Child report Clinical interview	Moderate (NOS)
Harvison et al (2008)	64	8.59	54.7	100	37.09	Parent anxiety PB (overcontrol)		ADIS-IV-P ADIS-IV-C	USA	Cross-sectio	Clinical intervie	Moderate (JBI)
Hudson et al (2011)	202	8.89	50		36.28	Parent anxiety Behavioural inhibition	DASS-21	PAS ADIS-P	Australia	Cross-sectio	Parent report	Moderate (JBI)
Johnco et al. (2021)	531	11.18	49.15	95.86		Parent anxiety PB (overprotection) PB (rejection)		SCAS-C SCAS-P	Australia	Longitudinal	Parent report Child report	High (NOS)
Kiel & Buss (2010)	93					Behavioural inhibition PB (overprotection) PB (intrusive)		ITSEA-R	USA	Longitudinal	Parent report	Moderate (NOS)
Lewis-Morrarty et al. (2012)	176	15.05	50.6			Behavioural inhibition PB (overcontrol)	TBAQ POS CCTI	SCARED K-SADS-PL	USA	Longitudinal	Parent report	Moderate (NOS)
Liber et al. (2008)	124	10.07	43.6	53.25	41.75	Parent anxiety	DASS	ADIS-C ADIS-P MASC CBCL(I)	Netherlands	Prospective	Parent report Child report	High (NOS)
Majdandžić et al. (2018)	132	2.54	55.3	50		Behavioural inhibition PB (overprotection)		PAS-R	Netherlands	Longitudinal	Parent report	Moderate (NOS)
Mian et al. (2011)	1,109	8.01	52.29			Parent anxiety Behavioural inhibition	ITSEA BAI	CBCL BPI	USA	Prospective	Parent report Child report	High (NOS)
Möller et al. (2015)	81	11.88	55.06			Parent anxiety PB (overinvolvement)	CPBQ-1 SCARED-A	IBQ-R	Netherlands	Cross-sectio	Parent report	High (JBI)
Morris & Oosterhoff (2016)	90	10.28	50	50	42.23	Parent anxiety	SPAI BAI	SPAI-C MASC	USA	Cross-sectio	Parent report Child report	High (JBI)
Muris et al. (2011)	206	6.6	55.8			Behavioural inhibition PB (overprotection)	BII EMBU	SCARED	Netherlands	Longitudinal	Parent report Child report	Moderate (NOS)
Platt et al. (2016)	130	8.82	55.4		40.78	Parent anxiety PB (overcontrol) PB (rejection)	BSI EMBU		USA	Cross-sectio	Parent report Child report	Moderate (JBI)
Price & Kiel (2022)	175		42.9		39.23	Parent anxiety Behavioural inhibition	PSWQ ECBQ	ITSEA PAS	USA	Longitudinal	Parent report	Moderate (NOS)
Rork & Morris (2009)	32	11.63	46.87	78	41.9	PB (overcontrol)	PBI	SPAI BAI	USA	Cross-sectio	Parent report Child report	Moderate (JBI)
Stuart-Parrigon & Kerns (2016)	1364		48			Parent anxiety	STAI	CBCL CAS-Y	USA	Longitudinal	Parent report Child report	Moderate (NOS)
van Brakel et al. (2006)	644	12.73	47.67			Behavioural inhibition PB (overcontrol)	BIS EMBU-C	SCARED	Netherlands	Cross-sectio	Child report	Moderate (JBI)
Vreeke et al. (2013)	168	4.54	46.42			Behavioural inhibition PB (overprotection)	BIQ-SF POM	ADIS-P PAS-R	Netherlands	Longitudinal	Parent report	Moderate (NOS)
Waters et al. (2012)	85	10.43	51.8			Parent anxiety PB (rejection) PB (overprotection)	STAI-T EMBU-C	SCAS-C	Australia	Cross-sectio	Child report	Moderate (JBI)

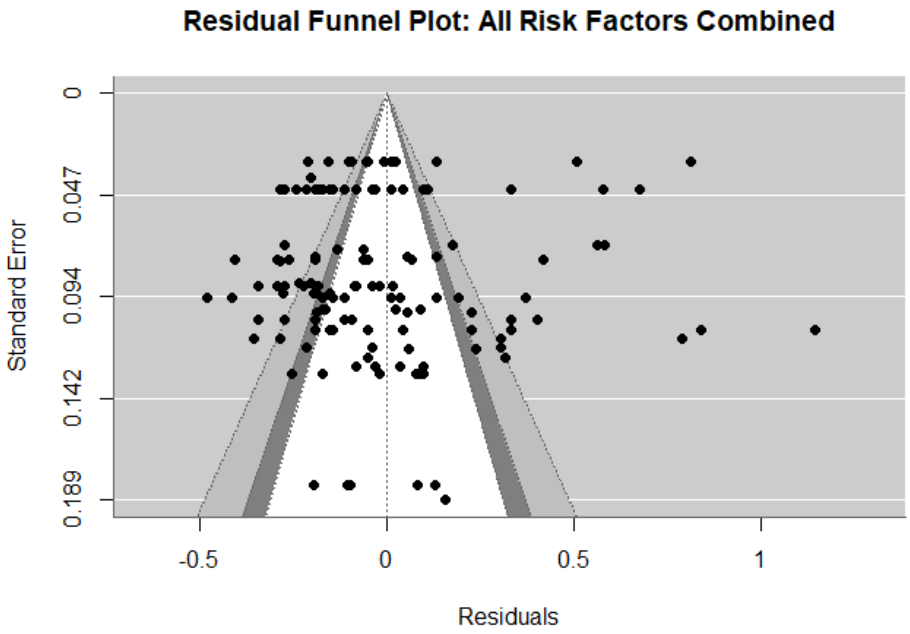
2.4.2. Association between risk factors and child anxiety

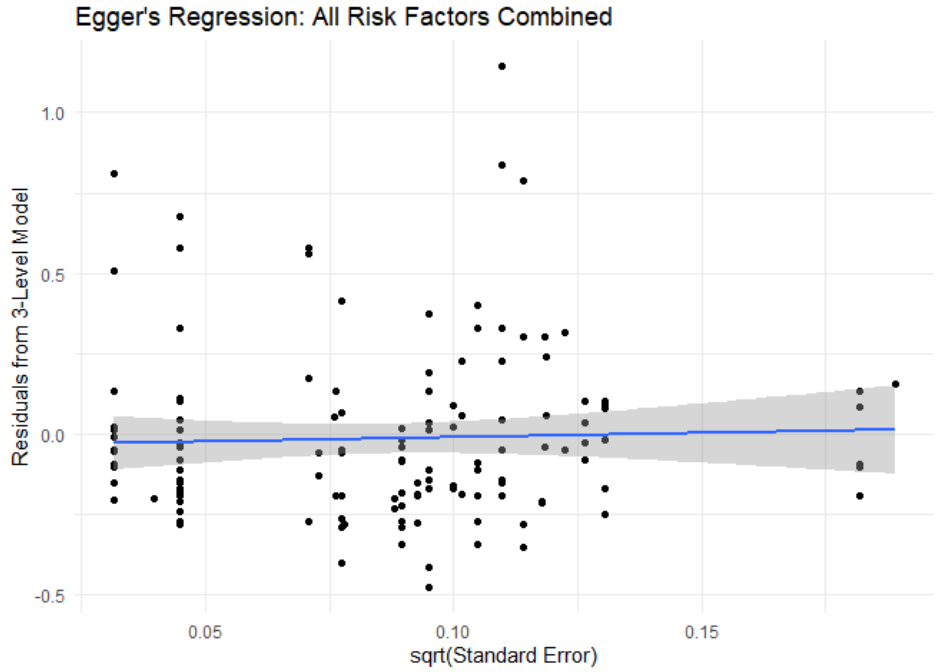
The multi-level meta-analysis comprising all 135 risk effect sizes (38 studies) found a significant moderate association between risk factors (parenting behaviours, BI and parent anxiety) and child anxiety (Z= 0.233, SE= .031, 95% CI [.1712, .2938], p < .0001). Statistically significant heterogeneity was observed (I^2 = 94.51%; Q(134) = 2586.82, *p* < .001), with more variance attributed to within-study differences (73.35%) than between-study differences (21.16%). Sensitivity testing revealed a significantly better fit for the full model over the reduced model (LRT = 10.09, p = .002), thus between-study variance is included (see figure 2.2 for residual funnel and egger's regression plots for the model containing all risk factors).

An adapted Egger's regression was conducted on the residuals of the three-level meta-analysis (k = 135). The intercept was non-significant (b = 0.0030, SE = 0.0845, p = .9714), suggesting no evidence of funnel plot asymmetry or small-study effects. The slope of the regression line was also non-significant (b = -0.0317, SE = 0.8854, p = .9715), indicating no relationship between residual precision and residual magnitude. Substantial residual heterogeneity was observed (QE(133) = 2577.02, p < .0001), consistent with considerable unexplained variance among effect sizes.

Figure 2.2.

Residual funnel and Egger's regression plots for all risk factors.



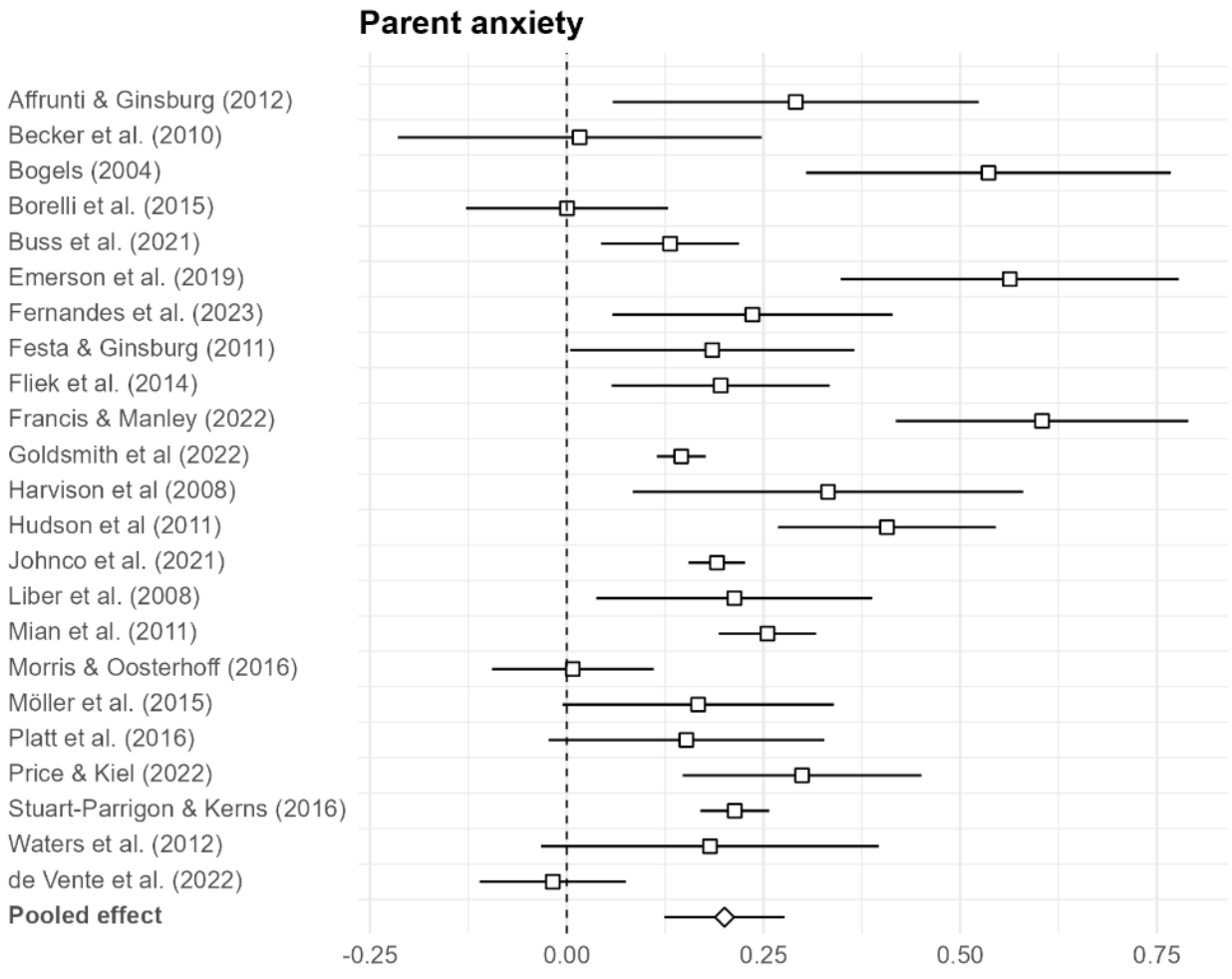


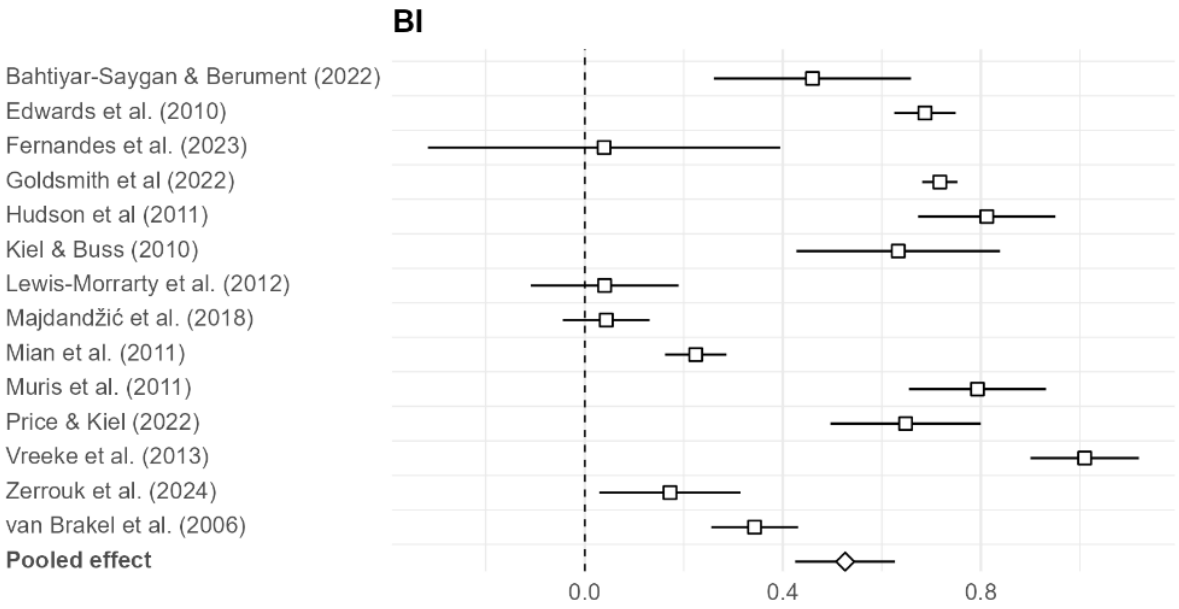
2.4.3. Effects of each risk factor

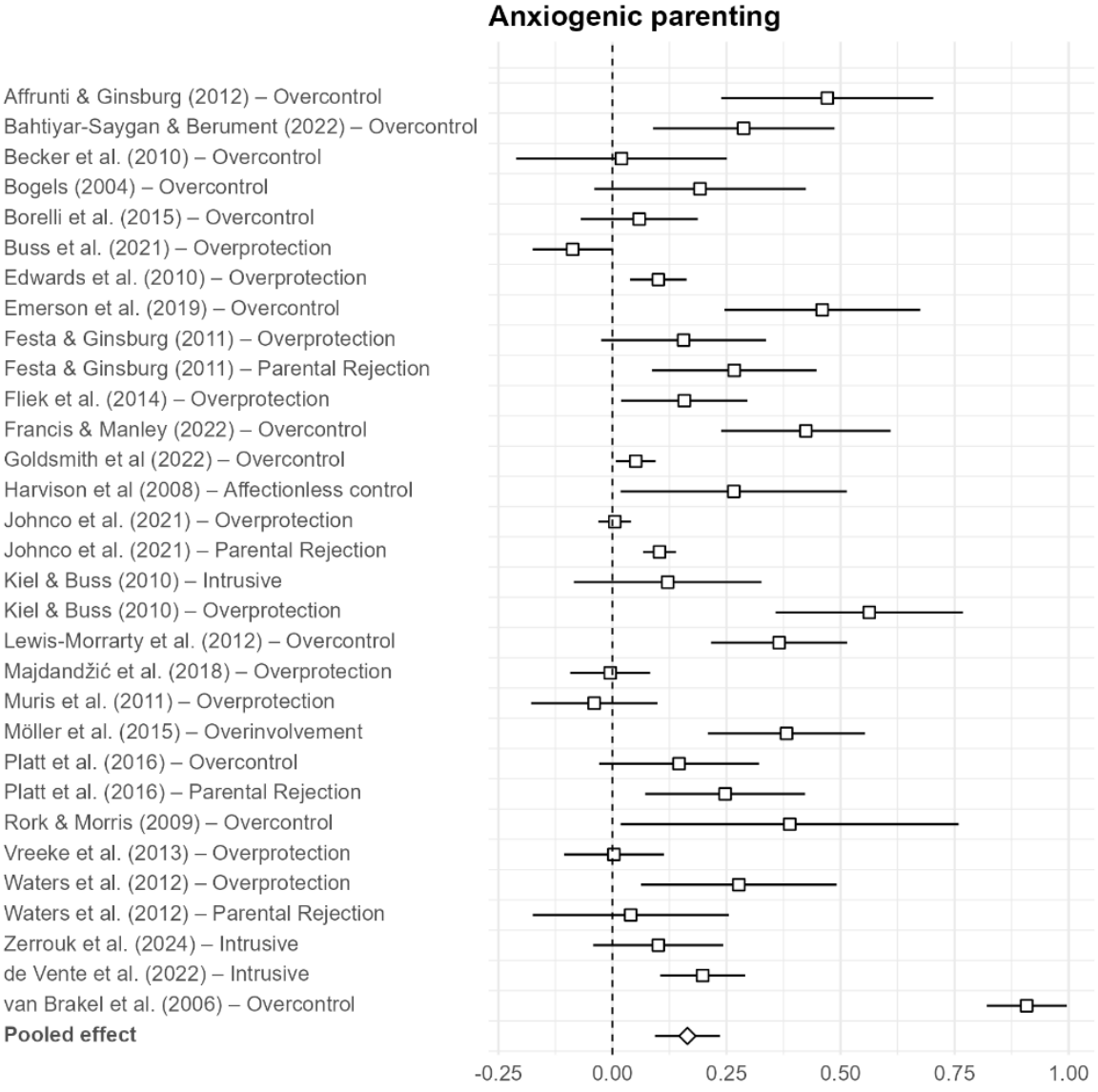
The model without intercept revealed the strongest association for BI (Z = .525, 95% CI [.424, .628], p < .001), followed by parent anxiety (Z = .201, 95% CI [.124, .278], p < .001). A small but significant association between anxiogenic parenting behaviours and child anxiety was

observed (Z = .164, 95% CI [.092, .236], p < .001), with significant between-category differences (QM[2] = 39.566, p < .001). Z scores and confidence intervals can be found in figure 2.3, where BI and parent anxiety effect sizes have been pooled for each study to reduce the plot size for easier visualisation. Effect sizes have been similarly pooled for anxiogenic parenting behaviour where multiple effect sizes are reported for each anxiogenic parenting behaviour type, with unique rows for each reported type of anxiogenic parenting behaviour per study.

Figure 2.3. Box plot of all risk factors with effect sizes pooled per study, with anxiogenic parenting behaviour type labels.



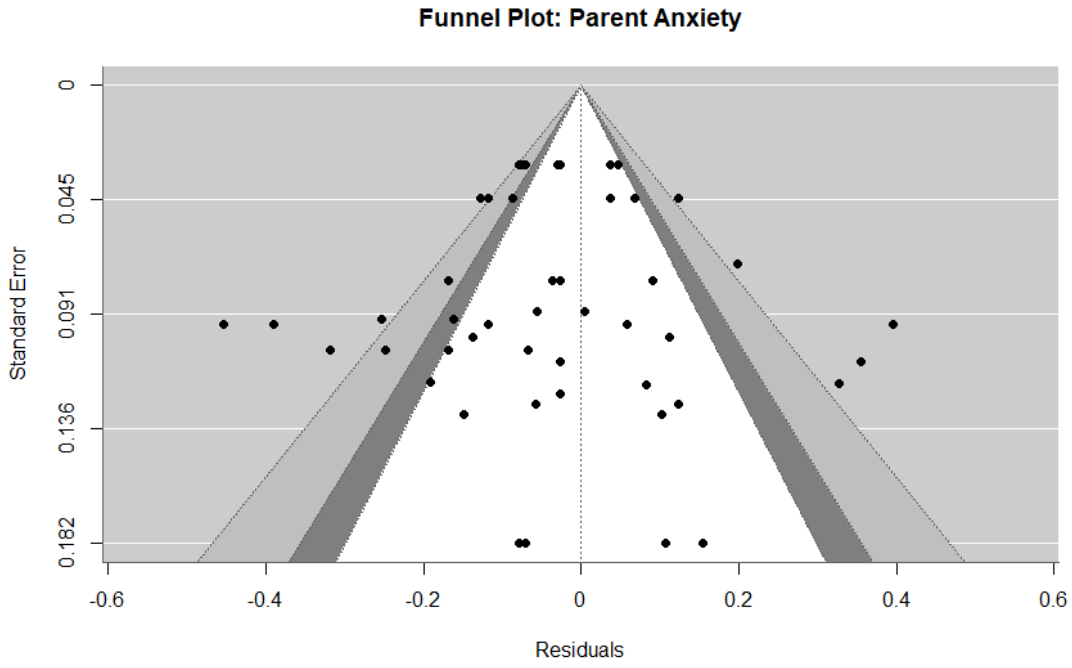

BI
Bahtiyar-Saygan & Berument (2022)
Edwards et al. (2010)
Fernandes et al. (2023)
Goldsmith et al (2022)
Hudson et al (2011)
Kiel & Buss (2010)
Lewis-Morrarty et al. (2012)
Majdandžić et al. (2018)
Mian et al. (2011)
Muris et al. (2011)
Price & Kiel (2022)
Vreeke et al. (2013)
Zerrouk et al. (2024)
van Brakel et al. (2006)
Pooled effect
0.0
0.4
0.8

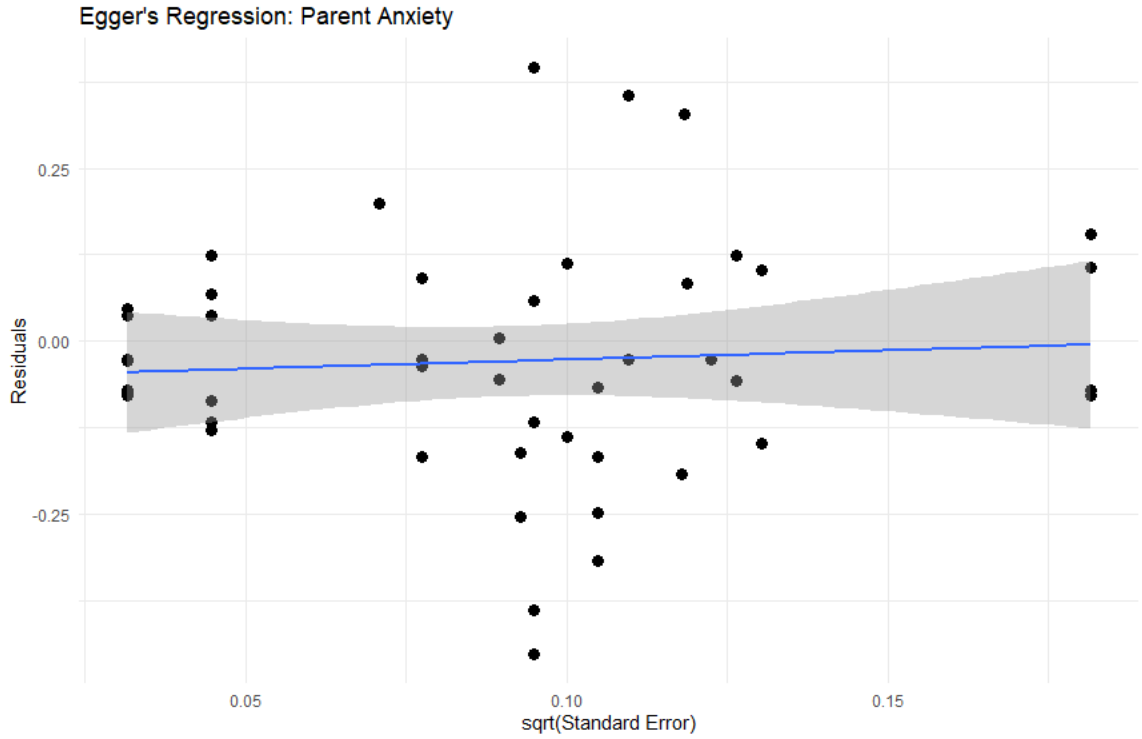

Anxiogenic parenting
Affrunti & Ginsburg (2012) – Overcontrol
Bahtiyar-Saygan & Berument (2022) – Overcontrol
Becker et al. (2010) – Overcontrol
Bogels (2004) – Overcontrol
Borelli et al. (2015) – Overcontrol
Buss et al. (2021) – Overprotection
Edwards et al. (2010) – Overprotection
Emerson et al. (2019) – Overcontrol
Festa & Ginsburg (2011) – Overprotection
Festa & Ginsburg (2011) – Parental Rejection
Fliek et al. (2014) – Overprotection
Francis & Manley (2022) – Overcontrol
Goldsmith et al (2022) – Overcontrol
Harvison et al (2008) – Affectionless control
Johnco et al. (2021) – Overprotection
Johnco et al. (2021) – Parental Rejection
Kiel & Buss (2010) – Intrusive
Kiel & Buss (2010) – Overprotection
Lewis-Morrarty et al. (2012) – Overcontrol
Majdandžić et al. (2018) – Overprotection
Muris et al. (2011) – Overprotection
Möller et al. (2015) – Overinvolvement
Platt et al. (2016) – Overcontrol
Platt et al. (2016) – Parental Rejection
Rork & Morris (2009) – Overcontrol
Vreeke et al. (2013) – Overprotection
Waters et al. (2012) – Overprotection
Waters et al. (2012) – Parental Rejection
Zerrouk et al. (2024) – Intrusive
de Vente et al. (2022) – Intrusive
van Brakel et al. (2006) – Overcontrol
Pooled effect
-0.25
0.00
0.25
0.50
0.75
1.00

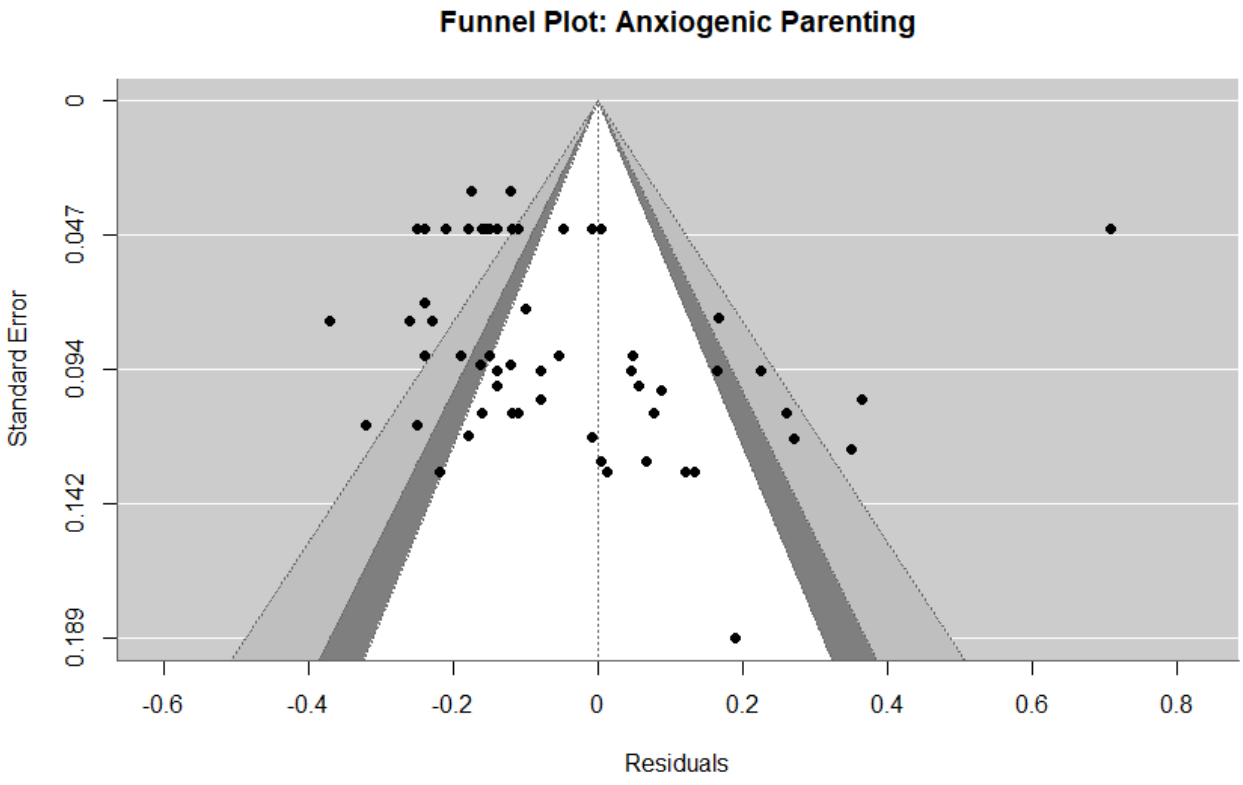
Adapted Egger's regressions were conducted separately for behavioural inhibition (BI), anxiogenic parenting, and parent anxiety. For BI (k = 23), the intercept was non-significant (b = .116, SE = .230, z = .511, p = .613, 95% CI [-.334, .567]), and the slope was also non-significant (b = -1.519, SE = 2.695, z = -.564, p = .573), indicating no evidence of funnel plot asymmetry. For anxiogenic parenting (k = 59), the intercept was again non-significant (b = -.177, SE = .120, z = -1.472, p = .141, 95% CI [-.413, .059]), and the slope was non-significant (b = 1.929, SE = 1.208, z = 1.597, p = .110), providing no evidence of small-study effects. Similarly, for parent anxiety (k = 47), the intercept (b = -.021, SE = .087, z = -.238, p = .812, 95% CI [-.190, .149]) and slope (b = .248, SE = .898, z = .276, p = .783) were non-significant. Thus, across all three risk factors, there was no statistical evidence of publication bias based on adapted Egger's tests. See figure 2.4 for funnel and Egger's regression plots for parent anxiety, anxiogenic parenting and BI.

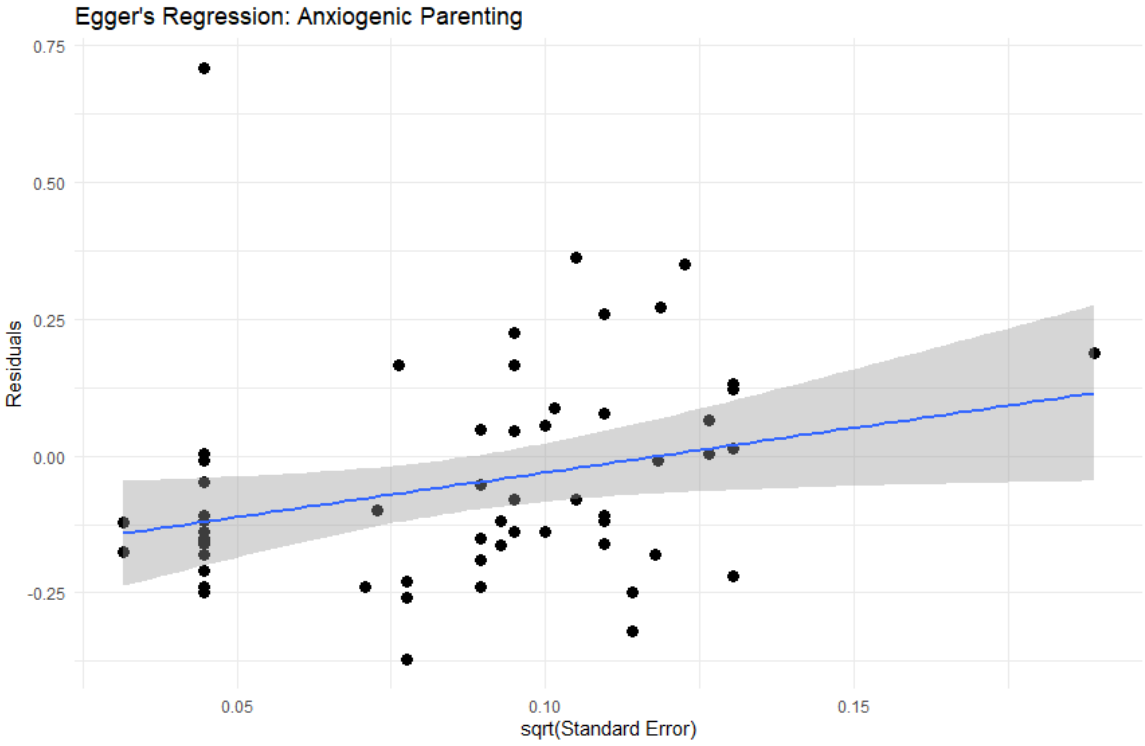
Figure 2.4.

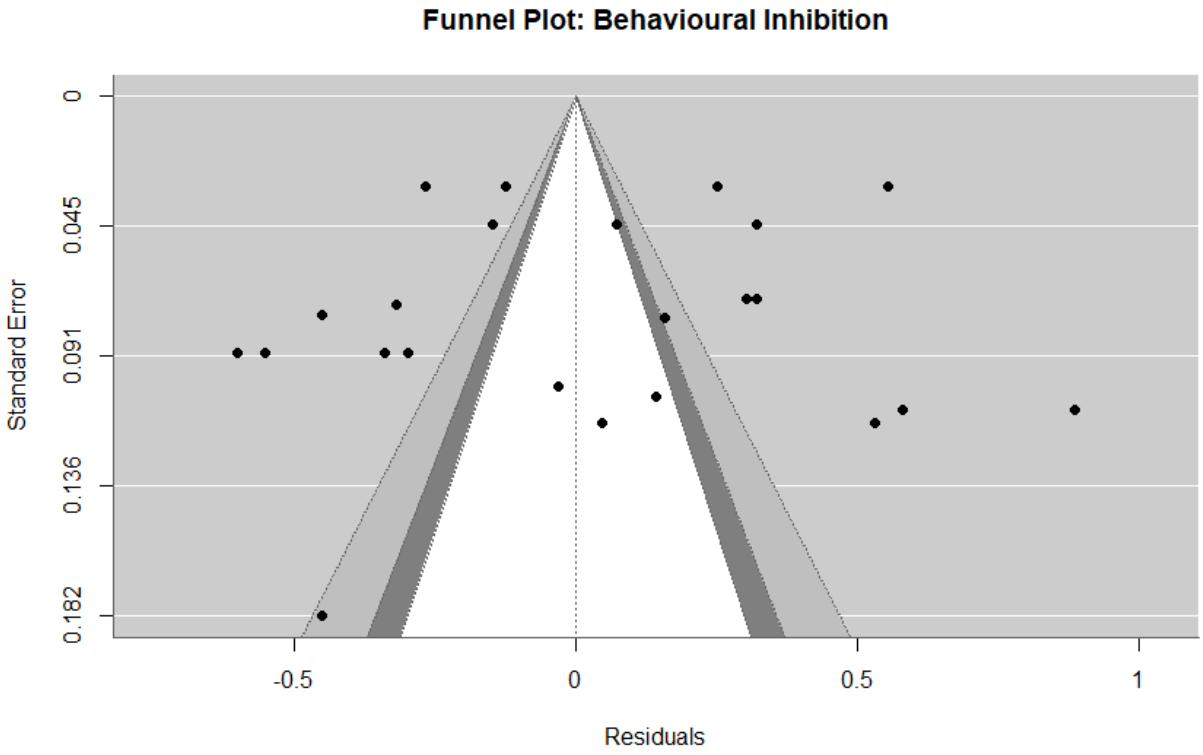
Funnel and Egger's regression plots for parent anxiety, anxiogenic parenting behaviour and BI.

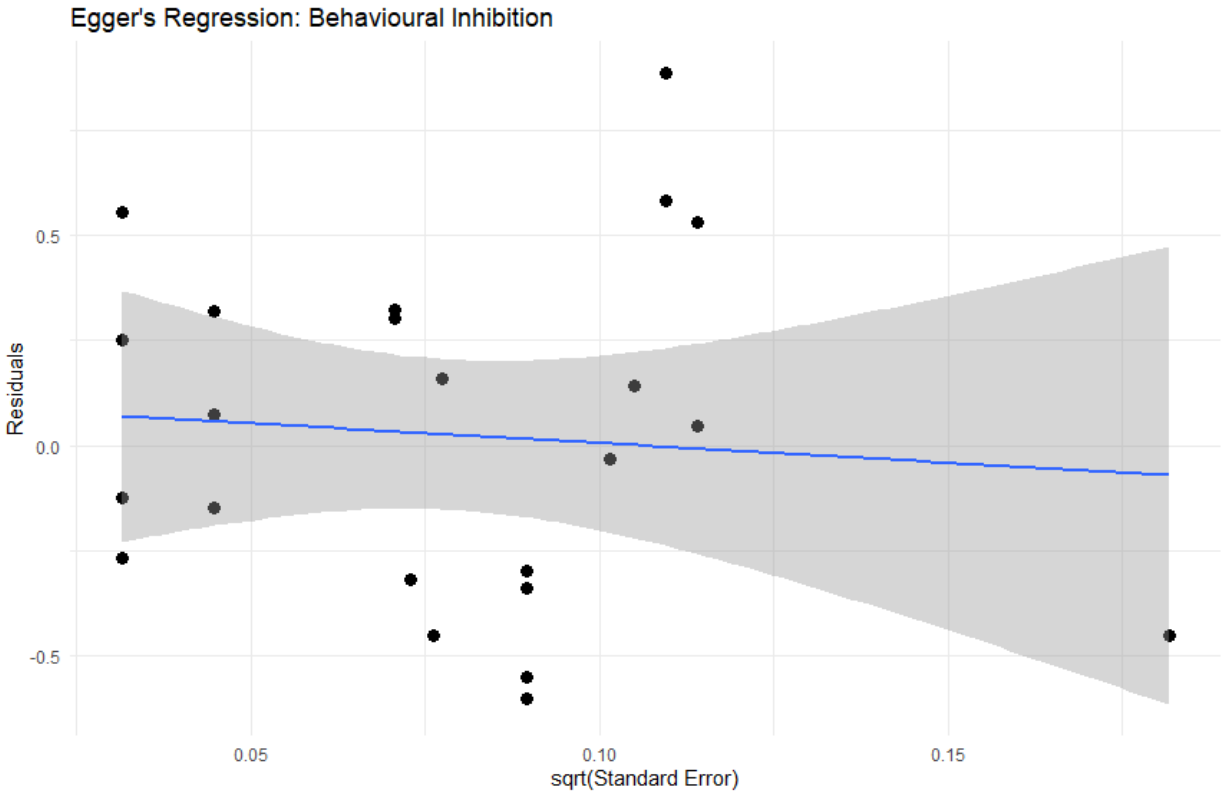



Egger's Regression: Parent Anxiety
Residuals
0.25
0.00
-0.25
0.05
0.10
0.15
sqrt(Standard Error)


Funnel Plot: Anxiogenic Parenting
Standard Error
0
0.047
0.094
0.142
0.189
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
Residuals


Egger's Regression: Anxiogenic Parenting
Residuals
0.75
0.50
0.25
0.00
-0.25
0.05
0.10
0.15
sqrt(Standard Error)


Funnel Plot: Behavioural Inhibition
Standard Error
0
0.045
0.091
0.136
0.182
-0.5
0
0.5
1
Residuals



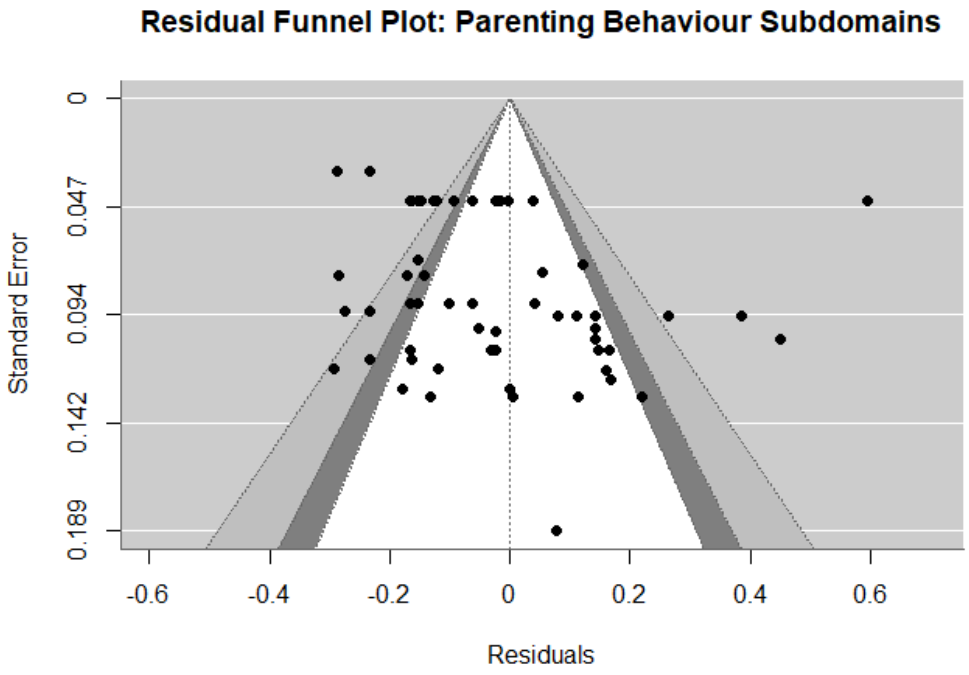
A moderator analysis of the 59 anxiogenic parenting behaviour effect sizes revealed significant variance between types of behaviour, with overcontrol (14 effect sizes) showing the largest significant association with child anxiety (Z= .312, 95% CI [.1926, .4309], p=<.001), followed by parental rejection (Z= .207, 95% CI [.0812, .3324], p= .002; 10 effect sizes). No significant associations were found for overinvolvement (Z= .381, 95% CI [-0.0555, .8169], p= .086; 2 effect sizes), intrusiveness (k= 6; -.020, 95% CI [-.2380, .1977], p= .854; 6 effect sizes), overprotection (Z= .112, 95% CI [-.0014, .2262], p= .053; 26 effect sizes), or affectionless control (Z= .226, 95% CI [-.2127, .774], p= .270; 1 effect size).

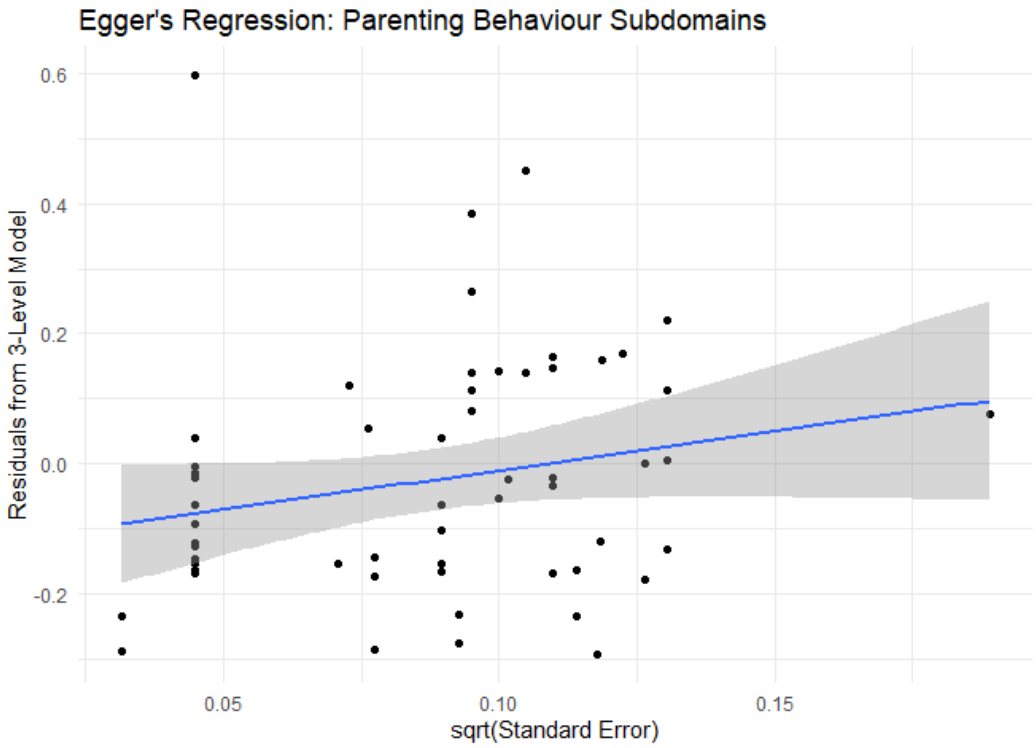
An adapted Egger's regression (Rodgers & Pustejovsky, 2021) was conducted using residuals from the three-level meta-analysis that included parenting behaviour subdomains as moderators (k = 59). The intercept was non-significant (b = -0.0620, SE = 0.1091, z = -0.5681, p = .570), suggesting no evidence of funnel plot asymmetry or small-study effects after accounting for differences between subdomains. The slope of the regression line, representing the association between study precision (sqrt(vi)) and residuals, was also non-significant (b = 0.6743, SE = 1.0994, z = 0.6134, p = .540), indicating no systematic relationship between effect

size magnitude and study precision. Substantial residual heterogeneity remained after moderator adjustment (QE(57) = 443.29, p < .0001), consistent with considerable unexplained variance among effect sizes. Taken together, these findings suggest that publication bias is unlikely to have materially influenced the observed associations between parenting behaviour subdomains and child anxiety symptoms. See figure 2.5 for residual funnel and Egger's regression plots for anxiogenic parenting behaviour subdomains.

Figure 2.5.

Residual funnel and Egger's regression plots for anxiogenic parenting behaviour subdomains





2.4.4. Combined risk factors

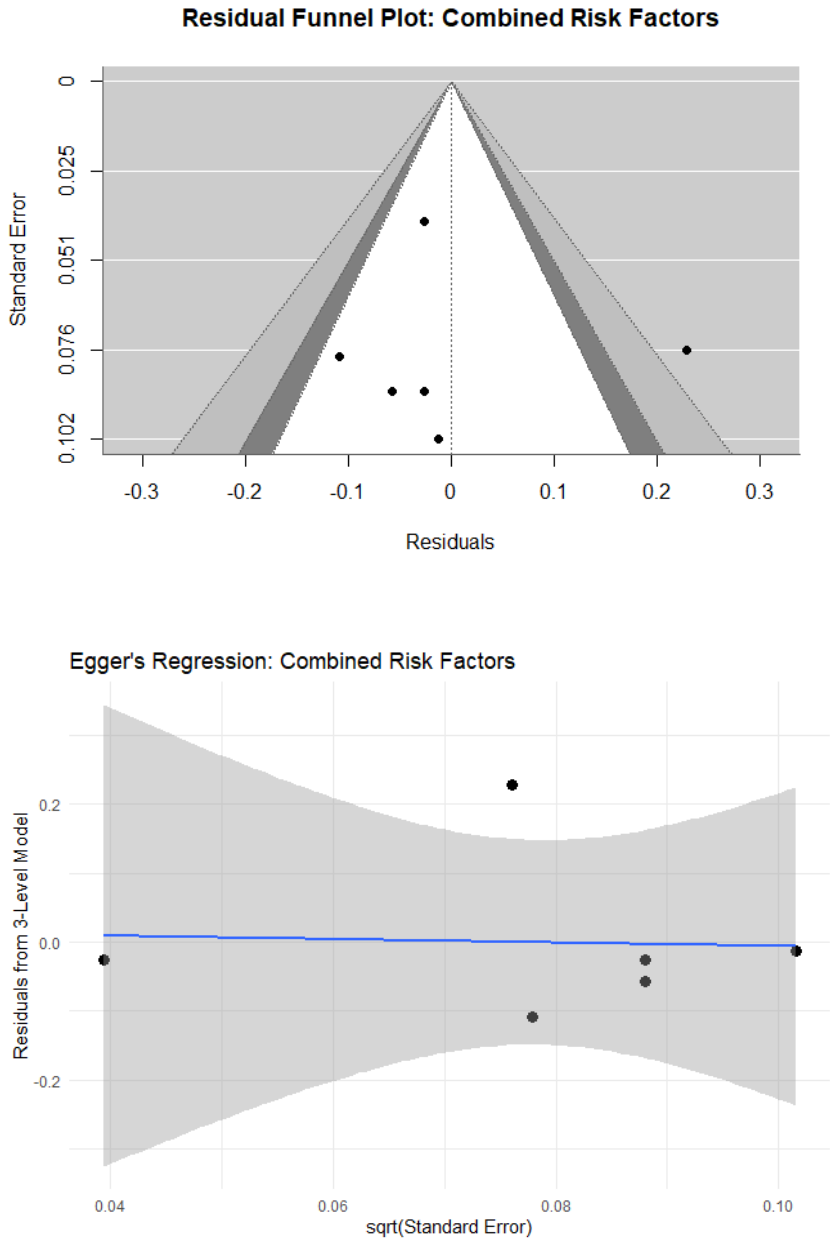
Of the 38 included studies, five studies reported the required statistics to explore multivariate regressions for combinations of risk factors (6 effect sizes). There was not a statistically significant pooled effect for combined risk factors (Z = .058, 95% CI [-0.0670 0.1824], p = .288) and moderate heterogeneity was observed (I^2 = 66.31%, $Q(5)$ = 11.92, p = .036). Between-study variance was low (τ^2 = 0.0041). No significant association between combined and individual risk factors (p = .599) was found. The difference between individual and combined factors remained non-significant when modelled as a moderator (b = 0.191, p = .095).

An adapted Egger's regression was conducted using residuals from the three-level meta-analysis of combined risk factors (k = 6). The intercept was non-significant (b = 0.0032, SE = 0.2105, z = 0.0153, p = .9878), suggesting no evidence of funnel plot asymmetry. The slope was similarly non-significant (b = -0.0421, SE = 2.6915, z = -0.0157, p = .9875), indicating no systematic association between study precision and residual effect size. Residual heterogeneity remained statistically significant (QE(4) = 11.77, p = .0192). However, given the small number of

included studies (k = 6), the Egger's test may have been underpowered to reliably detect asymmetry. See figure 2.6 for residual funnel and Egger's regression plots for combined risk factors.

Figure 2.6.

Residual funnel and Egger's regression plots for combined risk factors.



2.4.5. Moderation analyses

After excluding 26 effect sizes with missing moderator data, a three-level meta-regression was conducted on the remaining 109 effect sizes to examine whether age, gender, country, and method of assessment (MOA) moderated the association between risk factors and child anxiety symptoms. Risk type (behavioural inhibition, parenting behaviour, or parent anxiety) was included as a covariate to account for systematic differences between types of risk factor assessed. The addition of moderators significantly improved model fit (QM(12) = 29.12, p = .0038), and the test of moderators for risk type alone was also significant (F(3, 126) = 39.57, p < .0001), suggesting meaningful variation in effect sizes across different types of risk. However, substantial residual heterogeneity remained (QE(96) = 836.63, p < .0001).

In the full model, studies assessing behavioural inhibition showed significantly stronger associations with child anxiety compared to studies focusing on parenting behaviour (b = 0.308, SE = 0.068, z = 4.51, p < .0001, 95% CI [0.174, 0.442]). A no-intercept model further revealed that each risk factor independently showed a significant positive association with child anxiety: behavioural inhibition (b = 0.526, SE = 0.051, t(126) = 10.23, p < .0001), anxiogenic parenting (b = 0.164, SE = 0.036, t(126) = 4.51, p < .0001), and parent anxiety (b = 0.201, SE = 0.039, t(126) = 5.15, p < .0001). These absolute effects are presented in Table 2.2. Planned moderation analysis for socioeconomic status was not possible due to missing data in primary studies.

Among the other moderators, age was marginally non-significant (b = 0.023, SE = 0.0121, z= 1.86, p = .064, 95% CI [–0.001, 0.046]). Gender (% female in sample) was not a significant moderator (b = –0.0005, SE = 0.0031, z = –0.17, p = .862, 95% CI [–0.007, 0.005]), nor were country (QM(5) = 1.08, p = .957) or method of assessment (QM(4) = 3.69, p = .450).

An adapted Egger's regression was conducted using residuals from the full three-level meta-regression model including risk type, age, gender, country, and MOA. Twenty-six effect sizes were excluded due to missing moderator data, resulting in a final sample of k = 109 effect sizes. The intercept was non-significant (b = –0.045, SE = 0.091, z = –0.50, p = .618), indicating no

evidence of funnel plot asymmetry. The slope was also non-significant (b = 0.4251, SE = 0.894, z = 0.48, p = .634), suggesting no systematic association between study precision and residual magnitude. Substantial residual heterogeneity remained (QE(107) = 888.26, p < .0001). See Figure 2.7 for residual funnel and Egger's regression plots for the full moderator model.

Figure 2.7.

Residual funnel and Egger's regression plots for the full moderator model.

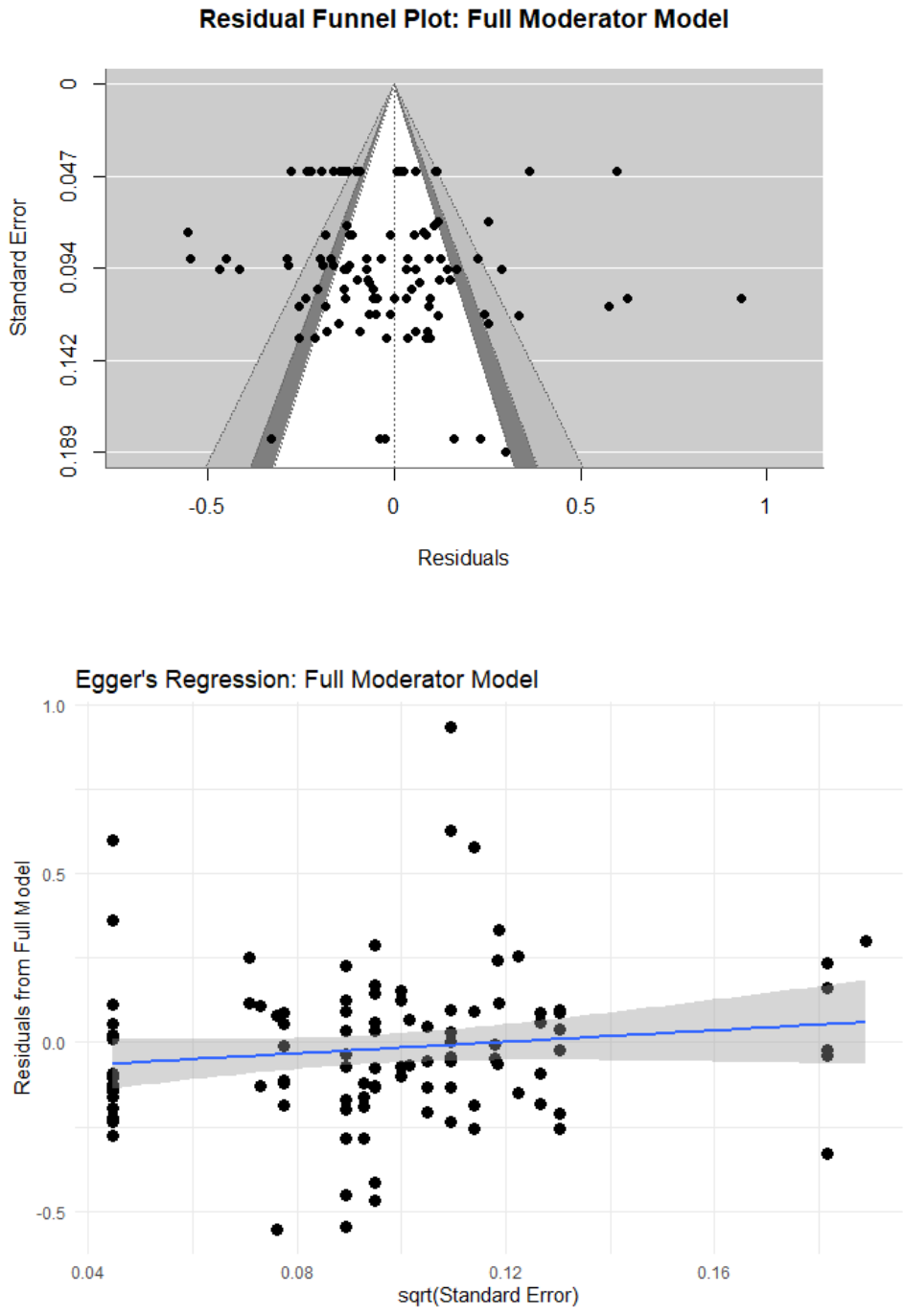


Table 2.2.

Test of moderators without intercept.

	k	Estimate (Z)	SE	95% CI	z-value	p
Country						
Australia	4	0.273	0.088	.1012, .4456	3.110	0.002*
Netherlands	12	0.226	0.057	.1145, .3367	3.980	<.001*
Portugal	1	0.197	0.185	-.1662, .5594	1.060	0.288
Turkey	1	0.249	0.173	-.0899, .5881	1.440	0.150
UK	1	0.443	0.204	.0434, .8431	2.170	0.030*
USA	20	0.224	0.047	.1305, .3165	4.710	<.001*
Method of assessment for child anxiety						
Clinical interview	3	0.237	0.133	-.0236, .4975	1.782	.0747
Child report	7	0.251	0.070	.1131, .3884	3.570	.0004*
Parent report	17	0.251	0.045	.1632, .3382	5.618	<.0001*
Parent and child report	10	0.163	0.067	.0326, 0.2935	2.450	.0143*
Parent report, child report and clinical interview	1	0.315	0.148	.0251, .6049	2.130	.0332*

2.5. Discussion

This meta-analysis synthesized evidence from 38 studies (135 effect sizes) examining the associations between behavioural inhibition (BI), parent anxiety, anxiogenic parenting behaviours, and child anxiety symptoms. Results confirmed that all three risk factors showed significant positive associations with child anxiety, with BI emerging as the strongest predictor (Z = 0.525, 95% CI [0.424, 0.628]), followed by parent anxiety (Z = 0.201, 95% CI [0.124, 0.278])

and anxiogenic parenting behaviours (Z = 0.164, 95% CI [0.092, 0.236]). Confidence intervals for BI did not overlap with the other risk factors, indicating it was significantly more strongly associated with child anxiety than other factors. However, confidence intervals for parent anxiety and parenting behaviours overlapped, suggesting no significant difference in their associations.

Moderator analyses revealed no significant moderation by child age, gender, method of anxiety assessment (MOA), or country of data collection, suggesting that the identified associations are relatively stable across developmental stages, measurement approaches, and cultural contexts—at least within predominantly Western samples. However, the trend-level finding for age (larger effects in older samples) hints that developmental processes may subtly influence the magnitude of risk, consistent with theories that adolescent developmental tasks (e.g., increased autonomy-seeking) may amplify anxiety when early vulnerabilities exist.

Combined Versus Individual Risk Factors

A primary aim of this meta-analysis was to explore whether combinations of risk factors conferred greater risk than individual factors alone. In contrast to expectations, the pooled effect size for combined risk factors was small and nonsignificant, and there was no significant difference between individual and combined risk factor effects. This contrasts somewhat with studies discussed in the introduction (e.g., Lewis-Morrarty et al., 2012; Thirlwall & Creswell, 2010), which suggested potential interactive effects between parenting behaviours and child BI. Our findings, therefore, underscore an important limitation in the existing literature: while individual risk factors are well-documented, there is a notable gap in understanding how they might combine or interact to shape child anxiety trajectories. However, our findings should be interpreted cautiously: only five studies reported the necessary data to examine combined effects, severely limiting statistical power. The inability to detect stronger effects for combined risks may reflect a lack of adequate evidence rather than a genuine absence of interactive or additive risk processes.

Contextual Factors and Theoretical Explanations

The high residual heterogeneity observed across models suggests that unmeasured contextual factors likely influence the strength and nature of associations. Cultural factors, for instance, may shape both the expression of parenting behaviours (Aaron et al., 2023) and children's responses to them. In cultures where parental control is normative, for example, overcontrol may be less anxiogenic than in highly individualistic societies (Louie et al., 2013).

Similarly, family structure (e.g., single parenting, grandparent caregivers) and child identity factors (e.g., LGBTQ+ status) may moderate risk (Farr et al., 2019), yet these were rarely reported in the available studies. Moreover, different anxiety domains (e.g., separation anxiety vs. social anxiety) may be differentially sensitive to specific parenting behaviours, an important nuance overlooked when only overall anxiety symptoms are assessed (Sandstrom et al. 2020). Thus, while anxiogenic parenting behaviours, BI, and parent anxiety are reliable predictors of child anxiety symptoms, the pathways linking these factors to anxiety are likely dynamic, influenced by broader socioecological systems, and may vary across developmental periods and cultural contexts.

This study had several strengths that enhance the credibility and utility of its findings. First, the meta-analysis was pre-registered, adhered to PRISMA guidelines, and applied rigorous, state-of-the-art three-level meta-analytic techniques to model both within- and between-study variance, reducing the risk of bias due to dependent effect sizes. Second, the search process yielded a large number of studies for screening (n= 3996) amounting to a broad view of extant literature. By examining behavioural inhibition (BI), parent anxiety, and anxiogenic parenting behaviours within the same analytic framework, the study allowed for direct comparison of these risk factors—something rarely attempted in prior reviews.

Nevertheless, several limitations warrant consideration. Most notably, only five studies reported appropriate data for multivariate models assessing combined risk factors, limiting the power to detect cumulative or interactive effects. The evidence base was also largely drawn

from high-income, Western countries, reducing the cultural generalizability of the findings. Although moderation by method of anxiety assessment (MOA) was not significant, the use of heterogeneous measurement tools across studies introduces the potential for inconsistency. Additionally, important contextual moderators—such as family structure, socioeconomic status, and specific child characteristics—were either inconsistently reported or missing entirely, preventing further analysis of their influence.

These findings highlight key priorities for future research. Studies should routinely report multivariate associations between BI, parenting behaviours, and parent anxiety to facilitate synthesis and modelling of combined effects. Researchers should also aim to diversify samples, with greater inclusion of non-Western, low- and middle-income countries and more varied family constellations. Improving conceptual clarity by distinguishing between parenting subdomains (e.g., overprotection vs. overcontrol) will further enhance interpretability. To establish causality, longitudinal and experimental designs are needed to investigate the mechanisms through which early vulnerabilities translate into child anxiety outcomes.

For clinicians and early intervention developers, the findings support early screening for BI as a means of identifying children at heightened risk before anxiety symptoms become entrenched. While evidence for integrated, multi-risk models remains limited, individual risk factors were consistently associated with child anxiety and therefore represent key targets for early intervention. Parenting programs that focus on reducing controlling behaviours and fostering autonomy-supportive interactions may offer particularly promising strategies for attenuating anxiety risk in children.

This meta-analysis affirms that behavioural inhibition, parent anxiety, and anxiogenic parenting behaviours are significant risk factors for child anxiety symptoms. Behavioural inhibition appears to be the most potent predictor, but parenting behaviours and parental anxiety also play meaningful, though smaller, roles. While the evidence for combined effects

remains limited, the results stress the need for nuanced, context-sensitive models of child anxiety development and improved reporting of statistics among researchers.

2.6. References

Aaron, E. M., Baumgartner, N. M., & Kiel, E. J. (2023). Temperament, Parenting, and Child Anxiety. Advances in Psychiatry and Behavioral Health, 3(1), 139-147. https://doi.org/https://doi.org/10.1016/j.ypsc.2023.03.017

Affrunti, N. W., & Ginsburg, G. S. (2012). Maternal overcontrol and child anxiety: the mediating role of perceived competence. Child Psychiatry Hum Dev, 43(1), 102-112. https://doi.org/10.1007/s10578-011-0248-z

Akün, E. (2017). Relations among adults' remembrances of parental acceptance-rejection in childhood, self-reported psychological adjustment, and adult psychopathology. Compr Psychiatry, 77, 27-37. https://doi.org/10.1016/j.comppsych.2017.05.002

Akün, E. (2017). Relations among adults' remembrances of parental acceptance-rejection in childhood, self-reported psychological adjustment, and adult psychopathology. Compr Psychiatry, 77, 27-37. https://doi.org/10.1016/j.comppsych.2017.05.002

Association, A. P. (2013). Diagnostic and statistical manual of mental disorders: DSM-5 (5th edition ed.). American Psychiatric Association.

Barker, T. H., Stone, J. C., Sears, K., Klugar, M., Tufanaru, C., Leonardi-Bee, J., Aromataris, E., & Munn, Z. (2023). The revised JBI critical appraisal tool for the assessment of risk of bias for randomized controlled trials. JBI Evid Synth, 21(3), 494-506. https://doi.org/10.11124/jbies-22-00430

Beesdo, K., Knappe, S., & Pine, D. S. (2009). Anxiety and anxiety disorders in children and adolescents: Developmental issues and implications for DSM-V. Psychiatric Clinics of North America, 32(3), 483-524. https://doi.org/10.1016/j.psc.2009.06.002

Bitsko, R. H., Claussen, A. H., Lichstein, J., Black, L. I., Jones, S. E., Danielson, M. L., Hoenig, J. M., Davis Jack, S. P., Brody, D. J., Gyawali, S., Maenner, M. J., Warner, M., Holland, K. M., Perou, R., Crosby, A. E., Blumberg, S. J., Avenevoli, S., Kaminski, J. W., & Ghandour, R. M. (2022). Mental Health Surveillance Among Children - United States, 2013-2019. MMWR Suppl, 71(2), 1-42. https://doi.org/10.15585/mmwr.su7102a1

Bögels, S. M., & Melick, M. v. (2004). The relationship between child-report, parent self-report, and partner report of perceived parental rearing behaviors and anxiety in children and parents. Personality and Individual Differences, 37(8), 1583-1596. https://doi.org/https://doi.org/10.1016/j.paid.2004.02.014

Cheung, M. W.-L. (2014). Modeling dependent effect sizes with three-level meta-analyses: a structural equation modeling approach. Psychological methods, 19(2), 211.

Chorpita, B. F., Brown, T. A., & Barlow, D. H. (1998). Perceived control as a mediator of family environment in etiological models of childhood anxiety. Behavior Therapy, 29(3), 457-476.

Copeland, W. E., Angold, A., Shanahan, L., & Costello, E. J. (2014). Longitudinal patterns of anxiety from childhood to adulthood: the Great Smoky Mountains Study. J Am Acad Child Adolesc Psychiatry, 53(1), 21-33. https://doi.org/10.1016/j.jaac.2013.09.017

Coplan, R. J., Prakash, K., O'Neil, K., & Armer, M. (2004). Do you" want" to play? Distinguishing between conflicted shyness and social disinterest in early childhood. Developmental psychology, 40(2), 244.

De Vente, W., Majdandzić, M., Colonnesi, C., & Bögels, S. (2011). Intergenerational Transmission of Social Anxiety: The Role of Paternal and Maternal Fear of Negative Child Evaluation and Parenting Behaviour. Journal of experimental psychopathology, 2, 1-22. https://doi.org/10.5127/jep.018811

Drossman, D. A., & Hasler, W. L. (2016). Rome IV-Functional GI Disorders: Disorders of Gut-Brain Interaction. Gastroenterology, 150(6), 1257-1261. https://doi.org/10.1053/j.gastro.2016.03.035

Duval, S., & Tweedie, R. (2004). Trim and Fill: A Simple Funnel-Plot–Based Method of Testing and Adjusting for Publication Bias in Meta-Analysis. Biometrics, 56(2), 455-463. https://doi.org/10.1111/j.0006-341X.2000.00455.x

Essau, C. A., Lewinsohn, P. M., Olaya, B., & Seeley, J. R. (2014). Anxiety disorders in adolescents and psychosocial outcomes at age 30. J Affect Disord, 163, 125-132. https://doi.org/10.1016/j.jad.2013.12.033

Farr, R. H., Bruun, S. T., & Patterson, C. J. (2019). Longitudinal associations between coparenting and child adjustment among lesbian, gay, and heterosexual adoptive parent families. Dev Psychol, 55(12), 2547-2560. https://doi.org/10.1037/dev0000828

Gottman, J. M., Katz, L. F., & Hooven, C. (2013). Meta-emotion: How families communicate emotionally. Routledge.

Greco, L. A., & Morris, T. L. (2005). Factors influencing the link between social anxiety and peer acceptance: Contributions of social skills and close friendships during middle childhood. Behavior Therapy, 36(2), 197-205.

Grolnick, W. S., & Pomerantz, E. M. (2009). Issues and challenges in studying parental control: Toward a new conceptualization. Child Development Perspectives, 3(3), 165-170.

Hammoud, R. A., Ammar, L. A., McCall, S. J., Shamseddeen, W., & Elbejjani, M. (2024). Brain volumes, behavioral inhibition, and anxiety disorders in children: results from the adolescent brain cognitive development study. BMC psychiatry, 24(1), 257. https://doi.org/10.1186/s12888-024-05725-z

Hudson, J. L., & Rapee, R. M. (2001). Parent—child interactions and anxiety disorders: An observational study [doi:10.1016/S0005-7967(00)00107-8]. Elsevier Science.

Jiang, Z., Liang, X., Wang, Z., Lin, Y., & Zhang, L. (2023). Intrusive parenting in early childhood: A review and meta-analysis. Psych J, 12(3), 335-354. https://doi.org/10.1002/pchj.637

Kagan, J., Reznick, J. S., Clarke, C., Snidman, N., & Garcia-Coll, C. (1984). Behavioral inhibition to the unfamiliar. Child development, 2212-2225.

Kagan, J., Reznick, J. S., Snidman, N., Gibbons, J., & Johnson, M. O. (1988). Childhood derivatives of inhibition and lack of inhibition to the unfamiliar. Child Dev, 59(6), 1580-1589. https://doi.org/10.1111/j.1467-8624.1988.tb03685.x

Khaleque, A., & Rohner, R. P. (2002). Perceived parental acceptance-rejection and psychological adjustment: A meta-analysis of cross-cultural and intracultural studies. Journal of Marriage and Family, 64(1), 54-64. https://doi.org/10.1111/j.1741-3737.2002.00054.x

Kiecolt-Glaser, J. K., & Glaser, R. (2010). Psychological stress, telomeres, and telomerase. Brain, Behavior, and Immunity, 24(4), 529-530. https://doi.org/10.1016/j.bbi.2010.02.002

Lawrence, P. J., Murayama, K., & Creswell, C. (2019). Systematic Review and Meta-Analysis: Anxiety and Depressive Disorders in Offspring of Parents With Anxiety Disorders. Journal of the American Academy of Child & Adolescent Psychiatry, 58(1), 46-60. https://doi.org/10.1016/j.jaac.2018.07.898

Lewis-Morrarty, E., Degnan, K. A., Chronis-Tuscano, A., Rubin, K. H., Cheah, C. S., Pine, D. S., Henderon, H. A., & Fox, N. A. (2012). Maternal over-control moderates the association between early childhood behavioral inhibition and adolescent social anxiety symptoms. J Abnorm Child Psychol, 40(8), 1363-1373. https://doi.org/10.1007/s10802-012-9663-2

Louie, J., & Oh, B. (2013). Cultural Differences in the Links Between Parental Control and Children's Emotional Expressivity. Cultural Diversity & Ethnic Minority Psychology, 19, 424. https://doi.org/10.1037/a0032820

Maccoby, E. E. (1994). The role of parents in the socialization of children: An historical overview.

McLeod, B. D., Wood, J. J., & Weisz, J. R. (2007). Examining the association between parenting and childhood anxiety: a meta-analysis. Clin Psychol Rev, 27(2), 155-172. https://doi.org/10.1016/j.cpr.2006.09.002

Möller, E. L., Nikolić, M., Majdandžić, M., & Bögels, S. M. (2016). Associations between maternal and paternal parenting behaviors, anxiety and its precursors in early childhood: A meta-analysis. Clin Psychol Rev, 45, 17-33. https://doi.org/10.1016/j.cpr.2016.03.002

Murray, L., Creswell, C., & Cooper, P. J. (2009). The development of anxiety disorders in childhood: an integrative review. Psychological medicine, 39(9), 1413-1423. https://doi.org/10.1017/S0033291709005157

Noel, M., Groenewald, C. B., Beals-Erickson, S. E., Gebert, J. T., & Palermo, T. M. (2016). Chronic pain in adolescence and internalizing mental health disorders: a nationally representative study. Pain, 157(6), 1333-1338. https://doi.org/10.1097/j.pain.0000000000000522

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—a web and mobile app for systematic reviews. Systematic Reviews, 5(1), 210. https://doi.org/10.1186/s13643-016-0384-4

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71

Piepoli, M. F., Hoes, A. W., Agewall, S., Albus, C., Brotons, C., Catapano, A. L., Cooney, M. T., Corrà, U., Cosyns, B., Deaton, C., Graham, I., Hall, M. S., Hobbs, F. D. R., Løchen, M. L., Löllgen, H., Marques-Vidal, P., Perk, J., Prescott, E., Redon, J., . . . Binno, S. (2016). 2016

European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts)Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). Eur Heart J, 37(29), 2315-2381. https://doi.org/10.1093/eurheartj/ehw106

Polanczyk, G. V., Salum, G. A., Sugaya, L. S., Caye, A., & Rohde, L. A. (2015). Annual research review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. Journal of child psychology and psychiatry, 56(3), 345-365.

Pollard, J., Reardon, T., Williams, C., Creswell, C., Ford, T., Gray, A., Roberts, N., Stallard, P., Ukoumunne, O. C., & Violato, M. (2023). The multifaceted consequences and economic costs of child anxiety problems: A systematic review and meta-analysis. JCPP advances, 3(3), e12149.

Racine, N., McArthur, B. A., Cooke, J. E., Eirich, R., Zhu, J., & Madigan, S. (2021). Global Prevalence of Depressive and Anxiety Symptoms in Children and Adolescents During COVID-19: A Meta-analysis. JAMA Pediatr, 175(11), 1142-1150. https://doi.org/10.1001/jamapediatrics.2021.2482

Rodgers, M. A., & Pustejovsky, J. E. (2021). Evaluating meta-analytic methods to detect selective reporting in the presence of dependent effect sizes. Psychological methods, 26(2), 141-160. https://doi.org/10.1037/met0000300

Rodgers, M. A., & Pustejovsky, J. E. (2021). Evaluating meta-analytic methods to detect selective reporting in the presence of dependent effect sizes. Psychological methods, 26(2), 141-160. https://doi.org/10.1037/met0000300

Rohner, R. P. (2004). The Parental "Acceptance-Rejection Syndrome": Universal Correlates of Perceived Rejection. American Psychologist, 59(8), 830-840. https://doi.org/10.1037/0003-066X.59.8.830

RStudio Team. (2024). *RStudio: Integrated Development Environment for R* (Version 4.2) [Computer software]. Posit, PBC. https://posit.co/products/open-source/rstudio/

Samdan, G., Kiel, N., Petermann, F., Rothenfußer, S., Zierul, C., & Reinelt, T. (2020). The relationship between parental behavior and infant regulation: A systematic review. Developmental Review, 57, 100923.

Sandstrom, A., Uher, R., & Pavlova, B. (2020). Prospective Association between Childhood Behavioral Inhibition and Anxiety: a Meta-Analysis. J Abnorm Child Psychol, 48(1), 57-66. https://doi.org/10.1007/s10802-019-00588-5

Spence, S. H. (1999). *Spence Children's Anxiety Scale – Parent Report (SCAS-P)*.

Sterne, J. A. C., & Egger, M. (2005). Regression Methods to Detect Publication and Other Bias in Meta-Analysis. In Publication Bias in Meta-Analysis (pp. 99-110). https://doi.org/https://doi.org/10.1002/0470870168.ch6

Sterne, J. A. C., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M. S., Eldridge, S. M., Emberson, J. R., Hernán, M. A., Hopewell, S., Hróbjartsson, A., Junqueira, D. R., Jüni, P., Kirkham, J. J., Lasserson, T., Li, T., . . . Higgins, J. P. T. (2019). RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ, 366, l4898. https://doi.org/10.1136/bmj.l4898

Thirlwall, K., & Creswell, C. (2010). The impact of maternal control on children's anxious cognitions, behaviours and affect: An experimental study. Behaviour research and therapy, 48(10), 1041-1046.

Van Ameringen, M., Mancini, C., & Farvolden, P. (2003). The impact of anxiety disorders on educational achievement. J Anxiety Disord, 17(5), 561-571. https://doi.org/10.1016/s0887-6185(02)00228-1

Viechtbauer, W. (2010). Conducting Meta-Analyses in R with the metafor Package. Journal of Statistical Software, 36(3), 1 - 48. https://doi.org/10.18637/jss.v036.i03

Wells, G., Shea, B., O'Connell, D., Peterson, j., Welch, V., Losos, M., & Tugwell, P. (2000). The Newcastle–Ottawa Scale (NOS) for Assessing the Quality of Non-Randomized Studies in Meta-Analysis.

Chapter 3 An experimental study of overcontrolling parenting by fathers and its effects on anxious cognition, emotion and autonomic nervous system activity in children.

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3.1. Abstract

This empirical study is the first to experimentally examine the effects of father's overcontrolling parenting behaviour on child anxiety. Using a within-subjects design, 25 non-anxious fathers were trained to exhibit autonomy-granting and controlling parenting behaviours during two separate interactions with their child (aged 4-6 years). After each interaction, children engaged in a mildly distressing speaking task. Child outcomes for both conditions included self-reported anxiety feelings and predictive and self-evaluative self-reported cognitions relating to their speech performance along with heart rate variability (HRV) as a physiological biomarker of autonomic dysregulation. Results revealed that children reported significantly higher self-reported anxious feelings after the overcontrolling interaction with their fathers, compared with the autonomy-granting interaction. No significant effects were found for HRV, performance-related predictions or evaluations. Behavioural inhibition (BI) did not moderate effects. Observed effects were also independent of the father's self-reported habitual overcontrolling behaviour and observed negativity during the interaction. In contrast with previous research, results tentatively suggest that the anxiogenic properties of overcontrolling

parent behaviours might differ between mothers and fathers while highlighting the need for further research.

3.2. Introduction

Anxiety disorders (ADs) are the most prevalent psychiatric disorders in children, with a global prevalence of approximately 6.5% and a European prevalence of 7.9% (Polanczyk et al., 2015; Sacco et al., 2024). Childhood anxiety disorders have a median age of onset of six years (Merikangas et al., 2010), and early symptoms can often be detected in children as young as two or three years (Egger & Angold, 2006). The persistence of childhood anxiety into adulthood places children at risk for a range of negative outcomes, including depression, educational underachievement, peer victimisation, and impaired physical health (Beesdo et al., 2009; Cabral & Patel, 2020; Hammoud et al., 2024). Family aggregation studies show that children of parents with ADs are nearly twice as likely to develop an AD themselves (Lawrence et al., 2019). Theoretical models propose two primary pathways for this transmission: genetic inheritance and exposure to environmental risk factors (Murray et al., 2009). Although genetic contributions to anxiety are evident (Polderman et al., 2015), evidence suggests that environmental influences, particularly parenting behaviours, play a critical role (Eley et al., 2015).

Attempts to develop prevention and early intervention programmes have emerged with some encouraging early evidence for programmes targeting parenting behaviours (e.g. the 'Cool Kids Programme,' Morgan et al., 2016; Mychailyszyn 2017). In their meta-analysis of child anxiety interventions, Jewell, Wittkowski and Pratt (2022) found that outcomes achieved by 'parent-only' interventions did not significantly differ from other, more comprehensive and child-focused interventions, though interestingly found no significant treatment effects on child-reported outcomes. While those developing parent-focused programmes have a growing body of evidence to draw from, understanding parenting-related causal mechanisms is limited by an evidence-base consisting of very little experimental evidence and a conspicuous absence of paternal parenting (Möller et al., 2016). Those seeking to develop interventions that include

fathers are left with little choice but to assume that research on anxiogenic maternal parenting applies equally to the father, despite evidence that this may not be the case (Budinger et al., 2013). The present study aims to be the first to provide experimental evidence on the role of father's parenting behaviour in the development of child anxiety.

Temperamental inhibition is characterized by wariness and withdrawal from novel stimuli and social situations, is a temperamental trait observable in children as young as four (Kagan et al., 1984), and is significantly associated with anxiety disorders (Fox et al., 2005; Degnan et al., 2010), though terms used depend on age, with 'reactivity' typically used in infancy (early months), 'behavioural inhibition' (BI) during late infancy and 'inhibited temperament' during childhood (toddlerhood through middle childhood; Lawrence et al., 2020). Despite robust evidence, however, inhibited temperament can only account for part of the aetiology of child anxiety disorders (Van der Bruggen et al., 2008; McLeod et al., 2007; Möller et al., 2007). For a more comprehensive understanding, many researchers have sought to understand interacting effects between multiple risk factors. For example, Hudson and Dodd (2011) explored combined effects of parenting behaviour and BI on child anxiety, while the same authors later explored combinations of BI, parenting behaviour and cognitive bias (Hudson & Dodd, 2011) . Given the significant socialising influence that parents may have on children, parenting behaviours have been considered a potential route of anxiety transmission (Aaron et al., 2023; Murray et al., 2008).

Many anxiogenic parenting behaviours have been defined, overcontrolling parenting behaviours have been found to be the most robust risk factors in meta-analyses (McLeod et al. 2007). Theoretically, overcontrolling parenting is thought to negate children's opportunities for independent exploration, problem-solving and self-efficacy by being excessively intruding in, or controlling of, the child's behaviour. Autonomy-granting parenting is thought to be protective against anxiety problems by supporting children to face appropriate challenges (Grolnick & Pomerantz, 2009). Theoretical models of the intergenerational transmission of anxiety through overcontrolling parenting behaviour is supported by evidence suggesting that parents with

anxiety disorders, compared to those without, are more likely to exhibit overcontrolling parenting behaviours, and that children of more overcontrolling parents are more likely to develop anxiety disorders themselves (Borelli et al., 2015; McLeod et al., 2007). While significant, effect sizes for overcontrolling parenting behaviours are consistently smaller than those for BI in meta-analyses on risk factors for child anxiety (Van der Bruggen et al., 2008; McLeod et al., 2007). In their model of childhood anxiety disorder development, Aaron et al. (2023) suggest that a child's risk may be determined by a combination of factors, with children who are more behaviourally inhibited more vulnerable to the anxiogenic effects of parenting behaviour. While scant research has studied interactive risk effects, BI has been found to moderate the anxiogenic effect of parenting behaviour (Fernandes et al., 2023).

Some meta-analyses have

Given that much of the research into anxiogenic parenting behaviour is cross-sectional, questions remain regarding causality and the direction of effects. It is plausible that parenting behaviours lead children to experience anxiety problems, and that parents are more likely to employ overcontrolling parenting behaviour *in response to* the child's anxiety remains to be seen. Indeed, some models suggest that the relationship may be one of a bi-directional 'anxious-coercive cycle' (Dadds & Roth, 2001). Furthermore, given that overcontrolling parenting behaviour is more common among parents with anxiety disorders, cross-sectional research cannot determine whether such parenting behaviours are indeed a causal mechanism, or merely a proxy for another heritable factor.

Parents are typically the main source of socialisation during early childhood years - which are critical for developing patterns of disordered anxiety of emotional self-regulation (Fox et al., 2005; Thompson, 2006). In 2010, Thirwall and Creswell provided some insight into overcontrolling parenting as a potential causal mechanism leading to anxiety in children aged 4-5 years. Using a sample of non-anxious mothers and non-anxious children, By capturing predictions and self-evaluations about the child's performance, self-reported 'scared' feelings

and observer-rated anxious behaviours, Thirwall and Creswell (2010) attempted to capture cognitive, emotional and behavioural symptoms of anxiety when delivering a mildly stressful speaking task. With a repeated-measures design, each child delivered two speeches in two experimental conditions. In one condition, the child's mother had been trained to exhibit overcontrolling behaviour during a 10-minute interaction to prepare for the speech. In the other, the mother had ben trained to exhibit autonomy-granting behaviour. They found that observer-rated child anxiety was significantly higher after an overcontrolling interaction with the mother than an autonomy-granting interaction after BI was added as a moderator. They also found that child-reported scared feelings were significantly higher, with predictions and self-evaluations of performance significantly more negative after a controlling interaction compared with autonomy-granting and that this was moderated by child temperament, such that the effect of controlling parenting on child anxiety was significantly larger for temperamentally inhibited children than for non-inhibited children.

None of these child-reported effects were moderated by child temperament. Effects remained significant after controlling for the mother's self-reported existing habitual parenting behaviour and observed parental negativity during the interaction, suggesting that neither a novelty effect of manipulating parenting behaviour, nor confounding effects of negative behaviour (such as frowning or expressing criticism) during the mother-child interaction, account for the effects. These findings are supported by similar results in an older sample. In a pilot study of children aged 7–13 years, de Wilde and Rapee (2008) experimentally manipulated maternal control during a speech task and found that children whose mothers behaved in a highly controlling manner showed significantly greater observed anxiety when subsequently preparing and delivering a speech alone. This study helps establish the broader generalisability of these effects beyond early childhood, reinforcing the view that maternal control can play a causal role in increasing children's state anxiety.

While Thirwall and Creswell's (2010) study provides evidence for the anxiogenic effects of overcontrolling parenting, they acknowledge several opportunities for new research. Given that

their sample consists entirely of maternal parents, one such opportunity is to observe whether similar effects are present from paternal parenting behaviour. Indeed, some theoretical models suggest that maternal and paternal parenting behaviours may have differential effects on the development of anxiety in children (Bögels & Perotti, 2011; Bögels &Phares, 2008) with some supporting empirical evidence suggesting the father's overcontrolling behaviour is particularly anxiogenic compared with mothers (Majdandžić et al., 2014; Möller et al., 2015). Furthermore, Thirwall and Creswell's (2010) study only examined anxiety that can be seen by observers or communicated by children. While such measures are informative, observer ratings of anxiety may not be sensitive to internalising symptoms (Comer & Kendall, 2004) and young children may lack the capacity to reliably report their own anxiety symptoms (Schniering et al., 2000).

The present study seeks to build upon existing evidence by examining the impact of fathers' controlling behaviours on children's anxiety, and measuring children's heart rate variability as an index of self-regulation. reproducing the repeated measures experimental design employed by Thirwall and Creswell (2010) with a sample of 24 father-child dyads. To prevent confounding effects of existing risks for transmission from the parent, fathers were screened to ensure a non-anxious sample. To enhance measurement objectivity and observe physiological components of the child's reaction to overcontrolling and autonomy-granting parenting behaviour, the present study will use child self-report measures with heartrate variability (HRV) via electrocardiogram (ECG). HRV is a measure of parasympathetic nervous system activity, with lower HRV indicating reduced autonomic regulation and greater stress (Thayer et al., 2012; Graziano & Derefinko, 2013). ECG data will be used to calculate RMSSD (root mean square of successive differences), a widely used time-domain measure of HRV that is sensitive to short-term changes and well-suited to experimental designs with young children (Quintana & Heathers, 2014). Prior studies have demonstrated the utility of HRV, and RMSSD specifically, in capturing physiological reactivity to stressors in children aged 8-12 years (Smiley et al., 2020).

While controlling for condition ordering effects, habitual overcontrolling parenting and negative parenting, the present study seeks to test a causal mechanism between

overcontrolling parenting and child anxiety, as indicated by reduced autonomic flexibility (dysregulated fear), self-reported fear and self-reported cognition, and to test whether effects are moderated by child temperament.

Using self-report measures of scared feelings, ratings of performance taken before (predicted) and after (self-evaluated) speeches along with HRV, we aim to test the following hypotheses:

i) Children will score higher in self-reported scared feelings after an overcontrolling interaction with their father, compared with an autonomy-granting interaction.

ii) Children will both predict and reflect upon their performances more negatively after a controlling interaction with their father, compared with autonomy-granting.

iii) Children will experience greater withdrawal of HRV scores between baseline and speech measurements in the overcontrolling condition, compared with the autonomy-granting condition.

iv) The above effects will be moderated by parent-reported child temperamental inhibition.

3.3. Methods

3.3.1. Ethics

Ethical approval was provided by University of Southampton's Research Integrity and Governance Committee (ERGO ID: 90456)

3.3.2. Participants

G* power (Fual et al., 2007) a priori power analysis estimates a suitable sample size of 24 father-child dyads to provide sufficient power (>.80) to detect a medium effect size at an

alpha level < .05. Sample size analyses are informed by Thirwall and Creswell's (2010) study, which is methodologically similar to the present study.

Participants were recruited through word of mouth, poster advertisements and direct contact with local schools, nurseries and play groups. Initial screening used the Generalised Anxiety Disorder scale (GAD7; Spitzer et al., 2006) to exclude parents scoring >7 (indicating above threshold anxiety). Additional screening questions identified for exclusion: i) participants diagnosed with intellectual disabilities, ii) fathers with anxiety disorder diagnoses and, iii) father-child dyads not fluent in spoken English. 2 parents were ineligible to take part after scoring above threshold on the GAD-7 and a further 4 participants did not respond after completing screening questionnaires. The sample consisted of 25 non-clinical children aged 4 and 5 years (32% female), and their non-anxious fathers. Demographic data were collected on parent age (*M*= 39.79, *SD*= 1.55, range= 33-54) and ethnic origin (88% white British). None of the participants who took part in the study discontinued during the procedure.

3.3.3. Procedure

The study used a within-subjects experimental design manipulating parenting behaviours in two conditions: i) controlling and, ii) autonomy-granting. To control for potential ordering effects, the order of these conditions was reversed for each participant (autonomy-granting first= 13, controlling first= 12).

Fathers interested in taking part received a web link including: consent and assent forms; GAD7 and additional screening questions (see above); a participant information sheet with details about the study; the Parental Overprotection Scale (POS; Edwards et al., 2010) and; the Anxiety Related Behaviour Questionnaire (ARBQ; Eley et al., 2003). After fathers provided formal written consent, eligible participants were contacted to arrange for the experimental procedure to be carried out within the child's home. Following Thirwall & Creswell's (2010) design, carrying out the procedure, we visited dyads at their homes to provide a naturalistic and familiar environment for the participants.

Upon arrival at the participant's home, child participants were given a basic overview of the experimental procedure. Fathers were also given an opportunity to re-read the participant information sheet, both father and child were given an opportunity to ask questions about the procedure. To minimise inconsistencies between experimental settings, rooms were arranged to remove possible distractions (e.g. turning off TVs, removing toys or pets). The room was set up to provide seats for the child and father side-by-side with a small desk or table to be used during preparation and a space for the child to present their speech. Both of these areas were within the view of an iPad used to record the procedure. Both child and father were informed that the procedure would be audio and video recorded.

The researcher supported the father in attaching three sensors to the child's back, which were attached to a wearable device transmitting ECG data wirelessly to the researcher's laptop computer. Children were informed that the device would provide the researchers with information about their heart rate. Video recording of the father and child was started as children watched a 5-minute non-threatening nature video on a separate iPad to capture baseline ECG readings. Fathers simultaneously watched a pre-recorded video on a second laptop instructing them to exhibit either controlling or autonomy-granting parenting behaviour during the upcoming 10-minute preparation task. To ensure that children were unaware of the content of the father's instructional video, fathers sat separately and used headphones with the laptop screen not visible to the child. After the first father training video and child nature video videos were completed, the child was asked to rate scared feelings on the feelings scale to obtain baseline self-reported anxiety.

Father and child were then instructed to spend 10-minutes sitting at the desk preparing for the child's first speaking task on the topic of "a fun day out," during which researchers left the room. Participants were provided with pens and paper to support their preparation. Researchers returned to the room and ended the preparation task after 10 minutes. The child was then asked to rate how they thought that they would perform compared to other children on the performance scale (prediction).

The child was then asked to stand in front of the recording camera and deliver their speech, which was ended after 3 minutes. Children who were unable to initiate or continue with their speech were encouraged by the researcher using pre-determined prompts. Speeches were discontinued when children did not speak for longer than 20 seconds, showed heightened distress or indicated that they wanted to stop. After completing the speech, children were asked to rate how they thought they performed compared to other children on the post-speech performance scale.

The father training and child nature video stage was then repeated for the remaining condition (autonomy granting or controlling) with a second speaking task topic ("my family") so that speech topic would alternate relative to the condition, preventing speech topic from producing confounding effects on outcomes. Upon completing the second speaking task, video, audio and ECG recording was stopped. ECG monitoring equipment was removed from the child, researchers debriefed participants and arranged for £30 compensatory vouchers to be sent. Children were also invited to watch a short mood repair nature video. The experimental procedure lasted approximately 60 minutes.

3.3.4. Parenting behaviour training

To manipulate parenting behaviour, training videos were developed for both autonomy-granting and overcontrolling conditions in which a father actor displayed the following behaviours derived from constructs operationalised by Thirlwall and Creswell (2010):

Controlling

i) Touching the paper and sitting close.

ii) Drawing or writing on the paper while the child is drawing or writing.

iii) Interrupting with a suggestion.

Autonomy-granting

i) Sitting back from the child.

ii) Offering input only when asked by the child.

iii) Allowing the child to come up with their own ideas.

3.3.5. Measures

Father measures

The Parental Overprotection Scale (Edwards, Rapee & Kennedy, 2008)

To control for novelty in fathers' use of manipulated parenting behaviours, this 19-item scale measures fathers' self-reported typical controlling and overprotective behaviours in situations deemed to pose a threat to their child. Items in the scale are derived from accounts of behavioural inhibition (Kagan et al., 1988) and clinical observations of anxious children (Hudson & Rapee, 2001). Sufficient validity and reliability of the scale has already been established in children aged 3-5 (Edwards et al., 2008) and the measure correlates sufficiently with independent ratings of observed maternal behaviour (Edwards et al., 2008), though the scale has yet to be used to measure fathers' parenting behaviour.

The Generalised Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006).

The GAD-7 is a seven-item self-report measure of anxiety with high internal consistency (Cronbach's α = 0.92), good test-retest reliability (intraclass correlation= 0.83; Spitzer et al., 2006) and convergent validity with other anxiety measures (Löwe et al., 2008). Answering on a four-point Likert scale, fathers rated how frequently they have been "bothered" by symptoms such as "feeling nervous, anxious or on edge" and "feeling afraid as if something awful might happen" between 1("not at all"), and 4 ("nearly every day"). Fathers were excluded from the study if GAD-7 total score exceeded 8, a widely-used anxiety screening cut-off in United Kingdom primary mental healthcare (Kroenke et al., 2010).

Child scores

The Anxiety Related Behaviours Questionnaire (ARBQ; Eley et al., 2003)

This 14-item parent report tool measures children's trait anxiety, allowing for the identification of moderating effects of inhibited temperament on the relationship between parenting behaviour and child anxiety. Parents scored on whether statements such as "takes a long time to warm to strangers" and "tends to be shy or timid" are "not true," "sometimes true," or "certainly true" about their child. The scale has shown good internal consistency in identifying trait anxiety in children as young as 4 (Wheatcroft & Creswell, 2007).

Child self-report scales

The 'Feelings Scale,' a five-point Likert scale measuring self-reported 'scared' feelings from 1 ("not scared at all") to 5 ("very scared"), was used to capture child-reported anxiety. The measure was completed at two time points: a baseline reading immediately after the 5-minute nature video and a second measurement after the father-child interaction and before delivering their speech. Changes in self-reported feelings between these two time points will be used to indicate experimental effects.

To measure anxiety-related predictive and self-evaluative cognitions, two separate 'performance scales' will be used. Both performance scales ask the child to compare their performance to other children on a 5-point Likert scale from 1 ("a lot better than other children") to 5 ("a lot worse than other children"). The first performance scale captures predicted performance ("how well do you think you will do…") and is administered immediately before the child delivers their speech. The second performance scale captures self-evaluated performance ("how well do you think you did…") and is administered immediately after the child delivers their speech. It should be noted that each performance scale is intended to measure the child's predictions and self-evaluations as separate domains of anxiety-related cognition. Predictions in the controlling condition will be compared with predictions in the autonomy-granting condition, while self-evaluations of performance in the controlling condition will be separately compared with self-evaluations of performance in the autonomy-granting condition.

Both scales were taken from Thirlwall and Creswell's (2010) study. To simplify the Feelings Scale for children, gender and ethnicity-neutral drawings depicting faces ranging from calm to afraid were used.

Observational Coding Schemes

Using the coding scheme developed by Thirlwall and Creswell (2010), an independent voluntary research intern coded video and audio recorded father-child interactions. A second voluntary research assistant independently coded five videos until reaching 100% consensus. Half of the videos were double-coded by the second research assistant to assess inter-rater reliability. Videos were trimmed to ensure the rater was blind to experimental condition.

To test the success of experimental manipulation, independent coders who did not know which condition they were coding scored instances of 'parental overcontrol' and 'autonomy granting' behaviours on video recordings of the preparation stages. Items in this coding scheme reflected instructions shown in the parenting behaviour instructional video shown to fathers. Coders scored +1 for each overcontrol behaviour and -1 for each autonomy-granting behaviour, with a higher total score depicting more overcontrolling parenting behaviours. Inter-rater reliability for observer ratings of parental overcontrol was good (ICC= .72).

Using a coding scheme developed by Thirlwall and Creswell (2010), coders scored the extent to which fathers demonstrated negative parenting behaviours (i.e. "laughing inappropriately in the face of the child's anxiety or their attempts to prepare for the task") during the preparation task to control for the potential confounding effect of parental negativity. Coders assigned a total score between zero and three, with higher scores reflecting more negative parenting behaviour. Inter-rater reliability for observer ratings of negativity was good (ICC= .72).

Physiological measurement

Primary analyses included heartrate variability (HRV) as a physiological biomarker of child anxiety and was used to compare pre-to-post interaction change in anxious state between experimental conditions. R-R intervals (milliseconds between heartbeats) were computed from Acknowledge software (BIOPAC Systems inc., 2023) and used to calculate mean heartrate (BPM) and root mean square of successive differences (RMSSD) for baselines and speeches for both autonomy-granting and controlling conditions. RMSSD is a measure of heartrate variability and indicates parasympathetic nervous system (PNS) activity, with lower scores indicating reduced PNS activity and higher anxiety. RMSSD was the chosen metric for this study due to its sensitivity to short-term changes and suitability for brief periods of measurement in within-subjects designs (Quintana & Heathers, 2014). RMSSD during each speech was compared to RMSSD during each respective 5-minute baseline, with time point comparisons to determine change.

3.3.6. Analysis plan

Using AcqKnowledge software (BIOPAC Systems inc., 2023), ECG waveforms were visually inspected and artefacts removed before using automated R-peak detection. Inspection of RR-interval (time between heart beats in milliseconds) and tachogram data facilitated manual correction using linear interpolation (Peltola, 2012). To preserve data integrity, measurements requiring correction for >10% of R-peaks were excluded from analysis, following previous studies employing a minimum 10% rule (e.g. Bazelmans et al., 2019). RMSSD was calculated from RR-intervals using the Root Mean Square (RMS) formula, while beats per minute (BPM) was also calculated. Between-beat intervals greater than 2 seconds or less than .3 seconds were deemed outside of the plausible range for child heartrate and treated as artefacts.

RStudio (2016) was used for data analysis, first calculating descriptive statistics (M, SD, range) for primary dependent variables (feelings scales, both performance scales and RMSSD) for each condition. T-tests of controlling behaviour during interactions in each condition then

tested for successful experimental manipulation of parenting behaviours. To test the effect of control variables, T-tests were also conducted comparing between-condition differences in parental negativity and observed parental overcontrol.

Performance scales (predicted performance and post-speech self-evaluation of performance) were treated as separate constructs. In keeping with Thirwall and Creswell's (2010) design, predicted performance at time 2 were compared with predicted performance at time 1, with post-speech scores compared likewise. The RMSSD (during speech) and feelings scale (after father-child interaction) were each compared with their respective baseline measurements collected prior to the father-child interaction.

To isolate within-subject effects and account for the non-independence of measurements in this repeated measures design, a Linear Mixed Effects Model (LMM) was used for primary analyses of all outcomes (Snijders & Bosker, 2011). The LMM model facilitates simultaneous analysis of both fixed effects (experimental condition and covariates) and random effects (between-participant differences). All models used a random intercept for participant ID to account for between-participant differences. Fixed effects were structured to test the primary effect of parenting style while controlling for habitual parental overprotection (POS), observed parental negativity and order of condition (autonomy-granting or controlling condition first).

Models were specified for each primary outcome variable (RMSSD, feelings, performance prediction and performance self-evaluation) with parenting condition (autonomy-granting or controlling) serving as the primary predictor. Time (baseline/speech) and condition (autonomy-granting/controlling) interactions were included for RMSSD and feelings scale models. For performance prediction and performance self-evaluation scales a model without time-condition interaction was used, with performance prediction and performance self-evaluation scores in the controlling parenting condition both separately compared with their respective scores in the autonomy-granting condition. All models included fixed effects for

moderators (inhibited temperament) and control variables (habitual parental overprotection [POS]; condition order and; observed parental negativity).

Assumptions of normality and homoscedasticity were evaluated using Q-Q plots and residual vs. fitted plots. Variance inflation factors (VIFs) were examined to assess multicollinearity, and Cook's distance was used to identify overly influential cases. Correlations between all outcome variables were computed to test convergent validity.

3.4. Results

One participant was excluded from RMSSD analysis due to excessive ECG artefacts requiring >10% correction, while all participants (*n*=25) were included in analyses for feelings scales and performance scales. Mean speech duration was 1 minute and 46 seconds in the autonomy-granting parenting condition (range= .58 to 3.70) and 1 minute 42 seconds in the controlling parenting condition (range= .45 to 3.4). Means, standard deviations and confidence intervals for outcome and covariate measures can be found in 3.1.

Table 3.1.

Means, standard deviations and confidence intervals.

Measure	*N*	*M*	*SD*	*SE*	95% CI
Heart-rate variability (RMSSD)					
Autonomy-granting condition					
Baseline	24	55.20	30.30	6.19	[43.1, 67.3]
Speech	24	32.40	17.10	3.49	[25.5, 39.2]
Controlling condition					
Baseline	24	60.20	38.80	7.92	[44.7, 75.7]
Speech	24	29.50	13.80	2.81	[23.9, 35.0]
Self-reported scared feelings (feelings scale)					
Autonomy-granting condition					
Pre-interaction	25	1.21	.59	.12	[.97, 1.44]
Post-interaction	25	1.29	.69	.14	[1.02, 1.57]
Controlling condition					
Pre-interaction	25	1.17	.38	.08	[1.01, 1.32]
Post-interaction	25	1.92	1.21	.25	[1.43, 2.40]
Performance prediction					
Autonomy-granting condition	25	1.42	.83	.17	[1.08, 1.75]
Controlling condition	25	1.38	.77	.16	[1.07, 1.68]
Performance self-evaluation					
Autonomy-granting condition	25	1.38	.77	.16	[1.07, 1.68]
Controlling condition	25	1.62	1.01	.21	[1.22, 2.03]
Observer-rated controlling behaviour					
Autonomy-granting condition	25	3.28	2.35	.47	[2.36, 4.2]
Controlling condition	25	9.80	2.47	.49	[8.83, 10.77]
Observer-rated negativity					
Autonomy-granting condition	25	.68	.85	.17	[.35, 1.01]
Controlling condition	25	.84	.62	.12	[.06, 1.08]
Covariates					
Habitual parental overprotection(POS)	25	31.52	11.09	2.22	[27.17, 35.87]
Moderator					
Inhibited temperament (ARBQ)	25	5.92	3.82	.76	[4.42, 7.42]

3.4.1. Convergent validity of measures

Pearson's R correlations revealed that performance prediction and evaluation scales were significantly positively correlated (r= .68, p= .002) with more negative predictions of performance associated with more negative post-speech self-evaluations. Associations between the feelings scale and both performance scales were non-significant (predicted: r= .38, p= .064; evaluation: r = .33, p = .114). RMSSD was not significantly associated with feelings scales (r= -.12, p= .589), performance prediction (r= -.06, p= .782) or performance self-evaluation (r= .00, p= .983).

3.4.2. Assumption checks

Assumptions of normality and homoscedasticity were evaluated using Q-Q plots and residual vs. fitted plots. Variance inflation factors (VIFs) were examined to assess multicollinearity, and Cook's distance was used to identify influential cases. All assumptions were met. Specifically, VIF values ranged from 1.02 to 1.74 across models, suggesting low multicollinearity. Cook's distances were all well below the threshold of 1.0, indicating no overly influential observations.

3.4.3. Manipulation checks

T-tests revealed that observer ratings of controlling parental behaviour during the father-child interaction were significantly higher in the controlling condition (M difference = 6.50, 95% CI lower bound= 5.37]) than in the autonomy-granting condition (t(24) = 9.82, p < .001; see figure 3.1), indicating successful manipulation of parenting behaviour in the expected direction. No significant difference was found between condition for observed parental negativity during the father-child interaction (t(24) = 1.31, p = .10, M difference = 0.21, 95% CI lower bound= -0.06]; see figure 3.2).

Figure 3.1.

Bar chart showing means and confidence intervals from observed parental control t-test.

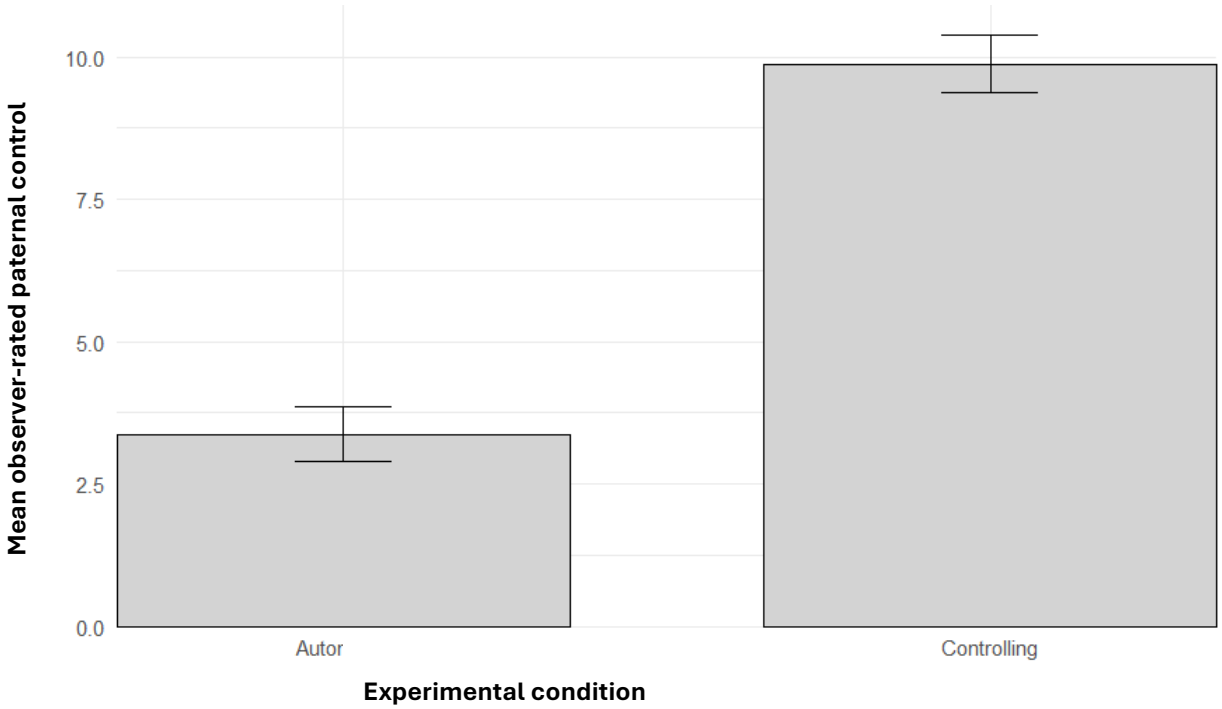


Figure 3.2.

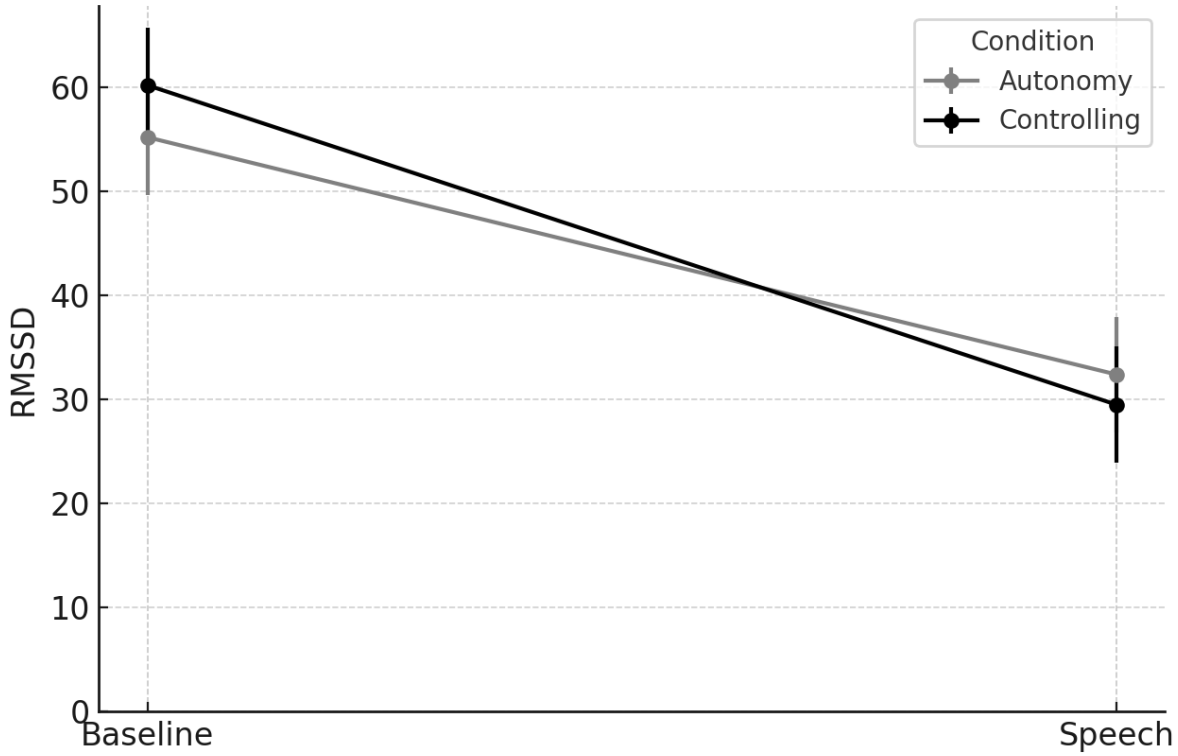
Bar chart showing means and confidence intervals from observed parental negativity t-test.

3.4.4. RMSSD (heartrate variability)

A significant main effect of time was found (b = -22.84, SE = 5.16, $t(69)$ = -4.43, p < .001) indicating a withdrawal in RMSSD scores from baseline to speech. The time-condition interaction was not significant (b = -7.88, SE = 7.30, p = .28), indicating no significant difference in RMSSD change between conditions. Estimated marginal means indicated a decrease in RMSSD from 55.1 ms (SE = 5.56) to 32.3 ms (SE = 5.56) in the autonomy condition and from 60.1ms (SE = 5.56) to 29.3 ms (SE = 5.56) in the controlling condition (Figure 3.3).

Figure 3.3.

Plot depicting RMSSD change between baseline and speech for each experimental condition.

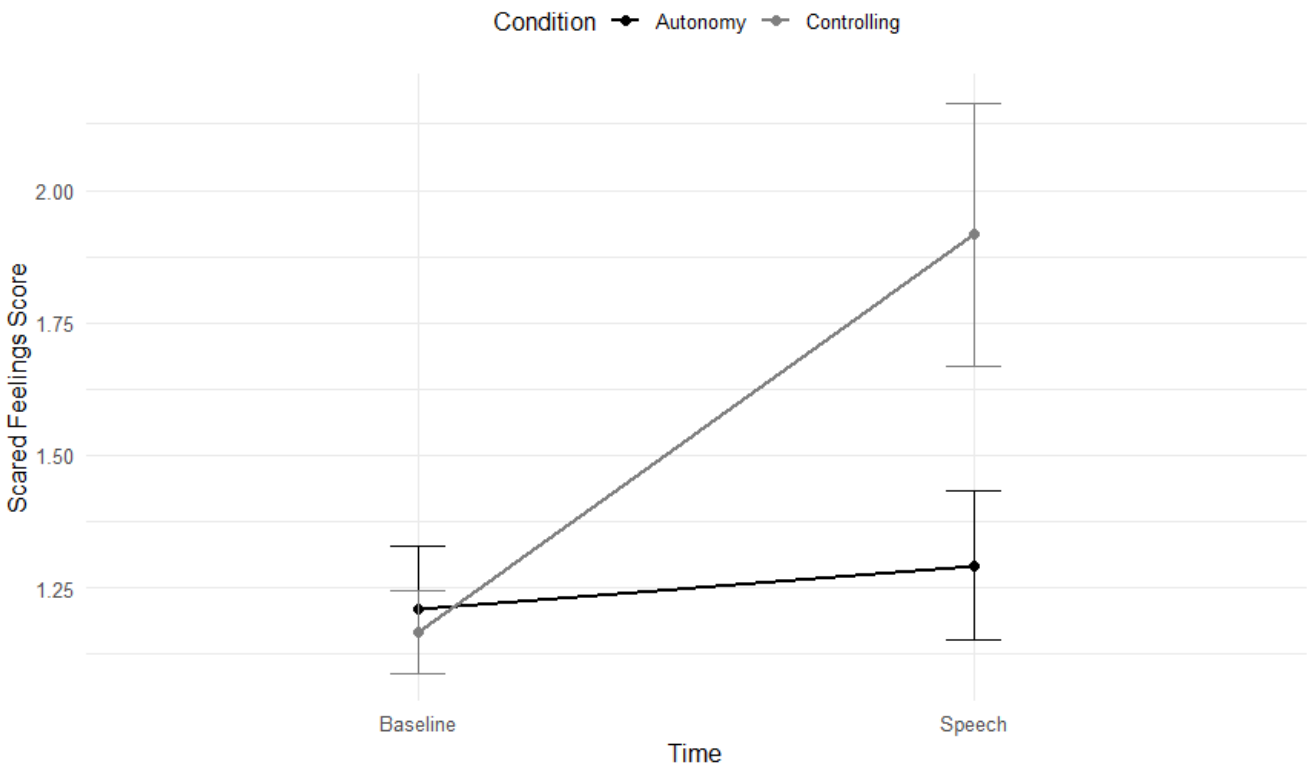


3.4.5. Scared Feelings (Self-Reported Anxiety)

A significant time-condition interaction emerged (b = 0.67, SE = 0.29, $t(69)$ = 2.31, p = .024) with children reporting greater increases in self-reported fear from pre to post speech in the controlling condition (Pre: M = 1.16, SE = 0.16; Post: M = 1.91, SE = 0.16) than in the autonomy condition (Pre: M = 1.21, SE = 0.16; Post: M = 1.29, SE = 0.16), indicating greater self-reported anxious feelings in the controlling parenting condition than the autonomy-granting condition (Figure 3.4).

Figure 3.4.

Plot depicting scared feelings (feelings scale) change between baseline and speech for each experimental condition.

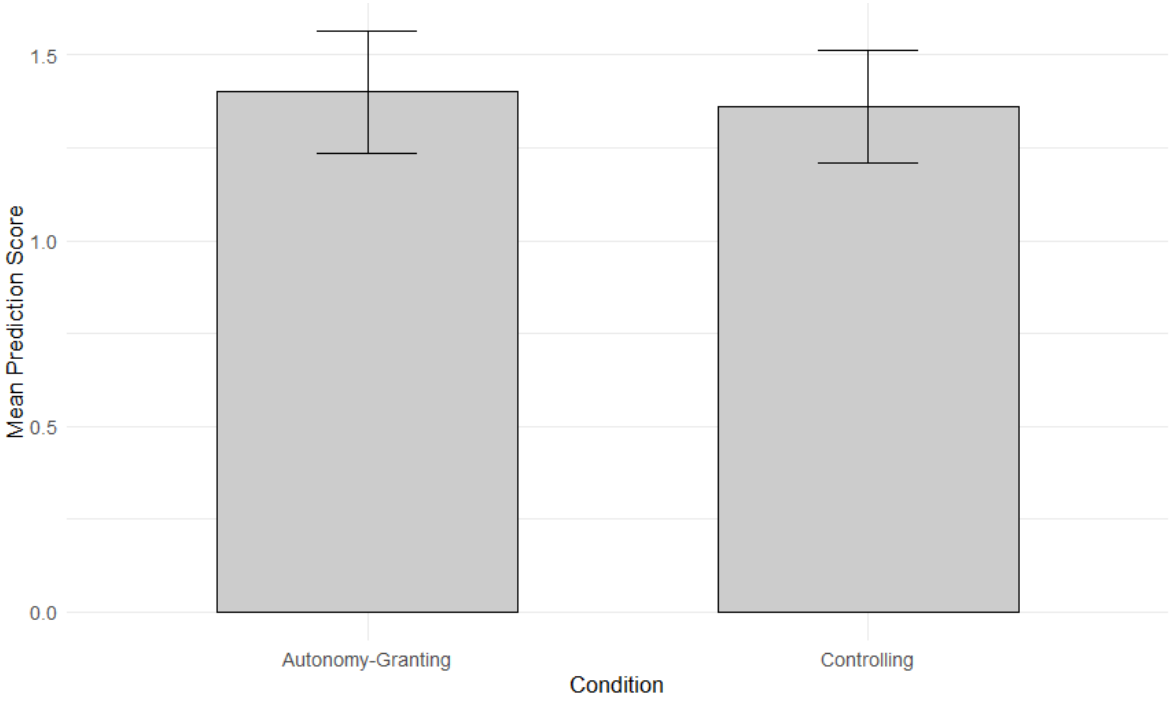


3.4.6. Performance Prediction

No significant effect of parenting condition was found (b = -0.04, SE = 0.15, $t(24)$ = -0.27, p = .79), with higher scores reflecting more negative predictions. Estimated marginal means were similar across conditions (autonomy-granting: M = 1.40, SE = 0.16; controlling: M = 1.36, SE = 0.16), indicating that parenting style did not affect children's expectations about their performance (Figure 3.5).

Figure 3.5.

Bar chart showing mean predicted performance scores between conditions with confidence intervals.



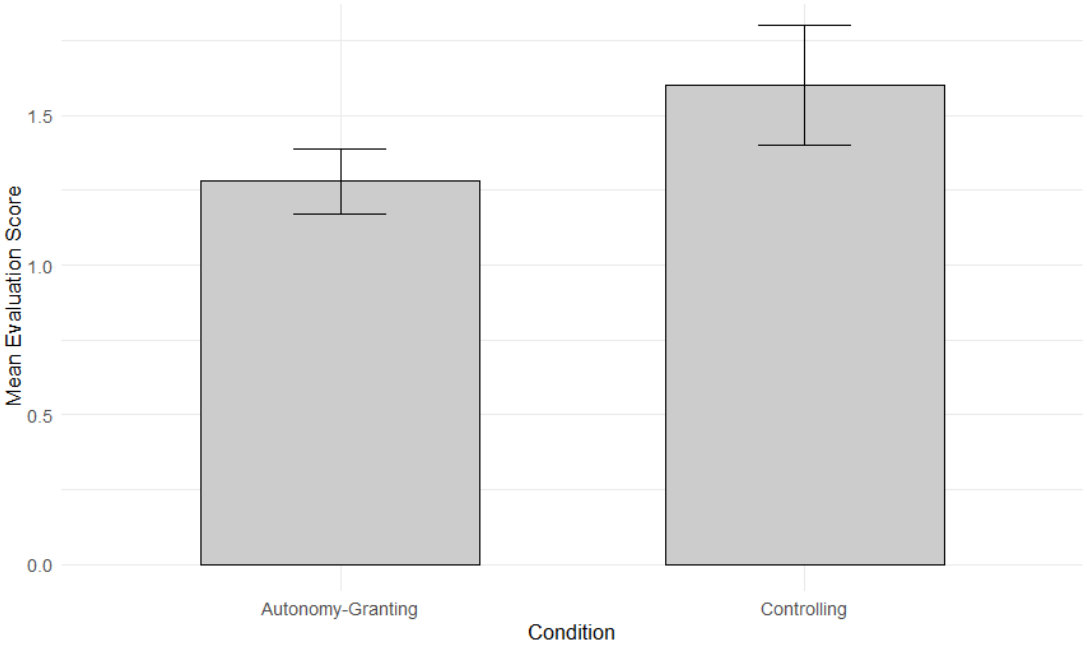
Note: Higher scores reflect more negative predictions.

3.4.7. Performance Evaluation

No significant differences in performance self-evaluation were found between the controlling (M = 1.62, SE = 0.16) and autonomy-granting (M = 1.24, SE = 0.16) conditions, with higher scores reflecting more negative self-evaluations. The effect of condition was not statistically significant (b = 0.38, SE = 0.19, $t(24)$ = 1.99, p = .059).

Figure 3.6.

Bar chart showing mean performance self-evaluation scores between conditions with confidence intervals.



Note: higher scores reflect more negative self-evaluations.

3.4.8. Covariates and moderators

To assess whether the order of condition presentation influenced outcomes within all models, condition order was included as a covariate in each linear mixed model. This variable did not significantly predict RMSSD (p = .63), scared feelings (p = .55), performance prediction (p = .76), or performance evaluation (p = .69). These results confirm previous t-test findings suggesting no significant ordering effect occurred. Parental negativity did not have a significant effect on any outcomes (RMSSD: b= −.11, SE = 0.44, p= .802; feelings scale: b= .002, SE = 0.01, p = .853; performance prediction: b = .01, SE = .01, p= .283; performance evaluation: b= 0.02, SE= 0.01, p= .102).

Temperamental inhibition (ARBQ) did not significantly moderate effects for any outcomes (RMSSD: b = −1.74, SE = 1.24, p= .175; feelings scale: b = 0.01, SE = 0.03, p= .804; performance prediction: b= −0.41, SE = 0.29, p= .166; performance evaluation: b= 0.02, SE = 0.01, p= .102). The sole significant main effect of condition (autonomy-granting or controlling) found for self-reported anxiety (feelings scale) was independent of covariates and moderators.

3.5. Discussion

25 non-anxious fathers were successfully trained to expose their children to autonomy-granting and controlling parenting behaviours in two father-child interactions. Compared to baseline readings, self-reported fear and HRV withdrawal (24 participants) indicate that speaking tasks successfully induced child anxiety. Children reported significantly greater increases in fear after fathers exhibited more controlling (rather than autonomy-granting) parenting behaviours while helping them to prepare for their speech. Overcontrolling parenting behaviour was not found to have a statistically significant effect on HRV, suggesting that changes in parasympathetic nervous system activity are unaffected by controlling or autonomy-granting parenting behaviour. Children's predictions of how they would perform and self-evaluations of their performance did not significantly differ between conditions, suggesting that controlling paternal parenting behaviour does not significantly impact upon simple expectations or appraisals of performance. In short, findings suggest that children believe themselves to be more anxious following a controlling interaction with their fathers compared with an autonomy-granting interaction, but neither measures of performance-related cognition nor physiology indicate significant anxiogenic effects from overcontrolling parenting behaviour, compared with autonomy-granting behaviour. Effects were all independent of habitual overprotective parenting behaviour and parental negativity, suggesting that neither pre-existing parental overprotective parenting nor parental negativity during the father-child interaction had confounding influence on observed outcomes.

In Thirwall and Creswell's (2010) study, no significant main effects of controlling maternal parenting behaviour were found but moderated effects were found, with children scoring higher in temperamental inhibition more susceptible to the anxiogenic effect of controlling maternal parenting. Curiously, the present study found a significant main effect of controlling paternal parenting behaviour on child self-reported fear, but no significant moderating effect of temperamental inhibition across any outcomes. Contrary to theoretical multi-risk models of child anxiety development (Aaron et al., 2023), this may suggest that the extent to which BI and anxiogenic parenting coalesce in the aetiology of child anxiety may differ between maternal and paternal parenting, though findings should be interpreted cautiously and do not confirm the absence of true effects. Father-reported temperamental inhibition may not be directly comparable to the mother-reported temperamental inhibition in Thirwall and Creswell's (2010) study. As fathers tend to report lower scores of BI in their children than mothers (Edwards et al., 2010), it is plausible that true moderating effects of BI were absent due to underreporting in the ARBQ questionnaire by fathers.

The present study finds no significant correlation between HRV and self-reported anxiety or performance-related cognitions. While comparable child research is scant, this finding reflects findings in adult studies finding that HRV withdrawal was significantly associated with observer-rated anxiety but not self-reported anxiety (Ham et al., 2023). Conversely, one child study previously found that parental anxiety is associated with reduced HRV in their offspring during a stressor task, but this finding was not correlated with child-reported anxiety (Koszycki et al., 2019). Non-convergence of self-reported anxiety and HRV in the present study may reflect intrinsic differences in the constructs captured by each measure. While self-report tools such as the feelings scale reflect a child's conscious experience of fear or anxiety, they do not not capture the regulation, interpretation, or contextual appropriateness of such feelings. For instance, a child may report feeling scared during a rollercoaster ride, yet this fear is wilful, contextually appropriate, and even enjoyable, whereas fear elicited by controlling parenting may be experienced as aversive and dysregulated. HRV is a

physiological index of emotion regulation and autonomic flexibility (Beauchaine & Thayer, 2015), and may better reflect the child's regulatory response to emotionally challenging environments than self-report alone.

While not conducted with child samples, previous research has found that reduced HRV during a speaking task was significantly associated with self-reported emotion dysregulation among undergraduate students (Visted et al., 2017). Among components of the emotion dysregulation questionnaire used in their study, 'inability to accept negative emotions' showed the strongest association with reduced HRV. Indeed, emotion dysregulation may be a more robust transdiagnostic predictor of psychopathology than anxiety alone (Bender et al., 2012; Paulus et al., 2021).

There are a number of important considerations when interpreting HRV effects. All baseline measurements were captured over five minutes and all speeches lasted longer than previous empirical research reporting reliable HRV scores using RMSSD with measurement windows as short as 30 seconds in duration (Shaffer, McCraty, & Zerr 2014). Of the 24 participants included in HRV analyses, only 2 gave speeches shorter than the 1-minute speech window suggested for reliable measurement of HRV in experiments involving children by Nussinovitch et al., (2011). Therefore, the duration of measurements in the present study are likely sufficient to reliably capture HRV in both baseline and speech phase measurements. However, HRV can be highly variable both within and between subjects, with factors such as posture, time of day and physical activity influencing measurements. Crucially, the present study controlled between-subject variance by employing a repeated measures design. However, the child's movement and respiration may have impacted upon HRV measurement error. For example, measuring HRV during speaking tasks can increase parasympathetic nervous system activity (increasing HRV) as a consequence of the extended exhalation required for talking (Dodo & Hashimoto, 2019). Given the variability of HRV measurements and the likelihood of measurement error, significant results often require larger samples than those for self-report or observation-based studies (Laborde et al., 2017). The power analysis conducted

for the present study therefore may have failed to account for the inclusion of physiological measurements when calculating an estimated sample size requirement based on Thirwall and Creswell's (2010) self-reported anxiety findings.

Contrasts between the present findings and those of Thirwall and Creswell (2010) may tentatively suggest that the roles of mothers and fathers in anxiogenic parenting affect cognitive and emotional domains of anxious symptoms differently. Furthermore, in contrast with Thirwall and Creswell's (2010) findings, ours may suggest that the effect of the fathers' overcontrolling behaviour on self-reported anxiety may be direct and independent of child temperament. These findings emphasise the need for more representative samples highlighted in previous meta-analyses (e.g. Möller et al., 2016). Additional demographic characteristics of the present sample should also be considered when interpreting these findings. Despite attempts to recruit from variety of communities including over 30 schools and several mosques, the resulting sample is predominantly white (24 out of 25) male (68%) children and socioeconomic status information was not collected. The generalisability of these findings among different populations should be cautious, especially given potential for parenting norms and practices to differ according to race, sexuality, family structure or culture (Aaron et al., 2023). Furthermore, given that boys and girls may significantly differ in their self-reported anxious feelings during stressor tasks (Michels et al., 2013), researchers should seek equal numbers of boys and girls in future studies while also coding child gender as a potential moderator.

Future researchers should seek to triangulate self-report and physiological measures with observer reports of anxious behaviour to further enhance validity and to facilitate comparison with Thirwall and Creswell's (2010) observer-rated findings. Researchers should explore child-report measures that capture a more nuanced appraisal of the child's experience than a single-item scale of scared feelings and examine whether significant effects seen in self-reported anxiety are also found for self-reported emotion dysregulation during the task.

Further exploration of physiological measures should seek to replicate HRV measurements with a sample of mothers to determine whether the observed non-significant effects on HRV are unique to paternal parenting. Furthermore, research should be conducted on a larger sample and consider the impact of HRV variance when estimating sample sizes. Researchers should consider using additional measures of child temperament, such as combined father and mother reports or observational measures, to reduce the risk of null effects for moderation by temperament due to measurement error and establish whether the present findings represent a true absence of interactive effects. Additionally, while this study offers rare insight into paternal parenting behaviours, more research is needed to explore the role of parenting behaviour among different family structures, including same sex parents and families from different ethnic backgrounds. Future research should also explore the potential moderating effects of child gender and consider measures that

Clinicians and those seeking to develop early intervention and prevention strategies for childhood anxiety should consider the significant role played by parenting behaviour and should be mindful that the effect of parenting behaviour may be complex, may be significantly anxiogenic even in children not temperamentally at risk, and may present different effects when employed by fathers rather than mothers.

3.6. References

Aaron, E. M., Baumgartner, N. M., & Kiel, E. J. (2023). Temperament, Parenting, and Child Anxiety. Advances in Psychiatry and Behavioral Health, 3(1), 139-147. https://doi.org/https://doi.org/10.1016/j.ypsc.2023.03.017

Bazelmans, T., Jones, E. J. H., Ghods, S., Corrigan, S., Toth, K., Charman, T., & Webb, S. J. (2019). Heart rate mean and variability as a biomarker for phenotypic variation in preschoolers with autism spectrum disorder. Autism Research, 12(1), 39-52. https://doi.org/https://doi.org/10.1002/aur.1982

Beesdo, K., Knappe, S., & Pine, D. S. (2009). Anxiety and anxiety disorders in children and adolescents: developmental issues and implications for DSM-V. Psychiatr Clin North Am, 32(3), 483-524. https://doi.org/10.1016/j.psc.2009.06.002

Bender, P. K., Reinholdt-Dunne, M. L., Esbjørn, B. H., & Pons, F. (2012). Emotion dysregulation and anxiety in children and adolescents: Gender differences. Personality and Individual Differences, 53(3), 284-288. https://doi.org/https://doi.org/10.1016/j.paid.2012.03.027

BIOPAC Systems, Inc. (2023). *AcqKnowledge (Version 5.0.4) [Computer software]*. https://www.biopac.com/product/acqknowledge-software/

Bögels, S., & Phares, V. (2008). Fathers' role in the etiology, prevention and treatment of child anxiety: a review and new model. Clin Psychol Rev, 28(4), 539-558. https://doi.org/10.1016/j.cpr.2007.07.011

Bögels, S. M., & Perotti, E. C. (2011). Does father know best? A formal model of the paternal influence on childhood social anxiety. Journal of Child and Family Studies, 20(2), 171-181. https://doi.org/10.1007/s10826-010-9441-0

Borelli, J. L., Margolin, G., & Rasmussen, H. F. (2015). Parental overcontrol as a mechanism explaining the longitudinal association between parent and child anxiety. Journal of Child and Family Studies, 24(6), 1559-1574.

Beauchaine, T. P., & Thayer, J. F. (2015). *Heart rate variability as a transdiagnostic biomarker of psychopathology*. International Journal of Psychophysiology, 98(2), 338–350. https://doi.org/10.1016/j.ijpsycho.2015.08.004

Cabral, M. D., & Patel, D. R. (2020). Risk Factors and Prevention Strategies for Anxiety Disorders in Childhood and Adolescence. Adv Exp Med Biol, 1191, 543-559. https://doi.org/10.1007/978-981-32-9705-0_27

Comer, J. S., & Kendall, P. C. (2004). A Symptom-Level Examination of Parent-Child Agreement in the Diagnosis of Anxious Youths. Journal of the American Academy of Child & Adolescent Psychiatry, 43(7), 878-886. https://doi.org/10.1097/01.chi.0000125092.35109.c5

Dadds, M. R., & Roth, J. H. (2001). Family processes in the development of anxiety problems. The developmental psychopathology of anxiety, 278-303.

Degnan, K. A., Almas, A. N., & Fox, N. A. (2010). Temperament and the environment in the etiology of childhood anxiety. J Child Psychol Psychiatry, 51(4), 497-517. https://doi.org/10.1111/j.1469-7610.2010.02228.x

Dodo, N., & Hashimoto, R. (2019). Autonomic nervous system activity during a speech task. Frontiers in neuroscience, 13, 406.

Edwards, S., Rapee, R., & Kennedy, S. (2008). Psychometric properties of a parent report measure of overprotection in preschool-aged children. Manuscript submitted for publication.

Edwards, S. L., Rapee, R. M., & Kennedy, S. (2010). Prediction of anxiety symptoms in preschool-aged children: examination of maternal and paternal perspectives. Journal of child psychology and psychiatry, 51(3), 313-321. https://doi.org/https://doi.org/10.1111/j.1469-7610.2009.02160.x

Egger, H. L., & Angold, A. (2006). Common emotional and behavioral disorders in preschool children: presentation, nosology, and epidemiology. J Child Psychol Psychiatry, 47(3-4), 313-337. https://doi.org/10.1111/j.1469-7610.2006.01618.x

Eley, T. C., Bolton, D., O'Connor, T. G., Perrin, S., Smith, P., & Plomin, R. (2003). A twin study of anxiety-related behaviours in pre-school children. J Child Psychol Psychiatry, 44(7), 945-960. https://doi.org/10.1111/1469-7610.00179

Eley, T. C., McAdams, T. A., Rijsdijk, F. V., Lichtenstein, P., Narusyte, J., Reiss, D., Spotts, E. L., Ganiban, J. M., & Neiderhiser, J. M. (2015). The intergenerational transmission of anxiety: a children-of-twins study. American Journal of Psychiatry, 172(7), 630-637.

Fernandes, C. C., Martins, A. T., Santa-Rita, A., & Faísca, L. (2023). The influence of parental variables and child behavioral inhibition on social anxiety in preschool children: The moderator effects of gender. Current Psychology, 42(25), 21435-21448. https://doi.org/10.1007/s12144-022-03247-z

Fox, N. A., Henderson, H. A., Marshall, P. J., Nichols, K. E., & Ghera, M. M. (2005). Behavioral inhibition: linking biology and behavior within a developmental framework. Annu Rev Psychol, 56, 235-262. https://doi.org/10.1146/annurev.psych.55.090902.141532

Graziano, P., & Derefinko, K. (2013). Cardiac vagal control and children's adaptive functioning: A meta-analysis. Biological psychology, 94(1), 22-37. https://doi.org/https://doi.org/10.1016/j.biopsycho.2013.04.011

Grolnick, W. S., & Pomerantz, E. M. (2009). Issues and challenges in studying parental control: Toward a new conceptualization. Child Development Perspectives, 3(3), 165-170.

Hudson, J. L., & Dodd, H. F. (2011). *Temperament, family environment, and anxiety in preschool children*. Journal of Abnormal Child Psychology, *39*(7), 939–951. https://doi.org/10.1007/s10802-011-9502-x

Hudson, J. L., & Dodd, H. F. (2012). Informing Early Intervention: Preschool Predictors of Anxiety Disorders in Middle Childhood. PLoS One, 7(8), e42359. https://doi.org/10.1371/journal.pone.0042359

Hudson, J. L., & Rapee, R. M. (2001). Parent—child interactions and anxiety disorders: An observational study [doi:10.1016/S0005-7967(00)00107-8]. Elsevier Science.

Jewell, C., Wittkowski, A., & Pratt, D. (2022). The impact of parent-only interventions on child anxiety: A systematic review and meta-analysis. J Affect Disord, 309, 324-349. https://doi.org/10.1016/j.jad.2022.04.082

Kantor, L., Endler, N. S., Heslegrave, R. J., & Kocovski, N. L. (2001). Validating self-report measures of state and trait anxiety against a physiological measure. Current Psychology, 20(3), 207-215.

Kagan, J., Reznick, J. S., Clarke, C., Snidman, N., & Garcia-Coll, C. (1984). Behavioral inhibition to the unfamiliar. Child development, 2212-2225.

Kagan, J., Reznick, J. S., Snidman, N., Gibbons, J., & Johnson, M. O. (1988). Childhood derivatives of inhibition and lack of inhibition to the unfamiliar. Child Dev, 59(6), 1580-1589. https://doi.org/10.1111/j.1467-8624.1988.tb03685.x

Koszycki, D., Taljaard, M., Bielajew, C., Gow, R. M., & Bradwejn, J. (2019). Stress reactivity in healthy child offspring of parents with anxiety disorders. Psychiatry Research, 272, 756-764. https://doi.org/https://doi.org/10.1016/j.psychres.2018.12.171

Kroenke, K., Spitzer, R. L., Williams, J. B. W., & Löwe, B. (2010). The Patient Health Questionnaire Somatic, Anxiety, and Depressive Symptom Scales: a systematic review. General Hospital Psychiatry, 32(4), 345-359. https://doi.org/https://doi.org/10.1016/j.genhosppsych.2010.03.006

Laborde, S., Mosley, E., & Thayer, J. F. (2017). Heart Rate Variability and Cardiac Vagal Tone in Psychophysiological Research – Recommendations for Experiment Planning, Data Analysis, and Data Reporting [Review]. Frontiers in Psychology, Volume 8 - 2017. https://doi.org/10.3389/fpsyg.2017.00213

Lawrence, P. J., Murayama, K., & Creswell, C. (2019). Systematic Review and Meta-Analysis: Anxiety and Depressive Disorders in Offspring of Parents With Anxiety Disorders. Journal of the American Academy of Child & Adolescent Psychiatry, 58(1), 46-60. https://doi.org/10.1016/j.jaac.2018.07.898

Lewis-Morrarty, E., Degnan, K. A., Chronis-Tuscano, A., Rubin, K. H., Cheah, C. S., Pine, D. S., Henderon, H. A., & Fox, N. A. (2012). Maternal over-control moderates the association between early childhood behavioral inhibition and adolescent social anxiety symptoms. J Abnorm Child Psychol, 40(8), 1363-1373. https://doi.org/10.1007/s10802-012-9663-2

Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. Med Care, 46(3), 266-274. https://doi.org/10.1097/MLR.0b013e318160d093

Majdandžić, M., Möller, E. L., de Vente, W., Bögels, S. M., & van den Boom, D. C. (2014). Fathers' challenging parenting behavior prevents social anxiety development in their 4-year-old children: a longitudinal observational study. J Abnorm Child Psychol, 42(2), 301-310. https://doi.org/10.1007/s10802-013-9774-4

Malik, M. (1996). Heart rate variability: Standards of measurement, physiological interpretation, and clinical use: Task force of the European Society of Cardiology and the North American Society for Pacing and Electrophysiology. Annals of Noninvasive Electrocardiology, 1(2), 151-181.

Merikangas, K. R., He, J.-p., Burstein, M., Swanson, S. A., Avenevoli, S., Cui, L., Benjet, C., Georgiades, K., & Swendsen, J. (2010). Lifetime prevalence of mental disorders in US adolescents: results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). Journal of the American Academy of Child & Adolescent Psychiatry, 49(10), 980-989.

Möller, E. L., Majdandžić, M., & Bögels, S. M. (2015). Parental anxiety, parenting behavior, and infant anxiety: Differential associations for fathers and mothers. Journal of Child and Family Studies, 24, 2626-2637.

Möller, E. L., Nikolić, M., Majdandžić, M., & Bögels, S. M. (2016). Associations between maternal and paternal parenting behaviors, anxiety and its precursors in early childhood: A meta-analysis. Clin Psychol Rev, 45, 17-33. https://doi.org/10.1016/j.cpr.2016.03.002

Morgan, A. J., Rapee, R. M., & Bayer, J. K. (2016). Prevention and early intervention of anxiety problems in young children: A pilot evaluation of Cool Little Kids Online. Internet Interv, 4, 105-112. https://doi.org/10.1016/j.invent.2016.05.001

Mychailyszyn, M. P. (2017). “Cool” youth: A systematic review and comprehensive meta-analytic synthesis of data from the Cool Kids family of intervention programs. Canadian Psychology / Psychologie canadienne, 58(2), 105-115. https://doi.org/10.1037/cap0000101

Murray, L., Creswell, C., & Cooper, P. J. (2009). The development of anxiety disorders in childhood: an integrative review. Psychological medicine, 39(9), 1413-1423. https://doi.org/10.1017/S0033291709005157

Murray, L., De Rosnay, M., Pearson, J., Bergeron, C., Schofield, E., Royal-Lawson, M., & Cooper, P. J. (2008). Intergenerational transmission of social anxiety: The role of social referencing processes in infancy. Child development, 79(4), 1049-1064.

Nussinovitch, U., Elishkevitz, K. P., Katz, K., Nussinovitch, M., Segev, S., Volovitz, B., & Nussinovitch, N. (2011). Reliability of Ultra-Short ECG Indices for Heart Rate Variability. Ann Noninvasive Electrocardiol, 16(2), 117-122. https://doi.org/10.1111/j.1542-474X.2011.00417.x

Paulus, F. W., Ohmann, S., Möhler, E., Plener, P., & Popow, C. (2021). Emotional Dysregulation in Children and Adolescents With Psychiatric Disorders. A Narrative Review [Systematic Review]. Frontiers in Psychiatry, Volume 12 - 2021. https://doi.org/10.3389/fpsyt.2021.628252

Peltola, M. (2012). Role of editing of R-R intervals in the analysis of heart rate variability [Review]. Frontiers in Physiology, Volume 3 - 2012. https://doi.org/10.3389/fphys.2012.00148

Polanczyk, G. V., Salum, G. A., Sugaya, L. S., Caye, A., & Rohde, L. A. (2015). Annual research review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. Journal of child psychology and psychiatry, 56(3), 345-365.

Polderman, T. J., Benyamin, B., De Leeuw, C. A., Sullivan, P. F., Van Bochoven, A., Visscher, P. M., & Posthuma, D. (2015). Meta-analysis of the heritability of human traits based on fifty years of twin studies. Nature genetics, 47(7), 702-709.

Quintana, D. S., & Heathers, J. A. (2014). Considerations in the assessment of heart rate variability in biobehavioral research. Front Psychol, 5, 805. https://doi.org/10.3389/fpsyg.2014.00805

Sacco, R., Camilleri, N., Eberhardt, J., Umla-Runge, K., & Newbury-Birch, D. (2024). A systematic review and meta-analysis on the prevalence of mental disorders among children and adolescents in Europe. European Child & Adolescent Psychiatry, 33(9), 2877-2894.

Schniering, C. A., Hudson, J. L., & Rapee, R. M. (2000). Issues in the diagnosis and assessment of anxiety disorders in children and adolescents. Clinical Psychology Review, 20(4), 453-478.

Shaffer, F., & Ginsberg, J. P. (2017). An Overview of Heart Rate Variability Metrics and Norms [Review]. Frontiers in Public Health, 5. https://doi.org/10.3389/fpubh.2017.00258

Shaffer, F., McCraty, R., & Zerr, C. L. (2014). A healthy heart is not a metronome: an integrative review of the heart's anatomy and heart rate variability. Front Psychol, 5, 1040. https://doi.org/10.3389/fpsyg.2014.01040

Smiley, P. A., Partington, L. C., Cochran, C. R., & Borelli, J. L. (2020). Autonomy-restrictive socialization of anger: Associations with school-aged children's physiology, trait anxiety, state distress, and relationship closeness. Developmental Psychobiology, 62(8), 1134-1149. https://doi.org/https://doi.org/10.1002/dev.21975

Snijders, T. A., & Bosker, R. (2011). Multilevel analysis: An introduction to basic and advanced multilevel modeling.

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. Archives of Internal Medicine, 166(10), 1092-1097. https://doi.org/10.1001/archinte.166.10.1092

Thayer, J. F., Åhs, F., Fredrikson, M., Sollers III, J. J., & Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: implications for heart rate variability as a marker of stress and health. Neuroscience & Biobehavioral Reviews, 36(2), 747-756.

Thirlwall, K., & Creswell, C. (2010). The impact of maternal control on children's anxious cognitions, behaviours and affect: An experimental study. Behaviour research and therapy, 48(10), 1041-1046.

Thompson, R. A., & Lagattuta, K. H. (2006). Feeling and Understanding: Early Emotional Development. In Blackwell handbook of early childhood development. (pp. 317-337). Blackwell Publishing. https://doi.org/10.1002/9780470757703.ch16

van der Bruggen, C. O., Stams, G. J., & Bögels, S. M. (2008). Research review: the relation between child and parent anxiety and parental control: a meta-analytic review. J Child Psychol Psychiatry, 49(12), 1257-1269. https://doi.org/10.1111/j.1469-7610.2008.01898.x

Visted, E., Sørensen, L., Osnes, B., Svendsen, J. L., Binder, P.-E., & Schanche, E. (2017). The Association between Self-Reported Difficulties in Emotion Regulation and Heart Rate Variability: The Salient Role of Not Accepting Negative Emotions [Original Research]. Frontiers in Psychology, Volume 8 - 2017. https://doi.org/10.3389/fpsyg.2017.00328

Wheatcroft, R., & Creswell, C. (2007). Parents' cognitions and expectations about their pre-school children: The contribution of parental anxiety and child anxiety. British Journal of Developmental Psychology, 25(3), 435-441.

Appendix APRISMA checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title Chapter 2
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract Chapter 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Introductior
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Introductior section 1.2.3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Methods 1.3.2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Methods section 1.3.1
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Methods and Appendix A
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Methods section 1.3.3
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Methods section 1.3.4
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Methods sections 1.3.3, 1.3.4 & 1.3.6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Methods 1.3.4
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Methods section 1.3.6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Methods section 1.3.7
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Methods section 1.3.7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Methods section

Section and Topic	Item #	Checklist item	Location where item is reported
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METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Methods 1.3.2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Methods section 1.3.1
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Methods and Appendix A
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Methods section 1.3.3
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Methods section 1.3.4
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Methods sections 1.3.3, 1.3.4 & 1.3.6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Methods 1.3.4
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Methods section 1.3.6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Methods section 1.3.7
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Methods section 1.3.7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Methods section
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Results section 1.4.1 Table 1
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Results Section 1.4
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Results Section 1.4
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Results Section 1.4.5, Table 6
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Results section 1.4.4, figure 4
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Discussion section 1.5
	23b	Discuss any limitations of the evidence included in the review.	Discussion section 1.5.1
	23c	Discuss any limitations of the review processes used.	Discussion section 1.5.1
	23d	Discuss implications of the results for practice, policy, and future research.	Discussion section1.5.2
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Methods 1.3
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Methods 1.3
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Supplement 1

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ

Appendix BSearch terms

(mother or matern* or father or patern* or parent*)

AND

(child* or adolescen* or teen* or youth* or young or offspring or infan* or paediatric* or pediatric*)

AND

(anx* or phobi* or "child* anx*" or "adolescen* anx*" or "teen* anx*" or "youth anx*" or "offspring anx*" or "infan* anx*") or (“anxiety disorder” or “anxiety” or “anxiety diagnosis” or “social anxiety disorder” or “generalized* anxiety disorder” or generalised* anxiety disorder” or “separation anxiety disorder” or “specific phobia” or “social phobia” or "agoraphobia”)

AND

("mother anx*" or "matern* anx*" OR "father anx*" or "patern* anx*" or "parent* anx*") AND (“behavioral inhibition” OR “behavioural inhibition” OR “BI” OR “inhibited temperament” OR “fearful temperament”)

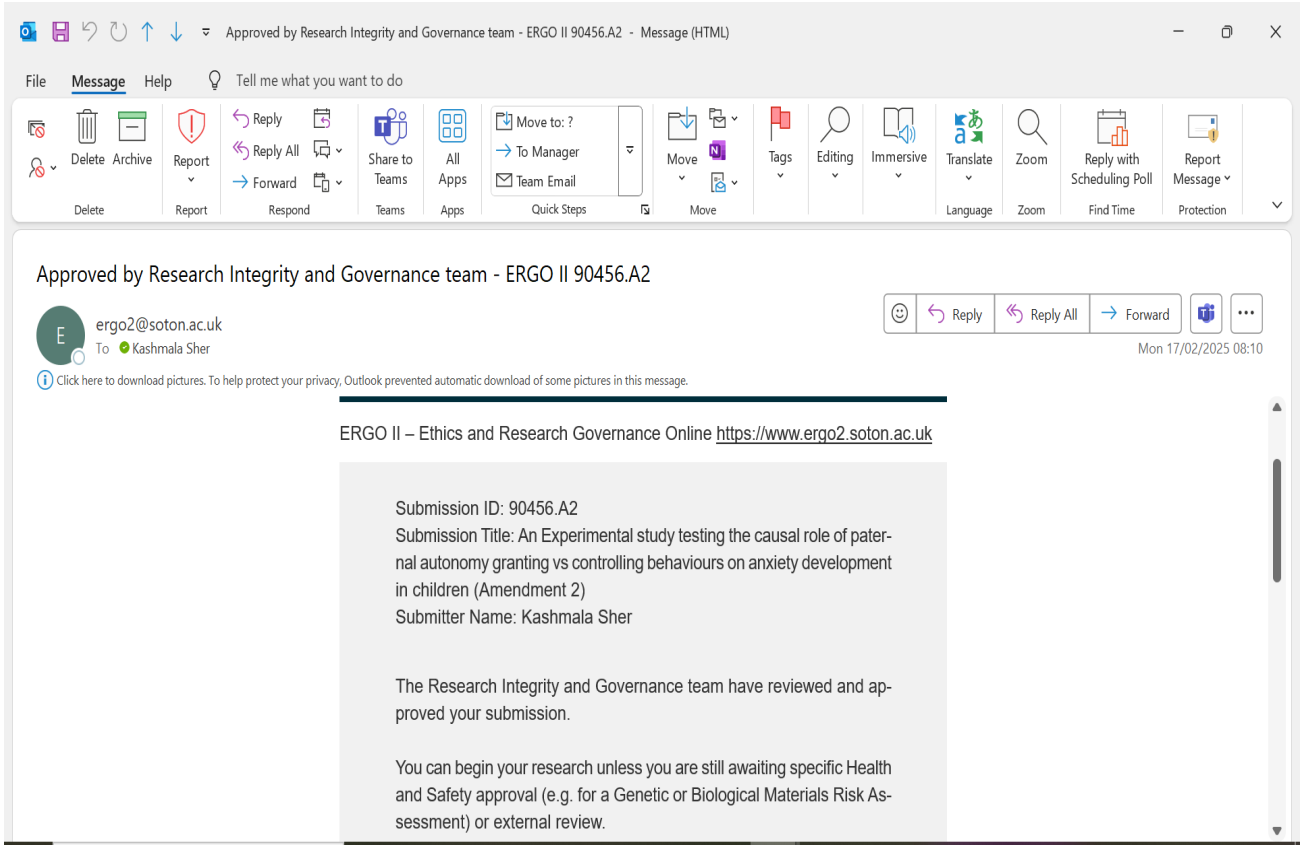
OR

("mother anx*" or "matern* anx*" OR "father anx*" or "patern* anx*" or "parent* anx*") AND (parenting or rearing or socializ* or socialis* or modelling or overcontrol or “over control” or autonomy or autonomous or “information transfer”)

OR

(“behavioral inhibition” OR “behavioural inhibition” OR “BI” OR “inhibited temperament” OR “fearful temperament”) AND (parenting or rearing or socializ* or socialis” or modelling or overcontrol or “over control” or autonomy or autonomous or “information transfer” or “verbal communication”)

Appendix C Ethics and Research Governance approval email



Appendix D Participant information sheet

Participant Information Sheet

Study Title: An Experimental study testing the causal role of paternal autonomy granting vs controlling behaviours on anxiety development in children.

Researcher: Dave Burniston, Kashmala Sher, Pete Lawrence, Tessel Bazzelman, Alessio Bellato

ERGO number: 90456. A2

You are being invited to take part in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done

and what it will involve. Please read the information below carefully and ask questions if anything is not clear or you would like more information before you decide to take part in this research. You may like to discuss it with others but it is up to you to decide whether or not to take part. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

The research is being conducted as part of our thesis project on the Doctorate in Clinical Psychology. The aim of the project is to investigate the impact parenting behaviours may have on anxiety development in their children.

Why have I been asked to participate?

You and your child are being invited to participate in this study because your child is in the eligible age-range and we are particularly interested in fathers.

What will happen to me if I take part?

If you express interest to take part in the study, then you can contact the researchers on the emails provided in the study advert. The researchers will then send a link to you to complete a set of questionnaires including demographic information. After this, a member of the research team will contact you to arrange a suitable time and date for the researchers to visit you in your home. The study will involve a mixture of activities including, filling in questionnaires, watching some videos, and for the child to prepare for and take part in brief talking tasks and reflecting on their performance after the talking tasks. During some of the activities, we will also ask your child to wear some sensors on their chest to measure their heart rate. This measure can give us extra information about the child's responses to the various movie clips and activities, which we would be unable to observe otherwise . The participants (father and child) will be video-taped using a digital camera during the activities. The reason for video-recording is to allow the researchers to view the recordings and conduct coding of the fathers' and children's observable behaviours of interest. Only the research team will have access to these recordings. The entire visit will take approximately 1 hour to complete.

Are there any benefits in my taking part?

You may benefit from participating because at the end you will learn about our specific research aims, as well as what researchers currently know about this area. You will also be told where to go for more information on this area of psychology. In addition, you will contribute to the present literature in the area of transmission of anxiety from parents to children. Families taking part in the study will receive £30 voucher for their participation and the children will receive certificates for completing the study. An additional £30 voucher will be provided to any

participants who have referred someone else to participate in the study, after their participation has been confirmed. By referring someone to the study, participants acknowledge that they are disclosing their own participation to the referrer. Additionally, if a referred individual decides to take part in the study, the referrer will likely be aware that the person they have referred has taken part in the study by receiving a voucher. Any participants seen prior to this amendment will be contacted and given the same opportunity to receive the additional referral voucher to ensure equity of opportunity.

Are there any risks involved?

There are no significant risks involved in this study beyond those you would encounter in everyday life. Although we have tried to ensure that the study does not cause distress some of the questions and activities may cause anxiety or mild distress, which is likely to be temporary. You may leave any questions blank that you would prefer not to answer or withdraw from the study at any point with no penalty.

What data will be collected?

Some demographic information such as age, gender, ethnicity will be collected by the research team and only research team directly involved in the study will have access to this. All this information collected about you and your child will be stored in a secure and locked office and on a password protected database. All research data will be stored separate from your personal data, using a unique code. Parts of the experiment recorded will be stored on password protected university computer and consent forms will be locked in a cabinet on campus at the University of Southampton.

Will my participation be confidential?

Your participation and the information we collect about you during the course of the research will be kept strictly confidential.

Only members of the research team and responsible members of the University of Southampton may be given access to data about you for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All of these people have a duty to keep your information, as a research participant, strictly confidential.

Electronic data such as video recordings will be stored on University of Southampton password protected secure encrypted server and will be deleted once the recordings has been coded. Only the research team will have access to these recordings.

Do I have to take part?

No, it is entirely up to you to decide whether or not to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part.

What happens if I change my mind?

You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights being affected. You can withdraw by talking to the researchers in the lab or simply emailing one of the researchers on the email address given below.

What will happen to the results of the research?

Your personal details will remain strictly confidential. Research findings made available in any reports or publications will not include information that can directly identify you without your specific consent.

Where can I get more information?

Please contact Kashmala Sher (trainee Clinical Psychologist), Dave Burniston (trainee Clinical Psychologist) at ks7g13@soton.ac.uk or if you have any questions or want to know more about the study.

What happens if there is a problem?

If you have a concern about any aspect of this study, you should speak to the researchers who will do their best to answer your questions.

If you remain unhappy or have a complaint about any aspect of this study, please contact the University of Southampton Head of Research Ethics and Clinical Governance (023 8059 5058, rgoinfo@soton.ac.uk).

Data Protection Privacy Notice

The University of Southampton conducts research to the highest standards of research integrity. As a publicly-funded organisation, the University has to ensure that it is in the public interest when we use personally-identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and

complete the research project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.

Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose.

For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for 10 years after the study has finished after which time any link between you and your information will be removed.

To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University's data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University's Data Protection Officer (data.protection@soton.ac.uk).

Thank you taking the time to read the information sheet and considering taking part in the research.

Appendix E Consent form

Study title: An Experimental study testing the causal role of paternal autonomy granting vs controlling behaviours on anxiety development in children

Researcher name: Dave Burniston, Kashmala Sher and Dr Pete Lawrence, Dr Tessel Bazzelman, Dr Alessio Bellato

ERGO number: 90456

Please initial the box(es) if you agree with the statement(s):

I have read and understood the information sheet (02.10 .2024 version 5) and have had the opportunity to ask questions about the study.

I agree for myself and my child to take part in this research project and agree for our data to be used for the purpose of this study.

I understand my participation and my child's participation is voluntary and both my child and myself may withdraw at any time for any reason without participation rights being affected.

I understand that myself and my child will be video and audio recorded, and that these recordings will viewed and coded by the researchers.

I understand that special category data (such as ethnicity and religion) will be collected as part of the study.

Name of participant (print name).....

Name of your child.....

Signature of participant (parent).....

Date.....

Name of researcher (print name).....

Signature of researcher .....

Date.....

Children's consent:

"We are asking you to tell us all about your favourite holiday and also about your family. We're going to ask you to spend a bit of time planning what you're going to say, and we want to know how you feel when you're doing it. For example, if you felt like you did really well or if you found it a bit scary to talk to us. We'll ask you a couple of questions about how you felt you did, and we'll also use these little stickers which will help to tell us how you're feeling. You do not have to do this if you don't want to, and you are allowed to stop at any time you like. If you do help us with this, you will be helping us to understand what helps us to be brave, and at the end of it we'll give you a small prize to say well done."

"Does it make sense what we're asking you to do?"

YES/NO

"Do you understand that you don't have to do it if you don't want to?"

YES/NO

"Do you want to do it?"

Appendix F Debrief form

Debriefing Form

Study Title: An Experimental study testing the causal role of paternal autonomy granting vs controlling behaviours on anxiety development in children.

Ethics/ERGO number: 90456

Researcher(s): Dave Burniston, Kashmala Sher, Pete Lawrence, Tessel Bazzelman, Alessio Bellato

University email(s): ks7g13@soton.ac.uk, dlb1e18@soton.ac.uk

Version and date: [V2, 25/06/2024]

Thank you for taking part in our research project. Your contribution is very valuable and greatly appreciated.

Purpose of the study

The aim of this research was to experimentally investigate the impact fathers' behaviours e.g., engaging in more controlling and less autonomy granting behaviours will have on a child's anxiety and to test whether this effect will be greater for children with higher trait anxiety than for children with low trait anxiety. Various studies have shown the role of mothers' parenting behaviours in anxiety development in children. However, very little attention has been given to the role of paternal behaviours and its impact on children anxiety. Therefore, to better understand the role parenting behaviours play in the development and maintenance of anxiety in children, it is important to study the role played by fathers in the transmission of anxiety from parent to child. Along with measuring children anxiety through questionnaires completed by parent and children, we also measured children's heart rate as research suggests that often physiological measure (e.g., heart rate) give us more objective ratings of anxiety.

Your data will help our understanding of transmission of anxiety from parents to children which will be important in the understanding of childhood anxiety development and maintenance as well as developing new and enhancing existing preventative programmes.

Please do not discuss this study, or show this debriefing form, to anyone until the study is complete, as this could affect the study results.

Now that you know the true purpose of our study and are fully informed, you may decide that you do not want your data to be used in this research. If you would like for your data to be removed from the study, please contact Kashmala Sher (trainee Clinical Psychologist), or Dave Burniston (trainee Clinical Psychologist) at ks7g13@soton.ac.uk or dlb1e18@soton.ac.uk

Confidentiality

Results of this study will not include your name or any other identifying characteristics.

Study results

If you would like to receive a copy of the summary of the research findings when it is completed, please let us know by using the contact details provided on this form.

Further support

We have tried to ensure that the questions and procedures in this study do not cause any distress. However, some activities may cause mild transient distress. Therefore, if taking part in this study has caused you discomfort or distress, you can contact the following organisations for support:

- UK participants: find a CBT therapist at www.bacp.org
- You can access free mental health support through your local NHS talking therapies
- Contact GP
- Referral to Mental health in schools teams

Further reading

If you would like to learn more about this area of research, you can refer to the following resources:

Möller, E. L., Nikolić, M., Majdandžić, M., & Bögels, S. M. (2016). Associations between maternal and paternal parenting behaviors, anxiety and its precursors in early childhood: A meta-analysis. Clinical Psychology Review, 45, 17-33.

Thirlwall, K., & Creswell, C. (2010). The impact of maternal control on children's anxious cognitions, behaviours and affect: An experimental study. Behaviour Research and Therapy, 48(10), 1041-1046

.Further information

If you have any concerns or questions about this study, please contact Kashmala Sher (trainee Clinical Psychologist) or Dave Burniston (trainee Clinical Psychologist) at ks7g13@soton.ac.uk, dlb1e18@soton.ac.uk who will do their best to help.

If you remain unhappy or would like to make a formal complaint, please contact the Head of Research Ethics and Governance, University of Southampton, by emailing: rgoinfo@soton.ac.uk, or calling: + 44 2380 595058. Please quote the Ethics/ERGO number which can be found at the top of this form. Please note that if you participated in an anonymous survey, by making a complaint, you might be no longer anonymous.

Thank you again for your participation in this research.

Appendix G Overprotection scale

The Overprotection Scale

0 = Not at all	1 = Sometimes	2 = Often	4 = Very much

1) I comfort my child immediately when he/she cries	1 2 3 4
2) When playing in a park, I keep my child within a close distance of me (ie within about 30m)	1 2 3 4
3) I protect my child from criticism	1 2 3 4
4) I give my child extra attention when he/she clings to me	1 2 3 4
5) I would not allow my child to go out with family friends if I were not present	1 2 3 4
6) I almost always take my child to the doctor if he/she is unwell	1 2 3 4
7) I keep a close watch on my child at all times	1 2 3 4
8) I tend to be over-protective of my child	1 2 3 4
9) I try to anticipate and avoid situations where my child might do something risky	1 2 3 4
10) I try to protect my child form making mistakes	1 2 3 4
11) I do not allow my child to climb trees	1 2 3 4
12) I shelter my child from life's difficulties	1 2 3 4
13) When away from home I tend to panic if my chid is out of my sight, even for a moment	1 2 3 4
14) I am reluctant for my child to play some sports for hear he/she might get hurt	1 2 3 4
15) I will only leave my child with close friends or relatives if I have to go out	1 2 3 4
16) I accompany my child on all outings	1 2 3 4
17) I shield my child from conflict	1 2 3 4
18) I do everything possible to protect my child from potential injury	1 2 3 4
19) I protect my child from his/her fears.	1 2 3 4

(Edwards et al., 2010)

Appendix H Anxiety related behaviour Questionnaire

1 = Not True	2 = Sometimes True	3 = Certainly True
1) Insists on doing something over and over so that It interferes with day to day life	1	2 3
2) Strongly refuses or resists sleeping alone	1	2 3
3) Has many fears, is easily scared	1	2 3
4) Fussy about keeping his/her hands clean	1	2 3
5) Often unhappy, down-hearted, tearful	1	2 3
6) Often complains of headaches, stomach aches or sickness	1	2 3
7) Fussy, over particular	1	2 3
8) Is often extremely upset or distressed when parent leaves	1	2 3
9) Is extremely afraid of day to day things, such as the dark, Water, animal, blood	1	2 3
10) Tends to be shy or timid	1	2 3
11) Cries easily	1	2 3
12) Takes a long time to warm to strangers	1	2 3
13) Independent, confident child	1	2 3
14) Asks for reassurance that he/she is ok	1	2 3

(Eley et al., 2003)

Appendix I Generalised Anxiety Disorder scale (GAD-7)

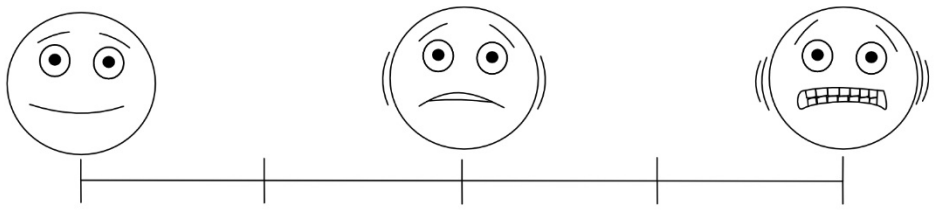
Over the last 2 weeks, how often have you been bothered by the following problems?	Not at all sure	Several days	Over half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

(GAD-7; Spitzer et al., 2006)

Appendix J Feelings Scale

Feeling scale
Please click on one of the options below to show how you are feeling about the talking task?

1 (not scared at all), 2 (a little bit), 3 (somewhat), 4, (quite scared) 5 (very scared)



Appendix K Performance Scale (prediction)

Performance Scale

‘How well do you think you will do in your speech compared to other children?

1 (a lot better), 2 (a little better), 3 (somewhat better), 4 (a little worse), 5 (a lot worse)

Appendix L Performance Scale (post-speech evaluation)

How well do you think you did compared to other children?’.

1 (a lot better), 2 (a little better), 3 (somewhat better), 4 (a little worse), 5 (a lot worse)

Appendix M Paternal control and autonomy granting coding scheme

	YES	NO
Parent offered frequent guidance and assistance.	1	0
Parent gave instructions and direction throughout the task	1	0
Parent spoke/drew/wrote on the paper whilst the child was drawing or taking time to think	1	0
Parent sat close to the child and touched the paper and crayons on occasion.	1	0
Parent was more involved that appeared necessary	1	0
Parent gave minimal guidance and assistance during the preparation period.	0	1
Parent allowed child to generate their own ideas and did not take over.	0	1
Parent complied with the child's own ideas,	0	1
Parent sat back on their chair, only leaning forward if/when child asked for help.	0	1
Parent only drew/wrote on paper if/when child asked for help.	0	1
Parent encouraged their child to try on their own if when child asked for help	0	1
If parent helped, parent checked with their child that they were doing what the child wanted.	0	1
	TOTAL:	

(Thirlwall & Creswell, 2010)

Appendix N Paternal negativity coding scheme

Negativity Rating

This is a measure of the extent to which the parent engaged in negative gestures during the preparation period.

Examples of negative gestures:

- Lack of reciprocity to child,
- Frowning as if to convey dissatisfaction or criticism,
- Laughing inappropriately in the face of the child's anxiety or attempts to do the task
- Verbal or physical behaviours that convey disagreement and criticism.

	Parent did **not engage in any negative gestures** during the preparation period	0
	Parent **momentarily gave one or two negative gestures** during the preparation period	1
	Parent **engaged in three or more negative gestures** during the preparation period	2
	Parent **engaged in negative gestures frequently (more than five)** throughout the preparation period	3

Appendix O R Code for meta-analysis

```
#multi-level MA on risk factors for anxiety

MA <- rma.mv(yi, vi, data= metafor_combindi, method= 'REML', slab = paste(study_ID), random = ~ 1 | study_ID/ES_ID, tdist = TRUE)

summary(MA)


#create a forest plot and save it in your computer

bmp(file="forest_MA.bmp", width = 500, height = 700)

forest(MA, slab = (metafor_combindi $study_ID), xlab = "yi", refline = 0, header = TRUE)

dev.off()


#[publication bias] Rank correlation Test for Funnel Plot Asymmetry

ranktest(MA)


#create a funnel plot and save it in our computer

bmp(file="funnel_MA.bmp", width = 500, height = 500)

funnel (MA)

dev.off()


# Now install dmetar from GitHub

install_github("MathiasHarrer/dmetar")


# Load the package

library(dmetar)
```

```
i2 <- var.comp(MA)

summary(i2)


removed <- rma.mv(yi, vi, data= metafor_combindi, method= 'REML', slab = paste(study_ID), random = ~ 1 | study_ID/ES_ID, tdist = TRUE, sigma2 = c(0, NA))

summary(removed)


anova(MA, removed)


#multi-level MA on risk factors for anxiety

MA <- rma.mv(yi, vi, data= metafor_combindi, method= 'REML', slab = paste(study_ID), random = ~ 1 | study_ID/ES_ID, tdist = TRUE)

summary(MA)


mod.model <- rma.mv(yi, vi, data= metafor_combindi, method= 'REML', slab = paste(study_ID), random = ~ 1 | study_ID/ES_ID, tdist = TRUE, mods = ~ IorC)

summary(mod.model)


#multi-level MA on risk factors for anxiety

MA <- rma.mv(yi, vi, data= metafor_combindi, method= 'REML', slab = paste(study_ID), random = ~ 1 | study_ID/ES_ID, tdist = TRUE)

summary(MA)


MA1 <- rma.mv(yi, vi, mods = ~ factor (IorC), data= metafor_combindi, method= 'REML', slab = paste(study_ID), random = ~ 1 | study_ID/ES_ID, tdist = TRUE)

summary(MA1)
```