

**Exploring how Attachment and Caregiving Discourse relate to
Caregivers' Physiological Regulation of Arousal in both Adoptive and
Biological Parent-Child Relationships**

Georgia Monk

20001036

Submitted to the University of Hertfordshire in partial fulfilment of the requirements of
the degree

of Doctor of Clinical Psychology

02/08/2025

Wordcount: (maximum 29,079)

(Excluding: acknowledgments, abstract, tables, figures, references, and appendices)

Author's Declaration

I declare that the work presented in this thesis, titled "*Exploring how Attachment and Caregiving Discourse relate to Caregivers' Physiological Regulation of Arousal in both Adoptive and Biological Parent-Child Relationships*", is my own original work and has not been submitted, either in the same or different form, for any other academic award.

This thesis includes both a systematic literature review and an empirical study, submitted in partial fulfilment of the requirements for the degree of Doctorate in Clinical Psychology at the University of Hertfordshire, and has been prepared in accordance with the University's regulations.

All sources of information have been acknowledged by means of references. Any work conducted collaboratively is clearly indicated within the thesis, and my individual contribution is made explicit.

Signed: 

Full Name: Georgia Monk

Date: August 2025

Acknowledgements

I would like to express my gratitude to my research supervisors, Ben Grey and Eadaoin Bhreathnach, for their dedicated support throughout this project. Your expertise, encouragement, and generosity with your time made it easy to seek guidance, and this project would not have been possible without you both.

My sincere thanks also go to Claire Ginty for facilitating recruitment, providing an interview space, and enabling this research to take place within such a meaningful area of practice, all while managing a busy schedule.

Thank you to the Meaning of the Child coders for your time, care, and thoughtfulness in engaging with the data so deeply.

I am especially grateful to my partner and my family, particularly my dad, for always believing in me, patiently listening to my stresses, and being my biggest supporters. Knowing you'll be there when I finish has made all the difference.

To my fellow doctorate friends, especially Yoni, thank you for getting me through these past three years, even when it was really tough. I would not be here without you all.

Finally, to the parents who participated in this study: thank you for your openness and generosity. Your contributions have been invaluable, and I hope this work will go on to inform interventions that support other families facing similar challenges.

Statement of Contributions

This empirical study was conducted alongside a related research project titled “*Understanding how parental caregiving is related to child attachment in adoptive and normative relationships*”, which shared ethics and recruitment processes.

The current project was supervised by Ben Grey and Eadaoin Bhreathnach, who provided conceptual guidance, foundational training in the Meaning of the Child (MotC) and Sensory Attachment Intervention (SAI) methods, and ongoing support with the interpretation of findings. Eadaoin also completed all SAI coding.

All attachment interviews were conducted by the primary researcher. Transcription of the MotC interviews was shared between the researcher and a fellow doctoral colleague (Florence Yeung), with each transcribing half the dataset. MotC coding was completed by trained external coders. The present study represents a secondary analysis of these coded interviews, undertaken by the primary researcher. This analysis involved detailed review of interview recordings, transcripts, and codings to examine points of convergence and divergence between narrative and physiological data.

Claire Ginty supported participant recruitment and facilitated access to the clinical setting. All data analysis, integration, interpretation, and write-up were carried out by the primary researcher. The findings will be prepared for submission to a peer-reviewed journal as a co-authored publication with the research team.

This study is submitted alongside a systematic literature review, authored independently by the primary researcher with guidance from Ben Grey, which forms the first part of this thesis.

Table of Contents

Table of Contents

Author's Declaration	3
Acknowledgements	4
Statement of Contributions	5
Table of Contents	6
List of Figures.....	7
List of Tables	8
List of Appendices	9
Glossary of Terminology	10
Abstract: Systematic Literature Review	13
Abstract: Empirical Study	14
Introduction.....	15
Part 1: SLR Introduction	15
Part 2: Empirical Study Introduction	21
Systematic Literature Review.....	29
Method	29
Results.....	34
Discussion	65
Conclusion	78
Empirical Study.....	79
Method	79
Results.....	93
Discussion	130
Conclusion	151
Integrated SLR and empirical findings	153
References	155
Appendices	168

List of Figures

<u>Figure 1. DMM of Attachment</u>	<u>23</u>
<u>Figure 2. PRISMA Diagram</u>	<u>35</u>

List of Tables

<u>Table 1. Inclusion/Exclusion Criteria</u>	<u>31</u>
<u>Table 2. Study Characteristics.....</u>	<u>38</u>
<u>Table 3. Quality Appraisal Summary</u>	<u>45</u>
<u>Table 4. ANS Study Results</u>	<u>49</u>
<u>Table 5. Hormonal Study Results.....</u>	<u>56</u>
<u>Table 6. Neural Study Results</u>	<u>59</u>
<u>Table 7. McLeod's Steps</u>	<u>80</u>
<u>Table 8. Results Summary</u>	<u>95</u>
<u>Table 9. Participant Demographics</u>	<u>100</u>
<u>Table 10. Cross-Case Analysis</u>	<u>123</u>

List of Appendices

<u>Appendix A. Full SLR Search Strings</u>	<u>168</u>
<u>Appendix B. JBI Critical Appraisal Tools.....</u>	<u>169</u>
<u>Appendix C. Ethical Approval</u>	<u>172</u>
<u>Appendix D. Participant Information Sheet</u>	<u>174</u>
<u>Appendix E. Participant Consent Form.....</u>	<u>178</u>
<u>Appendix F. Coded MotC Example</u>	<u>180</u>
<u>Appendix G. Coded SAI Example</u>	<u>182</u>
<u>Appendix H. MotC Classification Definitions</u>	<u>184</u>
<u>Appendix I. Supplementary Interview Quotes</u>	<u>186</u>
<u>Appendix J. Development of Cross-Cases Analysis.....</u>	<u>201</u>
<u>Appendix K. Reflective Journal Extract.....</u>	<u>202</u>
<u>Appendix L. Dissemination of Findings.....</u>	<u>204</u>

Glossary of Terminology

AAP: *Adult Attachment Projective Picture System*, a narrative-based assessment used to evaluate adult attachment representations.

AAI: *Adult Attachment Interview*, a semi-structured interview designed to assess an adult's internal working model of attachment.

ANS: *Autonomic Nervous System*, the part of the nervous system responsible for automatic bodily functions, including heart rate and digestion. It comprises the sympathetic and parasympathetic branches.

Attachment: The emotional bond formed between a child and caregiver, influencing the child's development and future relationships.

Attachment classifications:

- **Type A:** *Avoidant*. Child minimises attachment needs.
- **Type B:** *Secure*. Child uses caregiver as a secure base (i.e., is comfortable going to them for support as well as exploring independence).
- **Type C:** *Anxious/ambivalent*. Child exaggerates attachment behaviours to maintain caregiver attention.
- **Disorganised:** *Unresolved*. Lacks a consistent attachment strategy often linked to fear or trauma.
- **Insecure attachment:** Broad category including avoidant, anxious, and disorganised attachment.
- **Organised attachment:** Refers to secure, avoidant, or anxious strategies where there is a coherent pattern of attachment behaviour.

Attunement: Caregiver's ability to accurately perceive, interpret, and respond to a child's emotional and physiological states in a timely and appropriate way. It underpins emotional connection and co-regulation.

Caregiver: An adult (usually a parent) who provides care and emotional support to a child.

Child-led: A caregiving approach where the child leads interaction and parenting is passive. In the MotC, this is often associated with unresponsive strategies.

Co-regulation: The process by which caregivers and children mutually regulate each other's emotional and physiological states through interaction.

Controlling: A *parent-led* MotC strategy where the caregiver manages the interaction through directiveness or withdrawal.

Controlling-withdrawal: A subtype of controlling MotC strategy where the caregiver controls by emotional disengagement rather than overt direction. (*See Appendix F for further detail.*)

Cortisol: A hormone released in response to stress, often measured in attachment research.

DMM: Dynamic Maturational Model of attachment.

Dyads: Pairs of individuals in a close relationship; here, typically refers to parent-child pairs.

EBE: *Expert by Experience*, a person with lived experience relevant to the study who contributes to research design or interpretation.

ECG: *Electrocardiogram*, a measure of electrical activity in the heart.

EEG: *Electroencephalography*, a technique to measure brain activity via scalp electrodes.

ERP: *Event-Related Potentials*, brain responses to specific stimuli measured through EEG.

fMRI: *Functional Magnetic Resonance Imaging*, a technique that measures brain activity by detecting changes in blood flow.

HR: *Heart Rate*, often used as an indicator of physiological arousal.

IWM: *Internal Working Model*. A mental representation of self and others formed through early attachment experiences.

Mentalisation: The ability to make sense of behaviour in oneself and others by attributing it to underlying mental states (e.g., beliefs, emotions, desires).

MotC: *Meaning of the Child Interview*, an assessment tool that examines a caregiver's relational patterns and internal representations of their child.

Organised attachment: See *Attachment classifications*.

Oxytocin: A hormone associated with bonding and caregiving behaviour.

Parent-led: A broad term that describes controlling MotC strategies where the caregiver guides or structures the interaction.

PDI: *Parent Development Interview*, a semi-structured interview assessing parental attachment.

Physiology: In this context, refers to bodily indicators of arousal and regulation (e.g., heart rate, clenched fists), used to understand emotion regulation in caregiving.

PNS: *Parasympathetic Nervous System*, part of the ANS involved in calming and restorative processes (e.g., slowing heart rate).

PVT: Polyvagal Theory, a theory linking autonomic regulation to social behaviour. (Not explained here due to complexity, see SLR Introduction.)

Reflective Functioning: The capacity to understand and interpret one's own and others' behaviour as rooted in underlying mental states such as thoughts, feelings, desires, or intentions. Closely linked to the concept of mentalisation and considered central to sensitive caregiving.

RSA: *Respiratory Sinus Arrhythmia*, a measure of parasympathetic nervous system function via heart rate variability with breathing.

SAI: *Sensory Attachment Intervention*, a coding system for identifying caregivers' physiological regulation during interview.

SBSK: *Secure Base Script Knowledge*, cognitive understanding of secure caregiving interactions.

SCL: *Skin Conductance Level*, a physiological measure of arousal through sweat gland activity.

Secure attachment: See Type B under Attachment classifications.

Sensitive: A MotC caregiving strategy characterised by emotional attunement, responsiveness, and warmth.

Sensitive-controlling: A mixed MotC strategy where the caregiver shows sensitivity alongside some directive or controlling behaviours. (*See Appendix F for more detail.*)

Sensitive-unresponsive: A mixed MotC strategy reflecting elements of both warmth and emotional distancing. (*See Appendix F for more detail.*)

SLR: *Systematic Literature Review*, a structured method of reviewing and synthesising research evidence on a given topic.

SFP: *Still Face Paradigm*, an observational procedure examining infant responses to caregiver non-responsiveness.

sAA: *Salivary Alpha-Amylase*, a biomarker of sympathetic nervous system activation.

SNS: *Sympathetic Nervous System*, part of the ANS associated with the body's stress response (e.g., increasing heart rate).

SSP: *Strange Situation Procedure*, a structured observational assessment of infant-caregiver attachment.

Synchrony: The reciprocal and coordinated interaction between caregiver and child, often involving matched rhythms of behaviour or emotion.

Abstract: Systematic Literature Review

Attachment theory increasingly recognises the role of physiological processes in shaping parent-child relationships. This systematic review robustly synthesised empirical studies examining how parental physiology relates to attachment in parent-child dyads, excluding studies based on self-report. A comprehensive literature search of 2,552 papers was conducted across Scopus, PubMed, and PsycArticles, identifying 11 eligible studies published between 1990 and 2025. All studies were quantitative: five experimental, six observational, one pre-test-post-test, and one longitudinal with experimental components. Studies were generally of good quality, assessed using Joanna Briggs Institute (JBI) critical appraisal tools. The review followed narrative synthesis guidance by Popay et al. (2006) and PRISMA guidelines.

Findings suggested secure parental attachment is broadly associated with greater physiological flexibility and regulation, while insecure attachment reflects distinct patterns of dysregulation. Avoidant attachment was most frequently studied, with anxious and disorganised patterns underrepresented. Most studies focused on autonomic nervous system (ANS) indices, particularly respiratory sinus arrhythmia (RSA), with fewer examining hormonal, neural, or alternative physiological indices. Emerging evidence suggested parental physiological regulation may influence caregiving behaviours and contribute to intergenerational transmission of attachment patterns. These findings support theoretical models positioning attachment as an embodied, neurobiological process.

However, significant heterogeneity in methodology limited comparability across studies. Sample sizes were often small, with fathers or diverse populations rarely included. Despite these limitations, the review highlights the value of integrating physiological and attachment constructs into assessments.

Future research should standardise physiological protocols, broaden the range of systems studied beyond the ANS, and incorporate qualitative approaches to deepen understanding of underlying processes. Greater inclusion of underrepresented attachment styles, diverse populations and caregiving contexts is needed. The review highlights the potential of physiological insights to inform clinical interventions, particularly for dyads affected by trauma or co-regulation difficulties.

Abstract: Empirical Study

Embodied models of attachment suggest physiological processes play a key role in shaping caregiving relationships, yet few studies have explored how these systems interact, particularly in adoptive contexts. This qualitative multiple case study examined whether and how caregivers' attachment narratives align with their physiological regulation during attachment interviews, across both adoptive and biological parent-child relationships. Eight caregivers took part in video-recorded interviews, which were coded using the Meaning of the Child (MotC) to assess attachment discourse and the Sensory Attachment Intervention (SAI) to identify subtle behavioural indicators of physiological regulation. Cross-case and within-case analyses were conducted using McLeod's (2010) theory-building framework.

Most cases demonstrated strong coherence between narrative and physiological regulation, providing support for embodied models of caregiving. However, several nuanced patterns emerged, including mismatches between discourse and physiology, different patterns for biological and adoptive caregivers, low-arousal sensitivity, effortful regulation, and physiological collapse under strain. These findings suggest caregiver regulation is dynamic and context-sensitive, rather than fixed. Adoptive caregivers generally showed more pronounced attachment or physiology patterns, potentially reflecting the complex relational and psychological demands of adoptive parenting. Notably, some sensitive caregiving emerged from low-arousal states, indicating that sensitivity can arise through top-down regulation, reflective capacity, and relational support, even from less "ideal" physiological baselines.

These findings extend embodied theories of attachment by showing narrative-physiology coherence is shaped by history, context, and relational scaffolding. Clinical implications include supporting caregiver regulation through body-based attachment interventions, particularly relevant for adoptive caregivers or those facing trauma or heightened relational stress. Future research could triangulate behavioural and biometric data, adopt longitudinal designs, and explore generalisability to diverse caregiving contexts such as foster families or neurodiverse populations.

Introduction

Overview

This chapter provides an integrated introduction to both the systematic literature review (SLR) and the empirical study. Part one introduces the broader theoretical and empirical context that underpins the SLR, including an overview of attachment theory and its relevance to physiological processes. Part two narrows in on relevant aspects for the empirical study, including the Dynamic Maturation Model (DMM) of attachment, sensory processing, and adoptive contexts.

Part 1: SLR Introduction

Attachment Theory

Attachment refers to an evolutionarily embedded system that supports infant survival by maintaining proximity to caregivers in times of need (Bowlby, 1969). In other words, it is a strategy or pattern of eliciting necessary protection and nurture in key relationships (Crittenden, 2008). These components underpin a broader understanding of attachment, not merely as a behavioural style, but as a dynamic, adaptive system.

How a caregiver responds to a child's bids for attention, and early childhood experiences, can shape their emotional and social development, providing a foundation, what Bowlby termed an internal working model (IWM), for how they relate to others later in life (Bowlby, 1969). IWMs are internalised templates of relational experience, encompassing cognitive representations and physiological regulation patterns, which guide an individual's emotional responses, behaviours, and interpretations in close relationships (Bretherton, 1990). In this way, parental attachment patterns can influence their children's, with the theory being that secure attachment enables individuals to form healthier and more attuned relationships with others. Ainsworth developed this further by identifying and categorising secure and insecure patterns of attachment (Ainsworth et al., 1978), later extended to include a fourth, disorganised pattern (Main & Solomon, 1990), which is commonly known as the ABC+D model of attachment. These categories are secure, avoidant, anxious, and

disorganised, and have formed the basis of how attachment is understood within the literature.

However, Bowlby's positioned his theory as not solely relational in nature, but also grounded in biology. Attachment is an *evolutionarily* system in which both infants and caregivers are biologically primed to maintain close bonds to survive. Crittenden expanded this by defining attachment as involving both "mental and physiological processing" (Crittenden, 2008). Despite these origins, much of the literature has focused predominantly on behavioural, narrative, or representational constructs of attachment, with limited attention to the body's physiological systems, such as arousal, stress regulation, or sensory processing.

For instance, widely used attachment assessment tools such as the Strange Situation Procedure (SSP) (Ainsworth et al., 1978) and the Adult Attachment Interview (AAI) (George et al., 1996), though valuable, have traditionally privileged observable behaviour or narrative coherence. Whilst the SSP, which is video-based, does examine embodied responses, this has typically been interpreted within an interpersonal framework. The AAI, in contrast, shifted the analytic focus to discourse, which, although rich in meaning, largely neglects how physiological arousal may underlie attachment strategies (although the way someone speaks about their key attachments may still carry traces of arousal and regulation capacity, an idea explored further in the empirical study).

In recent years, interest has grown in exploring the physiological correlates of attachment. Studies have begun to show a relationship between attachment and bodily systems such as the autonomic nervous system (ANS) and neural activity (Comte et al., 2024; Schneider et al., 2022). For instance, activation of specific brain regions or fight-or-flight responses in response to relational triggers, may offer insight into the attachment system. Such research positions attachment not only as a behavioural system but as a relationally embedded physiological process. This opens new doors for understanding how parents regulate themselves and how this, in turn, may shape the attachment bond, particularly during emotionally charged relational interactions.

Physiology: The Mind and Body

Recent research suggests that examining biological markers such as respiratory sinus arrhythmia (RSA), or cortisol, may help build a clearer picture of the physiological processes underlying attachment (Jaremka et al., 2013; Qu et al., 2018). A traditional framework for understanding stress physiology emphasises the role of the ANS, which regulates internal bodily states in response to environment (Berntson et al., 1993). This system is conceptualised as comprising of two opposing branches: the sympathetic nervous system (SNS), which supports mobilisation ('fight-or-flight') responses, and the parasympathetic nervous system (PNS), which facilitates calm, restorative functions (Carlson, 2007). These branches operate in a reciprocal manner, with the activation of one suppressing the other, with the idea being that balance between systems equates to better physiological regulation (Berntson et al., 1993; Gunnar et al., 2007).

However, Polyvagal Theory (PVT) expands this binary view by introducing a more nuanced model of the vagus nerve, the primary component of the PNS (Porges, 2007). Porges argued that the traditional two-branch model is insufficient to explain the complexity of social behaviours, particularly those relevant to attachment, such as facial expression or eye contact. Instead, he proposed that the PNS is composed of two distinct circuits, resulting in three hierarchically organised neural pathways. These include: the ventral vagal complex (part of the PNS), which supports social engagement behaviours; the SNS, which facilitates defensive mobilisation (e.g., fight or flight); and the dorsal vagal complex (part of the PNS), associated with immobilisation or shutdown responses. These systems are activated in response to environmental cues, depending on whether cues are unconsciously interpreted as safe or threatening. While the social engagement system supports connection through cues like gentle eye contact, the mobilisation system may trigger heightened arousal or withdrawal, and the immobilisation system may lead to collapse, freeze, or dissociation. In attachment relationships, such physiological states may interfere with a caregiver's ability to respond with emotional attunement (emotional sensitivity to others' needs), even when there is a strong desire to connect.

Despite its widespread influence, it is worth noting PVT has faced critique. Researchers have questioned the empirical basis for distinguishing between vagal pathways, as well as the evolutionary claims, which remain difficult to test (Grossman et al., 2007). There are concerns about its strength of supporting physiological evidence (Grossman, 2023).

Further empirical validation is needed to clarify its utility. Nevertheless, PVT offers a compelling framework for understanding social behaviour in attachment research.

Schore's (2001) theory on affect regulation and right-brain development offers a complementary view. Schore states an infant's right brain hemisphere, which is dominant during the first years of life, is deeply involved in processing emotional cues and managing stress. Through a process referred to as affect "synchrony", Schore argues parental physiology shapes the development of infant physiology. For instance, if a parent displays soft gaze and a calm vocal tone, this helps parents and infants "co-regulate", organising the infant's stress response system so that they too can regulate during periods of distress. This theory has been supported by findings looking at synchrony between parent and infant behaviour, physiology, and neural activity (Feldman, 2007).

Broader biosocial theories also reinforce the notion that physiological and relational systems are deeply intertwined. For example, ecological systems theory emphasises the interaction between biological dispositions and relational environments (Bronfenbrenner, 1979), while Sameroff's transactional model (2009) highlights the bidirectional influence between a child's biology and their caregiving context. Similarly, Cicchetti and Valentino (2015) argue that early relational trauma can shape the development of physiological stress systems, supporting the view that attachment is both biologically and socially grounded. These perspectives strengthen the rationale for studying attachment through a psychobiological lens.

Together, these theories support the view that attachment is not merely cognitive or relational, but a fundamentally embodied process. By failing to consider the body, previous research may have overlooked a vital dimension of attachment. Integrating physiological data allows researchers to more fully capture attachment dynamics. Nonetheless, key gaps remain.

Existing Literature & Gaps

In recent years, more attention has been paid to the attachment-physiology relationship within the literature (Gander et al., 2015). Much of this research has focused on romantic relationships, non-parent adults, or child physiology. For instance, studies looking at

romantic relationships have found attachment differences in how couples physiologically respond to conflict, as well as evidence to suggest partner presence can reduce physiological stress and facilitate co-regulation (Beck et al., 2023; Bourassa et al., 2019; Diamond et al., 2008; Feeney et al., 1996; Helm et al., 2014; Powers et al., 2006). Studies looking at children's physiology have demonstrated a mediating relationship between attachment patterns and physiology, with those classified as secure showing greater physiological regulation and protection from stress (Borelli et al., 2023; Gilissen et al., 2008; Movahed Abtahi et al., 2017; Paret et al., 2015; Qu et al., 2018; Smeekens et al., 2010; vanBakel et al., 2004). Other studies have found similar findings in teenagers or adult non-parents (Baskak et al., 2020; Gander et al., 2022; Niermann et al., 2015; Petrowski et al., 2017).

Although evidence of embodied attachment is growing, limited research has focused specifically on parental physiology. Yet Bowlby's theory of IWMs, physiology and biosocial theories, such as PVT and Schore's emphasis on co-regulation, all support the idea that parents' physiological states play a central role in shaping attachment. Thus, to ignore the role of parents is to ignore a significant contributor when thinking about this process in parent-child relationships.

Additionally, a noteworthy proportion of literature has used self-report measures of attachment (Domin-Siede et al., 2024; Maunder et al., 2006; Pruitt et al., 2020). Whilst self-report tools are easy to administer and can highlight general tendencies, they lack depth and may not access the implicit processes that shape attachment (Crowell et al., 1999). Given that attachment is often shaped by unconscious dynamics (Bakermans-Kranenburg et al., 2009), relying solely on self-report risks overlooking key relational patterns. By contrast, discourse-based or observational methods, such as clinical interviews or live interactions, assess how individuals regulate affect and physiological state in real time. These approaches are better suited to detecting embodied regulatory patterns, including narrative coherence, vocal tone, nonverbal behaviour, or cues that reflect interoception and autonomic activity (Crittenden et al., 2011). Therefore, this review focused not only on parental physiology, but also on the use of validated, non-self-report attachment measures, which may more accurately capture underlying dynamics.

This review has important implications for clinical practice, developmental psychology, and parenting support. By synthesising literature on how parental physiology may influence attachment, this review contributes to a more integrated view of attachment

that extends beyond narrative-based frameworks. These insights may inform future research directions and support the development of body-based interventions for families.

Current Review

To our knowledge, there has been no attempt to robustly review literature looking specifically at parental physiology in relation to attachment. This SLR seeks to address this gap. The researcher aims to synthesise empirical studies published from 1990 which examine parental physiological arousal and attachment, using non-self-report measures. The decision to include studies post 1990 was made to reflect modern attachment and physiology measures. This review aims to use narrative synthesis to understand more about embodied attachment in parents, robustly appraising literature using quality appraisal tools and adhering to PRISMA guidelines (Page, 2021). It is guided by the following question: *How is parental physiological arousal associated with attachment in parent-child relationships?*

Although focusing on parental physiology, both parental and child attachment classifications were included. This is because attachment in caregiving contexts is inherently relational, and examining child attachment in relation to parental physiology can still offer meaningful insight into the embodied dynamics of the parent-child relationship. However, as the physiological component of attachment remains underexplored, particularly in parents, studies measuring only child physiology were excluded to maintain a clear focus on the unique contributions of parental bodily processes.

This review is also informed by the theoretical proposition that attachment is embodied through distinct physiology patterns. Drawing on assumptions from embodied attachment theories (e.g., Polyvagal Theory, Schore's affect regulation model) and findings from related literature, secure attachment is expected to be associated with greater physiological flexibility and regulation, supporting sensitive caregiving, while insecure attachment may involve difficulties in regulating or co-regulating.

Part 2: Empirical Study Introduction

The preceding SLR introduction laid out a theoretical foundation for understanding attachment as a fundamentally embodied process, focusing on parental physiology within parent-child relationships. To extend this, the empirical study presented in the second half of this thesis builds on these conceptual foundations. It narrows the focus of the broader review and offers a more detailed exploration of how attachment strategies, caregiving discourse, and physiological arousal regulation intersect within both biological and adoptive caregiver relationships. This context is especially important given the increased likelihood of attachment trauma histories and relational complexity in adoptive families.

The study also develops the methodological approach used by drawing on discourse- and observation-based tools. Specifically, it utilises the Meaning of the Child (MotC) interview (Grey et al., 2017), grounded in the Dynamic-Maturational Model (DMM) of attachment (Crittenden, 2008), and the Sensory Attachment Intervention (SAI) (Bhreathnach, 2025) which offers a structured framework for observing caregivers' physiological regulation during attachment-related discourse. Together, these tools enable a novel and more in-depth qualitative understanding of embodied attachment across both biological and adoptive contexts.

The following introduction section will outline the DMM framework, sensory processing theory, and the adoptive caregiving literature, before setting out specific aims and rationale for the empirical study.

Attachment Theories: DMM Model

The ABC+D model of attachment, also known as the Berkeley model, conceptualises attachment behaviours into four patterns: A (avoidant), B (secure), C (ambivalent), and D (disorganised). These patterns are seen as adaptive responses to the caregiving environment, except for the disorganised category, which represents a breakdown in strategy and is not typically considered “functional” (Main & Solomon, 1990). This model has informed much of the attachment literature to date and underpins several widely used assessment tools, including the AAI, originally coded using the Main and Goldwyn system, based on the Berkeley model (Main et al., 2002).

However, the Berkeley model has been critiqued for being overly categorical and for lacking developmental nuance (Solomon et al., 2011). Notably, there has been a shift away from viewing disorganised attachment as a fixed classification, toward understanding these apparently contradictory behaviours as context-specific breakdowns in strategy, rather than enduring traits (Granqvist et al., 2017).

The DMM of attachment, developed by Crittenden (2008), builds on and extends these foundational ideas. It reconceptualises attachment not only as a system for seeking comfort but also as one that functions to protect the self from perceived danger. From a DMM perspective, avoidant (A) and ambivalent, or anxious (C), strategies are not single, uniform types. Rather, they represent a range of possible patterns that vary in complexity depending on developmental and relational context.

Unlike the Berkeley model, the DMM does not include a disorganised category. Instead, it interprets behaviours typically labelled as “disorganised” as coherent, albeit complex, self-protective strategies, developed in response to overwhelming or conflicting cues from caregivers. This offers a more dimensional and clinically meaningful lens for understanding attachment, especially in high-risk or trauma-exposed populations.

Please see the diagram below for a visual representation of the DMM model (Figure 1). Attachment strategies are mapped along two interconnected continuums: avoidant (A) and anxious (C), with secure (B) strategies positioned at the top of the wheel. As strategies become more complex, they move down each side of the wheel. This structure reflects the DMM’s view that even seemingly contradictory behaviours can be understood as adaptive efforts to manage relational danger:

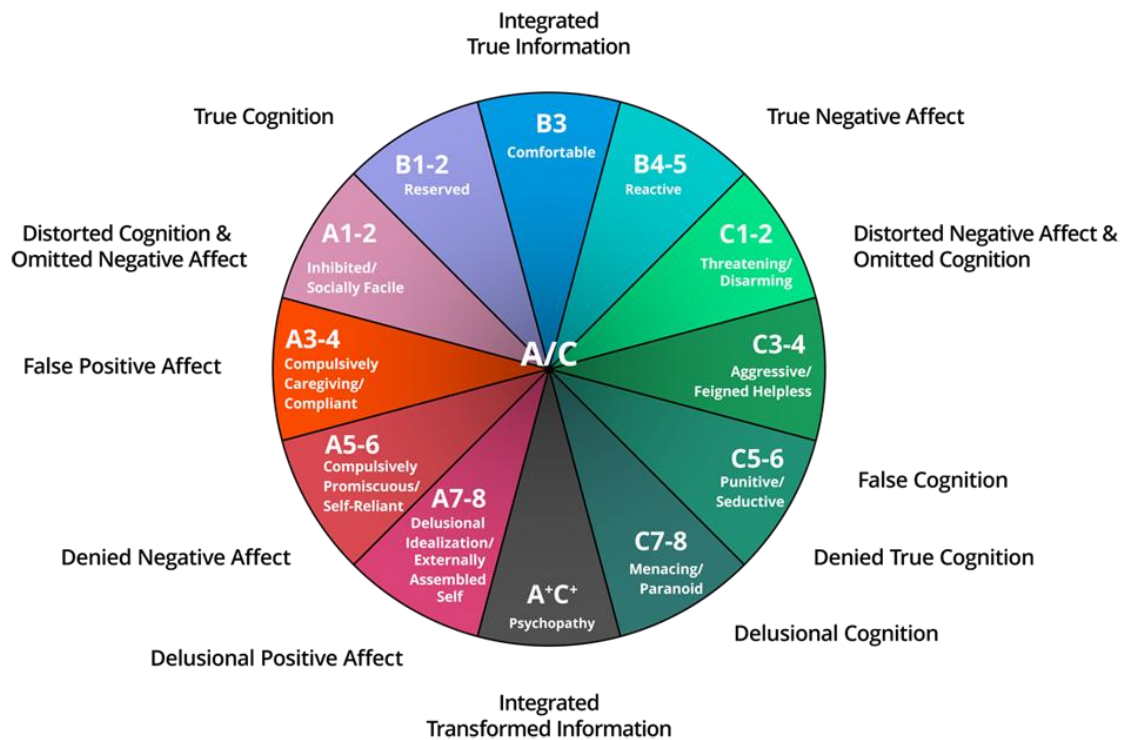


Figure 1. DMM

A core DMM feature is that attachment strategies are shaped not only by early relational experience but also by neurological maturation and cognitive development. The more developed an individual's brain, the more complex their relational strategies may become in response to their environment, such as involving manipulation or coercion. This extends Bowlby's original model, which despite roots in developmental psychology, did not explicitly account for neurodevelopmental factors.

Importantly, the DMM places considerable emphasis on information processing. Crittenden proposed that attachment strategies influence how information is processed in the brain, particularly in terms of affect and cognition (Crittenden, 2008). For instance, type A strategies rely more on cognition (involving procedural memory), and Type C strategies on affect (involving imaged memory). Thus, the model distinguishes between "cognitive" and "affective" strategies.

According to the DMM, what distinguishes a balanced (Type B) strategy is the ability to integrate cognition and affect, referred to as "*reflective integration*" (Crittenden, 2008). This enables caregivers to revise their interpretations in light of new or conflicting emotional information, supporting greater attunement. While this overlaps with "*mentalisation*" (the

ability to hold a child's perspective in mind), reflective integration also involves reappraising past perceptions. For example, a parent might initially assume their child is “fine”, but later reflect on signs of distress. Type A or C strategies may struggle with this due to defensive processing biases that reduce flexibility.

The empirical study incorporates the MotC interview, based on the DMM, to examine how caregivers' attachment strategies are reflected in their narratives. While the MotC and other DMM-informed tools offer valuable insight into relational representations and behavioural patterns, comparatively little attention has been given to the physiological processes that may underpin or accompany these strategies. One such process is sensory processing, an area of growing interest in occupational therapy and psychology, which may play a key role in how attachment strategies are experienced and expressed on a bodily level. The next section explores how differences in sensory processing may shape caregivers' physiological regulation, and in turn, their capacity for sensitive caregiving.

Sensory Processing and Arousal Regulation

Sensory processing refers to the way the nervous system detects, interprets, and responds to sensory input from the environment (Dunn, 1997). Researchers have observed sensory processing and attachment difficulties frequently co-occur (Purvis et al., 2013). This connection may be particularly salient in caregiving contexts, which are often highly sensory environments, filled with sounds, smells, and physical contact. Variations in how caregivers and children process this can shape their interactions (Turner et al., 2012). For instance, a caregiver who becomes easily overwhelmed by stimuli, such as crying, may experience heightened physiological arousal, making it more difficult to respond sensitively. Consistent with Bowlby's (1969) theory of IWMs, such repeated ruptures in attuned caregiving could contribute to insecure attachment patterns in children.

Sensory sensitivity is also relevant when considering attachment as embodied. Rather than promoting a state of calm social engagement, sensory overload may activate fight, flight, or freeze physiology responses during high-stress moments (Porges, 2007), compromising caregiver's ability to co-regulate with their child (Schoore, 2001).

The most widely used model of sensory processing, the Sensory Processing Framework (Dunn, 2001), outlines four sensory patterns. Individuals with high thresholds

may display *sensory seeking* (active attempts to gain input) or *low registration* (passive failure to notice input). Those with low thresholds may show *sensory sensitivity* (becoming easily overwhelmed) or *sensory avoidance* (actively limiting input). A recent scoping review found that adults with low thresholds were more likely to report attachment-related anxiety or avoidance (Kerley et al., 2023). Similarly, those with registration patterns were also linked to greater attachment insecurity. Sensory seeking was the only pattern negatively associated with insecure attachment, suggesting a more adaptive regulatory function. The same review also noted balanced or more typical sensory modulation was associated with secure attachment in children (Kerley et al., 2023). These findings parallel research in psychology linking flexible physiological regulation with secure attachment outcomes (e.g., Gilissen et al., 2008; Paret et al., 2015; Smeekens et al., 2010).

Taken together, these insights suggest that parents with sensory processing differences may face physiological barriers to responsive caregiving. Such individuals may appear “insensitive”, not due to a lack of care, but because their nervous systems are overwhelmed. Thus, integrating these findings from occupational therapy adds a critical layer to understanding embodied attachment in psychology literature, offering a physiological explanation for why attachment sensitivity may be harder for some parents.

However, most studies have relied on self-report measures of sensory processing, which may miss unconscious or momentary regulatory challenges that arise in interactions. Additionally, literature has focused on biological parent-child relationships, despite findings being of particular relevance to families with disrupted or complex relational histories, where past trauma or unresolved attachment experiences may impact sensory sensitivities. The next section will explore this further by examining the role of attachment in adoptive parent-child relationships.

Adoptive Parent-Child Relationships

Trauma has been widely associated with disruptions to bodily regulatory systems (van der Kolk, 2014). When individuals are exposed to chronic or overwhelming stress, their nervous system may adapt in protective ways, such as becoming hypersensitive to perceived danger (fight or flight) or shutting down (freeze or dissociation) to enable survival in hostile environments. While adaptive for survival, these physiological patterns can impair long-term capacities for self-regulation and social engagement. Trauma can also alter how sensory input

is processed, leading to heightened reactivity to everyday stimuli and reduced tolerance for emotional distress (van der Kolk, 2014).

These adaptations are particularly relevant in adoptive caregiving contexts, where children are more likely to have experienced early adversity and relational trauma. Given the link between attachment, physiological regulation, and sensory processing (Schoré, 2001; Kerley et al., 2023), adoptive parent-child dyads may face additional challenges in achieving co-regulated (or secure) attachment relationships. However, research exploring embodied attachment processes within adoptive relationships remains limited.

Nevertheless, broader literature on attachment patterns in adoptive children offers important context. Several studies have found adopted children are more likely to develop insecure or disorganised attachment patterns compared to non-adopted peers (Barone et al., 2017; Kaniuk et al., 2004; Pace et al., 2014; Vorria et al., 2006). Furthermore, studies looking at institutionalised children were significantly more likely to develop insecurity (Lionetti et al., 2015; van de Dries et al., 2009). This offers support for Bowlby's theory that early caregiving relationships shape IWMs of attachment, particularly in contexts of relational trauma (Bowlby, 1969).

While attachment literature in adoptive populations is growing, few studies have directly examined the physiological or sensory mechanisms that underpin these patterns. However, one preliminary study has suggested adopted children with attachment difficulties frequently also present with sensory processing challenges (Gounaridis, 2020). These findings align with a growing body of research showing associations between sensory sensitivities and attachment insecurity (Kerley et al., 2023), suggesting sensory dysregulation may contribute to difficulties in forming secure, embodied relationships.

Importantly, parents' own difficulties with sensory or physiological regulation may play a role in disrupting co-regulation during high-stress interactions in adoptive relationships. Yet, much of the existing research has focused on the child's attachment system, overlooking parental contributions. Theories from Bowlby, Porges, and Schoré all suggest that attachment is inherently relational, and that a parent's capacity for regulation is central for supporting security. These perspectives highlight a critical gap in the literature: the need to explore sensory and physiological processes in parents as well as children, particularly in the context of adoptive families.

The Current Study

This study uses a multiple case study design to investigate how attachment-related processes are reflected, not only in parental discourse, but also in physiological embodiment within both adoptive and biological parent-child relationships. Parents took part in an attachment interview, namely an adapted version of the Parental Development Interview (PDI), which was analysed using the MotC, to understand caregiving patterns through discourse (Aber, 1985; Grey et al., 2017). These interviews were video-recorded and analysed using the Sensory Attachment Intervention (SAI) coding system to explore how parents manage their sensory and physiological arousal. This study is guided by the following research question: *Exploring the relationship between attachment, caregiving discourse, and physiological regulation of arousal in adoptive and biological parent-child relationships.*

Thus, this study seeks to address several important gaps: the need for further exploration of sensory processing and the embodied attachment process, within adoptive relationships, using a model (DMM) less frequently used that may better capture complex relational strategies. A further aim is to identify which embodied reactions appear linked to attachment processes. By integrating narrative and physiological indicators of attachment, this study hopes to contribute to the development of more comprehensive assessment frameworks, combining knowledge from both occupational therapy and psychology fields, and to support therapeutic work for adoptive families impacted by relational trauma.

Study Aims

- 1) To explore the relationship between attachment and caregiving discourse and management of arousal observed through video technology.
- 2) To explore differences in the management of arousal within adoptive parents compared to biological parents.
- 3) To explore how attachment and sensory assessments can be integrated to improve psychological understanding and support for families affected by complex relational trauma.

Based on existing research, this study anticipates that parents with more secure attachment narratives (assessed through MotC) will show greater physiological and sensory regulation (assessed through SAI) during the attachment interview. It is also anticipated that adoptive parents may display different patterns of arousal regulation compared to biological parents, potentially reflecting the impact of relational trauma and differing caregiving contexts.

Systematic Literature Review

Method

Registration & methodological introduction

This review was registered on ‘Prospero’ (CRD420251021700), and PRISMA guidelines for observational studies were followed (Page et al., 2021). Initially, the review aimed to explore the broader attachment-physiology relationship. However, scoping the literature revealed a larger body of relevant work than expected. This prompted a more focused review question: to investigate parental physiology within parent-child relationships. This refinement was conceptually grounded in theoretical models previously outlined (e.g., Bowlby, Porges, Schore), which emphasise parental influence in shaping a child’s regulatory capacities. Despite this, most existing research has focused on child physiology or attachment outside of parenting contexts, with relatively few studies examining parents’ physiological contributions to the parent-child attachment process. This review aimed to address this gap.

Definition of ‘physiology’

In this review, we understand ‘physiology’ as a bodily process that reflects how the body responds to or processes attachment-related stimuli. This includes physiological indicators such as heart rate, as well as biological markers, such as neural activity, hormonal, or immune system functioning. Genetic factors were excluded as these do not directly measure bodily responses. Given limited research in this area, a broad conceptualisation was adopted to ensure relevant biological processes involved in attachment were captured.

Search strategy & procedure

Searches were conducted on three databases: PsycARTICLES, Pubmed, and Scopus, in line with guidelines suggesting 2-3 databases are sufficient (Lefebvre et al., 2022). These were selected due their comprehensive interdisciplinary coverage when used together.

Prior to the finalised search, ‘dummy’ searches were run to test out various search terms. Any terms frequently used in titles and abstracts of relevant papers were noted. Finalised search terms included variations of attachment terminology combined with

physiological and regulatory terms (e.g., “*attachment pattern*”, “*affect regulation*”, “*psychophysiology*”). Boolean operators (AND, OR) and proximity operators (W/5 in Scopus) were used to refine results, and terms adapted to each database's syntax. Although the review narrowed to focus more specifically on parental physiology within parent-child relationships, the original search terms remained intentionally broad to ensure comprehensive inclusion of relevant studies. Please see appendix A for full search strategies for each database. The original search was run on 27th November 2024, with a final search taking place on 29th March 2025 to check for any recently published papers.

All papers were uploaded onto ‘Covidence’, an online platform for managing systematic reviews, and backed up on an Excel spreadsheet. Titles/abstracts were searched, with irrelevant papers excluded. Included papers were then read in full to determine suitability. Reference lists of final papers were also checked. To ensure reliability, a random sample of 10% of title/abstracts and full-text screening stages were independently checked by a second reviewer. Discrepancies were resolved through consultation with a third reviewer. The decision to double-screen 10% was based on good practice guidelines for reviews (Page, 2021), balancing rigor with practical time constraints. Double-screening yielded a 98.7% agreement rate ($\kappa = 0.96$), indicating strong inter-rater reliability (Landis et al., 1977).

Once disagreements had been settled, the final list of studies was extracted and study characteristics recorded using Excel. A second reviewer checked a random sample of 25-30% of studies at data extraction stage, with only minor disagreements settled through discussion with the primary researcher (Page et al., 2021). This was completed to increase validity through the integration of multiple viewpoints and critical examination of researcher assumptions. Studies were then quality appraised before moving onto data-synthesis.

Inclusion and exclusion criteria

Inclusion/exclusion criteria were initially kept broad to not prematurely exclude relevant studies. However, after scoping the literature and when the question was finalised, this was adjusted. This included focusing on studies looking at parent-child relationships, where parent physiology had been measured. Self-report attachment measures were also excluded. All other original criteria remained. Please see table 1 below for details:

Inclusion	Exclusion	Rationale
Studies investigating the relationship between attachment and physiological arousal.	Studies where attachment and physiology are not the core focus.	Excluded papers not aligning with the core aim of this review.
Human parents (or expectant parents) in caregiving roles with their child.	Animals, studies, non-parent-child, peer, or romantic relationships etc.	Ensured relevance to caregiving context in attachment.
Studies with parent-infant/child dyads drawn from normative, or more typical populations.	Studies focused on non-normative or high-risk populations (e.g., severe mental illness, significant trauma histories, clinical treatment samples, adoptive or foster care contexts).	To focus the review on how attachment-physiology patterns operate in typical circumstances, where findings are currently unclear, before extending to high-risk or clinical contexts where patterns may differ significantly.
Published in English.	Not written in English.	Ensured accessibility.
Published from 1990 onwards.	Published before 1990.	Reflects modern methodological advancements in attachment & physiology. Most attachment assessment methods (e.g., AAI) were not developed until late 1980s.
Empirical, peer reviewed studies.	Non-empirical, non-peer-reviewed studies.	Enabled focus on empirical studies only which have been reliably reviewed to maintain methodological rigour. This was deemed especially important for this topic given the complexity of physiological and attachment measures.
Studies using any validated, non-self-report attachment measures.	Studies only using self-report attachment measures or no validated attachment measure.	Ensured depth and reliability in capturing implicit attachment processes.
Studies using any validated, non-self-report physiological measures.	Studies using only self-report physiology, “stress” scales, or genetic, observational physiology.	To exclude potentially less reliable measures. To focus on biological physiology only to understand this relationship first.
Studies where attachment is a moderator.	Studies where physiology is a moderator.	If physiology is treated only as a statistical variable, then it is not a core focus.

Studies including biological markers (e.g., brain functioning or imaging, immune system responses, hormones etc).	Studies focusing solely on genetics in relation to attachment.	To maintain relevance to physiology processes.
Quantitative, qualitative, mixed-method, multiple-case study, & intervention studies investigating the relationship between attachment and physiology.	Single case studies & intervention studies with a core focus on effectiveness.	Single cases are illustrative, not sufficient for inclusion in systematic synthesis. Intervention effectiveness studies are unrelated to core focus of this review.

Table 1: Inclusion/exclusion criteria.

Data Extraction

After screening, data was extracted for each study: author(s), year of publication, title, country, aim, study design, participant information, sample size, attachment relationship (e.g., mother-infant), attachment measures, physiology measures, measurement context, key findings, key quotations, conclusions, strengths, and limitations. A second reviewer independently checked a random sample (27%) of studies at data extraction stage, with no disagreements noted. This followed review guidance (Page et al., 2021) and supported validity through interpretive rigour and independent scrutiny.

Quality Assessments

The Joanna Briggs Institute (JBI, 2017) tool was used to assess study quality, in line with good practice guidance for reviews (Page et al., 2021). This tool was selected as all eleven studies were quantitative, using cross-sectional, cohort, or experimental designs, which align well with JBI checklists (Tufanaru et al., 2020). It is also among the most widely used and comprehensive tools for psychology reviews (Munn et al., 2014). While no universal scoring thresholds exist, papers meeting most criteria (e.g., 9/11 or 6/8 ‘yes’ ratings) are generally considered high quality. See Appendix B for full appraisal tools.

Quality assessments were completed by the primary researcher, with 27% of papers independently reviewed by a second assessor. Agreement was high (95.8% across 24 items), with one minor discrepancy resolved through discussion.

Data Synthesis

A narrative synthesis based on guidance by Popay et al. (2006) and the PRISMA checklist, were used to synthesise study findings (Page et al., 2021). While this framework was originally designed for synthesising intervention research, its focus on exploring patterns and relationships robustly made it a suitable approach that can be adapted for reviewing observational studies. Given significant diversity in physiological systems and attachment classifications, a narrative synthesis allowed for flexible yet systematic integration of heterogeneous findings for quantitative studies. A meta-analysis approach would not have been appropriate due to lack of presence of effect sizes.

Results

Studies Description

The electronic database search returned 2,552 papers. After removal of 186 duplicates, 2,366 papers remained. Titles/abstracts were screened for relevance, resulting in 2,243 records excluded based on the following: irrelevant focus or attachment-physiology not the primary topic (n = 1,894); non-human samples (n = 132); non-empirical studies (n = 119); non-normative samples (n = 58); non-English language (n = 13); non-peer-reviewed sources (n = 12); no validated physiological measure (n = 9); and no validated attachment measure (n = 6). This left 122 articles for full-text review.

At full-text screening, the following studies were excluded: non-parent-child relationships (n = 34); no measure of parental physiology (n = 36); or self-report attachment measures (n = 34). Additional exclusions included non-normative samples (n = 6), no physiology measure (n = 2), and non-English-language papers (n = 1).

This left nine articles for final inclusion. An additional two studies were identified through backward reference searching, resulting in 11 studies for the final review. See PRISMA diagram (Figure 2) for a visual summary:

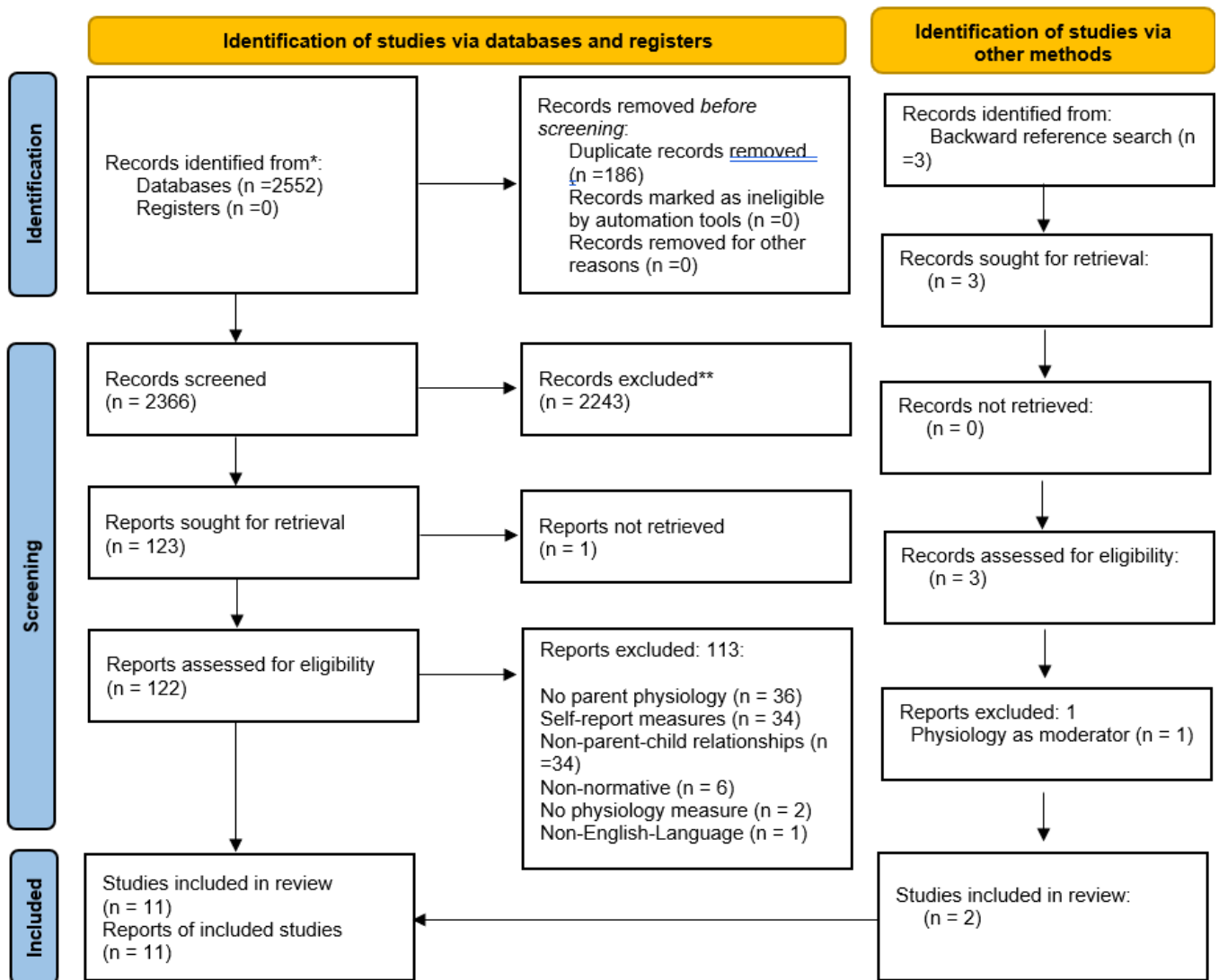


Figure 2: PRISMA diagram.

Study Characteristics

Publication dates ranged from 2008 to 2024. All studies were published in Western countries, with eight in the United States, two in Germany, and one in Canada. All studies were quantitative. Seven studies reported specifically on parental attachment (Ablow et al., 2013; Groh et al., 2015; Groh et al., 2018; Koehler-Dauner et al., 2024; Krause et al., 2016; Leerkes et al., 2017; Strathearn et al., 2009). Three focused on infant attachment (Groh et al., 2019; Hill-Soderlund et al., 2008; Nofech-Mozes et al., 2019), and one examined both parental and infant (Xu et al., 2023). Five studies used experimental designs; two of which were cross-sectional (Groh et al., 2015; Groh et al., 2018), one longitudinal (Ablow et al.,

2013), one pre-post design (Krause et al., 2016), and one with experimental components within a longitudinal cohort study (Strathearn et al., 2009). The remaining six studies were observational, including three longitudinal (Groh et al., 2019; Koehler-Dauner et al., 2024; Leerkes et al., 2017) and three cross-sectional correlational designs (Hill-Soderlund et al., 2008; Xu et al., 2023; Nofech-Mozes et al., 2019).

Two experimental studies used within-subject manipulations comparing responses to familiar and unfamiliar infant cues: infant cries (Groh et al., 2018) and infant faces (Strathearn et al., 2009). The four studies incorporating longitudinal follow-up (e.g., Ablow et al., 2013; Strathearn et al., 2009; Groh et al., 2019; Koehler-Dauner et al., 2024), ranged from infancy to early childhood, enabling prospective examination of attachment-physiology outcomes. All studies reported final sample sizes, and most, described reasons for exclusions or missing data.

Participant Characteristics

Samples sizes ranged from 30-259 participants. Ten of the eleven studies consisted of mother-infant, or mother-child, dyads and one study consisted of expectant mothers (Ablow et al., 2013). None of the studies included fathers. Children's ages ranged from 3-83 months, although eight studies were conducted within the infant's first year of life. Nine studies reported mothers ages as 18-46 years and two studies did not report this (Strathearn et al., 2009; Groh et al., 2019).

All included studies used healthy, non-clinical samples. However, one study reported a subset of (44%) had a history of childhood maltreatment (Koehler-Dauner et al., 2024). This study was retained as the sample was not recruited based on this history and the majority were healthy. Seven studies either explicitly reported white and middle-class samples or were silent on these identities and used educated samples, suggesting lack of diversity (Ablow et al., 2013; Hill-Soderlund et al., 2008; Groh et al., 2015; Groh et al., 2018; Krause et al., 2016; Strathearn et al., 2009; Koehler-Dauner et al., 2024). Four studies had samples recruited from racially, ethnically, and socio-economically diverse backgrounds (Groh et al., 2019; Nofech-Mozes et al., 2019; Xu et al., 2023; Leerkes et al., 2017). Two studies were drawn from the Durham Child Health and Development Study and may include some overlapping participants (Groh et al., 2019; Hill-Soderlund et al., 2008). Although not explicitly stated,

two papers (Groh et al., 2015; Groh et al., 2018), which share authors, methods, and recruitment procedures, may also include overlapping samples.

Attachment and physiology measures

Of the studies measuring parental attachment, three used the AAI (Ablow et al., 2013; Leerkes et al., 2017; Strathearn et al., 2009), two used the Adult Attachment Projective picture system (AAP) (Krause et al., 2016; Koehler-Dauner et al., 2024), and two used the Attachment Script Assessment (ASA) (Groh et al., 2015; Groh et al., 2018). Studies measuring infant attachment used the SSP (Groh et al., 2019; Hill-Soderlund et al., 2008; Nofech-Mozes et al., 2019). One study (measuring both) used the ASA and the SSP (Xu et al., 2023).

Physiological responses were captured across various domains, including ANS responses, hormonal responses, and brain activation responses. Six studies measured at least one ANS response, including Respiratory Sinus Arrhythmia (RSA), Skin Conductance Level (SCL), heart rate (HR or ECG), or salivary alpha-amylase (sAA), a non-invasive biomarker of SNS activation (Ablow et al., 2013; Groh et al., 2019; Hill-Soderlund et al., 2008; Koehler-Dauner et al., 2024; Leerkes et al., 2017; Xu et al., 2023). Two studies measured hormonal responses (Krause et al., 2016; Nofech-Mozes et al., 2019). Two studies measured brain activation (Groh et al., 2015; Groh et al., 2018). One study measured both hormonal and brain activation (Oxytocin, fMRI) (Strathearn et al., 2009). Physiological data was measured across numerous different contexts (see table 2).

It should be noted the Groh et al. (2018) paper differed from the others in its focus on attentional processing (EEG P3b amplitude). This study was retained as attentional engagement is considered a component of physiological regulation in the literature (Thayer et al., 2012). Thus, excluding it may have omitted relevant attachment-related arousal regulation.

Please see table 2 for summary study characteristics:

Author, Year & location	Study Design	Sample Characteristics	Brief Task & Procedural Context	Attachment Measures	Physiology Measures	Additional Measures
Ablow et al. (2013), USA.	Quantitative, experimental laboratory study with longitudinal follow-up.	53 primiparous expectant mothers (aged 19-41) in their third trimester. 77% European American, educated, higher socio-economic class. Infants in utero and at 9 months during follow-up.	Lab-based viewing of video clips where they listened to two types of infant cry (simple and complex) whilst pregnant. Cry aversiveness & emotional responses measured. 9 months postpartum, mothers were then observed playing with their infant and responding to their distress following a brief separation.	AAI (maternal attachment)	RSA, SCL, HR.	Self-report ratings of cry aversiveness and emotional responses to infant crying measured (asked to rate as if they are the infants' mother). Maternal sensitivity coded from mother-infant reunion using global ratings of interaction (Murray et al., 1996).
Groh et al. (2015), USA.	Quantitative, cross-sectional laboratory study.	108 mothers (aged 22-46) of children aged 18-83 months (M = 38.49 months). 63.9% European American, relatively high education and socio-economic class.	Lab-based setting. Mothers listened to a 3-minute audio recording of infant crying while EEG and facial expression were recorded. Emotion ratings via a questionnaire taken before and after stimulus.	ASA (maternal attachment)	EEG neural activity (frontal and parietal alpha asymmetry).	Emotional Experience Questionnaire (EEQ). Observed facial tension.

Groh et al. (2019), USA.	Quantitative, longitudinal laboratory-based study.	127 mothers (no ages given) from diverse backgrounds (Durham Child Health and Development Study). Infants were 6 months old and 12 months at follow-up.	Lab-based setting at 6 months. Maternal physiology, observed emotional responding, & infant distress were all measured during the SFP. Maternal sensitivity assessed during free-play session at home within 2 weeks of lab task. Mother-infants then came back to the laboratory at 12 months and SSP completed. Researchers then tested which aspects of maternal responding (RSA and emotional affect) at 6 months predicted levels of infant avoidance or resistance at 12 months.	SSP coded both dimensionally and categorically (infant's attachment).	RSA.	Observed infant distress and maternal emotional responding (infant & maternal behaviour). Maternal emotional responding coded via facial affect (positive, neutral, negative). Coding approach described but no formal tool given.
Hill-Soderlund et al. (2008), USA.	Quantitative, experimental, observational study.	132 mother–infant dyads from a diverse longitudinal sample. Mothers mean age = 28.4. Infant mean age = 13.55 months (SD = 1.2).	Lab-based setting. Infant & maternal RSA measured continuously during SSP procedure. Maternal sAA measured at 3 time-points.	SSP (infant attachment).	RSA and Salivary alpha-amylase (sAA).	N/A

Koehler-Dauner et al. (2024), Germany.	Quantitative, longitudinal observational study with mediation analysis.	163 mothers (aged 18-43 years) from a non-clinical sample within a larger longitudinal study (TransGen). No specific demographics information provided but participation involved suggests higher education and socio-economic class. Infants were 12 months old.	Mothers were recruited just after giving birth and completed self-reported stress scales. At 3 months, self-report stress scale & used to assess attachment. At 12 months, SSP completed whilst maternal physiology measured.	AAP (maternal attachment).	HR.	Perceived Stress Scale (PSS-14).
Krause et al. (2016), Germany.	Quantitative, experimental pre-post design.	44 mothers (21.9-44.2 years), 3 months postpartum, non-breastfeeding, from maternity ward of Ulm University Hospital. No demographic information given. Participants required	Hormone levels measured before and after interview.	AAP (maternal attachment)	Oxytocin (plasma) and cortisol (serum) via blood samples.	N/A

		to attend a laboratory & fast, suggesting high-functioning, educated sample. Infants were 3 months old.				
Leerkes et al. (2017), USA.	Quantitative, observational, longitudinal correlational study.	259 mothers (aged 21-46 years) from diverse backgrounds, who are part of a longitudinal study. Infants were 6 months.	Maternal attachment measured prenatally. At 6 months, maternal physiology & sensitivity is recorded during mild infant stress tasks (arm restraint, novel toy, SFP). At 14 months, maternal sensitivity re-assessed during infant stress tasks. At 27 months, infant attachment measured & maternal questionnaire on infant behavioural problems completed.	AAI (coherence of mind rating, 1–9) and SSP (maternal and infant attachment)	RSA & SCL.	Maternal sensitivity observed and coded via INTERACT 9 using behavioural coding system described in paper. Infant behaviour measured using BITSEA self-report questionnaire (administered to mothers). Various self-report measures administered to measure maternal emotion: Center for Epidemiologic Studies Depression Scale (CES-D); Difficulties in Emotion Regulation Scale (DERS);

						Differential Emotions Scale (DES); NEO Five-Factor Inventory (NEO-FFI).
Nofech-Mozes et al. (2019), Canada.	Quantitative, cross-sectional, multi-method study.	256 mother-infant dyads (mothers aged 21-46), normative sample, relatively diverse. Average infants age 17 months.	Lab-based setting. Both maternal and infant hormonal measures taken at 3 time-points during the SSP (baseline, 20 minutes and 40 minutes afterwards).	SSP (toddler attachment)	Cortisol (salivary).	N/A
Xu et al. (2023), USA.	Quantitative, correlational, cross-sectional study.	127 mother-infant dyads (mothers aged 20-33), primarily white and educated backgrounds. Infants aged 12 months.	Lab-based setting. At 6 months, maternal physiology measured during various interaction tasks with their infant (SFP, free play, and toy clean up). Approximately 9 days later, maternal attachment is measured.	ASA (maternal attachment. The SSP is used, but not to assess infant attachment and this is not reported.)	RSA (ECG measured to derive RSA).	N/A
Groh et al (2018), USA.	Quantitative, experimental, cross-sectional study.	70 mother-infant dyads (maternal mean age = 30). No demographic information provided but	Maternal attachment assessed & then mothers took part in an emotional oddball task (viewing images of their own infant displaying happy, neutral, and distressed	ASA (maternal attachment)	EEG P3b amplitude (neural activity).	Maternal accuracy & reaction time recorded.

		recruitment through university suggests lack of diversity. Infant aged 6 months.	faces). Mothers asked to accurately identify emotion whilst physiology measured.			
Strathearn et al. (2009, USA.	Quantitative, longitudinal, cohort study with experimental components.	30 mother-infant dyads. No maternal ages provided. No demographics information provided but participation involved, and university links suggest lack of diversity. Infants aged 7 months during first measure and 11 months at second measure.	Maternal attachment measured during pregnancy. 7 months postpartum, hormonal maternal physiology measured at 3 points (baseline, during free-play, and during SFP). At 11 months, maternal neural physiology measured whilst viewing images of their own and unknown infants displaying happy, sad, and neutral facial expressions.	AAI (maternal attachment, coded using DMM framework)	Oxytocin blood sample & fMRI.	N/A

Table 2: Study Characteristics (see glossary for explanation of abbreviations)

Quality Appraisals

Quality appraisal was conducted using the JBI Critical Appraisal Checklists (JBI, 2017). Five studies used the JBI Cohort Checklist and six used the Analytical Cross-Sectional Checklist. All studies were generally strong quality, with criteria met ranging from 9 to 11/11 for cohort studies, and 7 to 8/8 for cross-sectional studies. Common strengths included clear aims, procedures, appropriate use of reliable measures and statistical tests. Points lost were generally for not explicitly stating exclusion criteria, or not adequately addressing missing data. See table 3 below:

Study	JBIChecklist Used	Number of Items met	Total Number of Items	% Items Met	Critical Appraisal Comments
Ablow et al., 2013	Cohort Checklist	11	11	100	Confounding variable clearly addressed, exclusion rationales transparently reported, strong handling of missing data. Overall, well designed and appropriately analysed.
Groh et al., 2015	Analytical Cross-Sectional Checklist	7	8	87.5	Study described in detail; appropriate measures & analyses, confounding variables addressed. Inclusion criteria not explicitly stated, although does state exclusion. Overall, strong design and reporting with only minor limitations.
Groh et al., 2018	Analytical Cross-Sectional Checklist	7	8	87.5	Appropriate and validated measures and statistical procedures, well described, confounding variables well handled. Exclusion but not inclusion criteria is explicitly stated. Overall, quality is strong with minor limitations.
Groh et al., 2019	Cohort Checklist	11	11	100	Clear recruitment, appropriate design, measures and statistical procedures. Confounding variables and missing data well handled. No notable limitations, very strong methodological quality.
Hill-Soderlund et al., 2008	Analytical Cross-Sectional Checklist	8	8	100	Although part of a broader longitudinal study, this study uses a single time-point with no follow-up; therefore was assessed using the analytical cross-sectional design.

					Study uses good quality measures, appropriate statistical measures. Confounding variables well handled. Inclusion and exclusion criteria stated. Strong methodological study.
Koehler-Dauner et al., 2024	Cohort Checklist	11	11	100	Clearly described, validated measures, appropriate statistical tests, confounding variables well handled. Attrition rates adequately handled and transparently reported. High quality study.
Krause et al., 2016	Analytical Cross-Sectional Checklist	8	8	100	Validated measures, clear inclusion and exclusion criteria, appropriate statistical procedures, clear handling of confounding variables. Transparent reporting of study limitations. Good quality overall.
Leerkes et al., 2017	Cohort Checklist	10	11	90.9	Clearly described, appropriate design, measures, and statistical analyses. Confounding variables handled. Missing data is described but not sufficiently handled as no statistical strategies are used to address this. Otherwise, sound methodological quality.
Nofech-Mozes et al., 2019	Analytical Cross-Sectional Checklist	8	8	100	Validated measures, criteria adequately described, appropriate statistical analyses, good handling of confounding variables. High methodological quality.
Xu et al., 2023	Analytical Cross-Sectional Checklist	7	8	87.5	Clearly described, validated measures, appropriate statistical analyses, confounding variables handled well. Inclusion criteria not explicitly stated although does state exclusion. Overall, a good quality study.
Strathearn et al., 2009	Cohort Checklist	9	11	81.81	Well described, validated measures, appropriate statistical procedures, confounding variables well handled. Missing

					data not adequately explained or accounted for, no strategies used to address this. Overall, methodological quality still high with some smaller limitations.
--	--	--	--	--	---

Table 3: Quality appraisal summary

Narrative Synthesis

As most studies focused on parental attachment, unless explicitly stated otherwise, reported attachment classifications refer to *parental* attachment (as measured by the AAI, ASA, or). Where studies used *infant* attachment classifications (e.g., SSP), this is clearly indicated in-text. Each results table will also make this distinction clear (see tables 4, 5, 6). All physiological data refers to *parental* physiology, unless explicitly stated that the study examined both parent and infant physiology.

ANS Response Studies

Six studies examined ANS responses (Ablow et al., 2013; Groh et al., 2019; Hill-Soderlund et al., 2008; Koehler-Dauner et al., 2024; Leerkes et al., 2017; Xu et al., 2023). Summaries of these findings are provided in table 4, followed by further in-text detail:

Attachment Category	Author & Date	Key Findings	Attachment Source	Physiological Measure
Secure	Ablow et al., 2013.	Secure mothers showed greater RSA withdrawal during cry tasks, i.e., better PNS regulation. Secure mothers showed stable, or decreasing SCL, i.e., better SNS regulation. No significant differences for HR across conditions. RSA and AAI were independent predictors of later maternal sensitivity, but RSA did not mediate the attachment-sensitivity link. In other words, both RSA and attachment classification contribute to sensitivity, but RSA did not explain the relationship between attachment classification and sensitivity (suggesting a separate physiology pathway).	Parent - AAI	RSA, SCL, HR.
	Hill-Soderlund et al., 2008.	All mothers showed RSA changes across the SSP, particularly during separations. Mothers of secure infants showed greater RSA withdrawal during the final reunion, suggesting more engagement/regulation in response to infant distress. No significant effects were found for maternal sAA across time or attachment status. Secure infants showed less RSA reactivity (i.e., more stable RSA across episodes) compared to avoidant infants. No evidence of physiological attunement (RSA or sAA) between mothers and infants was found, suggesting independent physiological regulation.	Infant - SSP	RSA & sAA (both parent & infant)
	Xu et al., 2023.	Mothers with high SBSK showed greater dynamic RSA change across the Still Face Paradigm (SFP): RSA increased from play to still-face and decreased again during reunion. This suggests great physiological flexibility & engagement with infant cues.	Parent – ASA.	RSA

	Koehler-Dauner et al., 2024.	Securely attached mothers reported lower levels of perceived stress and had a lower average HR during the stress induction task compared to insecure mothers (suggestive of better physiological regulation).	Parent-AAP	HR.
Insecure (broadly)	Xu et al., 2023.	Mothers with low SBSK showed a blunted RSA response across the SFP, with little physiological change between episodes. This indicates reduced physiological flexibility, possibly reflecting lower sensitivity or engagement during infant stress.	Parent - ASA	RSA
	Koehler-Dauner et al., 2024	Insecurely attached mothers reported higher perceived stress and showed a higher heart rate during the stress task, indicating greater physiological arousal. A mediation analysis found that perceived stress significantly mediated the relationship between attachment and heart rate. In other words, insecure attachment led to greater stress perception, which in turn elevated heart rate.	Parent-AAP	HR.
Avoidant (dismissing)	Ablow et al., 2013	Dismissing mothers showed less RSA withdrawal, indicating lower physiological engagement. These mothers also showed increased SCL during complex cry task (higher SNS arousal). Dismissing mothers with high SCL were particularly less sensitive to distressed infants. No HR group difference. RSA and AAI predicted later sensitivity, but RSA did not mediate.	Parent - AAI	RSA & SCL
	Groh et al., 2019	Less RSA withdrawal in mothers during the <i>reunion</i> episode of the SFP at 6 months predicted higher infant avoidance at 12 months. This association was independent of maternal sensitivity or observed emotion (i.e., it remained significant even after controlling for sensitivity and affect). Logistic regression using the categorical	Infant - SSP	RSA

	Hill-Soderlund et al., 2008	secure/avoidant contrast was non-significant, the association remained in the expected direction (i.e., lower RSA withdrawal linked to avoidance). Maternal RSA withdrawal during non-distressing contexts (e.g., normal play) was not associated with either attachment dimension. Mothers of avoidant infants showed less RSA withdrawal, particularly during reunion, compared to mothers of secure infants. No group differences were observed in maternal sAA. Avoidant infants showed greater RSA withdrawal (more vagal reactivity), especially during separation episodes of the SSP. They also had higher baseline and reactive sAA levels than secure infants, indicating elevated SNS activation. As with secure dyads, no physiological attunement was found, suggesting separate regulatory processes in mother and infant.	Infant- SSP	RSA & sAA
Anxious (preoccupied) or resistant	Groh et al., 2019	Mothers who displayed more neutral (vs. positive) facial affect during the reunion were more likely to have infants with higher resistance scores. This was independent of maternal sensitivity. There was no significant association between maternal RSA withdrawal and infant resistance. Although categorical analysis for secure/resistant was also non-significant, the pattern of association with maternal emotional affect was in the expected direction. Maternal RSA withdrawal during non-distressing contexts (e.g., normal play) was not associated with either attachment dimension.	Infant - SSP	RSA
Disorganised (unresolved)	Leerkes et al., 2017	Disorganised attachment was not predicted by maternal RSA, SCL, or maternal sensitivity alone. However high maternal SNS arousal (SCL) predicted greater infant disorganisation only when vagal withdrawal (RSA) was low. When RSA withdrawal was high, SCL was unrelated to disorganisation. Poor regulation (high arousal coupled with low	Parent & infant- AAI and SSP	RSA & SCL

		regulation) may contribute to disorganised attachment independently from maternal sensitivity.		
--	--	--	--	--

Table 4: ANS studies

Secure Attachment

Secure attachment in both parents and infants was associated with greater physiological flexibility, including dynamic RSA modulation and greater RSA withdrawal (Ablow et al., 2013; Hill-Soderlund et al., 2008 [parent and infant physiology]; Xu et al., 2023). Secure mothers also showed more regulated SNS responses, such as stable or decreasing SCL (Ablow et al., 2013). RSA and attachment classification independently predicted later maternal sensitivity (Ablow et al., 2013). No significant group differences for infant attachment were found for sAA (Hill-Soderlund et al., 2008). HR findings were mixed, with one study reporting no group differences and another reporting lower HR in secure mothers (Ablow et al., 2013; Koehler-Dauner., 2024).

Overall, studies reporting on both maternal and infant secure attachment suggest more adaptive and flexible physiological regulation (Ablow et al., 2013; Hill-Soderlund et al., 2008; Koehler-Dauner et al., 2024). The remaining ANS-focused studies examined avoidant attachment (in infants) and disorganised attachment, with limited analysis of secure attachment (Groh et al., 2019; Leerkes et al., 2017).

Insecure Attachment

Two studies reported findings for insecure attachment more broadly, without examining subtypes (Koehler-Dauner et al., 2024; Xu et al., 2023).

Avoidant (dismissing) attachment

Three ANS studies reported specifically on avoidant attachment (Ablow et al., 2013; Groh et al., 2019; Hill-Soderlund et al., 2008), with the latter two focusing on infant attachment. Mothers of avoidant infants or dismissing parents tended to show reduced RSA withdrawal during stress or reunion episodes. However, some studies also examined SCL and sAA, with findings suggesting elevated SNS activity in avoidant dyads. No evidence of physiological attunement between mothers and infants was observed.

Anxious (preoccupied) attachment

Only one ANS study reported findings relevant to anxious attachment in infants (Groh et al., 2019). No significant association between maternal RSA withdrawal and infant anxiety was found. Other ANS studies did not include anxious groups in their analyses due to small sample sizes (Ablow et al., 2013; Hill-Soderlund et al., 2008), limiting findings for this group.

Disorganised (unresolved) attachment

Only one ANS study reported findings specific to disorganised attachment, in both mothers and infants (Leerkes et al., 2017). This study found disorganisation seemed to be associated with a combined pattern of heightened SNS and low PNS arousal. This effect was independent of maternal sensitivity. No other ANS studies examined disorganised attachment, limiting broader findings.

Summary of ANS findings by domain

RSA was the most frequently assessed physiological indicator, examined in five studies (Ablow et al., 2013; Groh et al., 2019; Hill-Soderlund et al., 2008; Leerkes et al., 2017; Xu et al., 2023). Secure attachment in infants and parents was generally associated with moderate RSA withdrawal and greater physiological flexibility, while avoidant attachment in infants and parents was linked to reduced RSA withdrawal. One study found no significant RSA differences between infant avoidant and anxious groups (Groh et al., 2019). Minimal RSA withdrawal, combined with heightened SNS arousal, was associated with disorganised attachment (Leerkes et al., 2017).

SCL results showed higher electrodermal activity in dismissing mothers (Ablow et al., 2013), and increased arousal in mothers of disorganised infants when PNS regulation was low (Leerkes et al., 2017). HR findings were mixed: one study reported no differences between attachment groups (Ablow et al., 2013), while another found higher HR in insecurely attached mothers more broadly (Koehler-Dauner et al., 2024). Finally, sAA, assessed in Hill-Soderlund et al. (2008), showed no significant differences across infant groups.

Hormonal Response Studies

Three papers looked at parental hormonal responses and attachment (Krause et al., 2016; Nofech-Mozes et al., 2019; Strathearn et al., 2009). Please see table 5 for a summary of findings:

Author & Date	Attachment Categories	Key Findings	Attachment Source	Physiological Measure
Krause et al., 2016.	Secure & Insecure	Secure mothers were less likely to show an oxytocin increase (33%) compared to insecure mothers (over 80%) but were significantly more likely to show a cortisol decrease (100%), suggesting stronger stress regulation. Insecure mothers consistently showed higher oxytocin reactivity but less consistent cortisol reduction. No significant differences were found between attachment groups in baseline or post-task hormone levels, and oxytocin and cortisol changes were not correlated, indicating separate physiological processes.	Parent - AAP	Cortisol & Oxytocin
Nofech-Mozes et al., 2019.	Organised & Disorganised	Infants' cortisol increased while mothers' decreased, showing divergent stress responses. These differences in cortisol between mother and infant widened over time. Disorganised dyads showed stronger coordination in the timing of their physiological changes, but in opposite directions (i.e., as one partner's cortisol rose, the other's fell), suggesting dysregulated co-activity rather than matched regulation. No evidence was found for predictive (lagged) attunement, i.e., mothers' cortisol did not predict infants' cortisol at later timepoints, and vice versa.	Toddler - SSP	Cortisol (both parent and infant)
Strathearn et al., 2009.	Secure & Avoidant	Secure mothers showed a significantly greater oxytocin increase after mother-infant interaction (e.g., free-play) compared to dismissing mothers. Avoidant mothers showed smaller oxytocin increase after infant interaction compared to secure mothers. No significant differences	Parent - AAI	Oxytocin

		in cortisol, epinephrine, norepinephrine, estradiol, or progesterone.		
--	--	---	--	--

Table 5: Hormonal studies

Summary of hormonal findings

Findings linking parental attachment with hormonal reactivity were mixed. The two studies assessing oxytocin (Strathearn et al., 2009; Krause et al., 2016) reported differing patterns: Strathearn et al. observed greater oxytocin increases in secure compared to avoidant mothers, whereas Krause et al. found post-task oxytocin increases in most mothers, with slightly higher reactivity among insecurely attached individuals. Cortisol findings were somewhat more consistent, with secure or organised attachment associated with greater reductions in maternal cortisol (Krause et al., 2016) and disorganised dyads showing more strongly coordinated, but oppositional, mother-infant cortisol responses (Nofech-Mozes et al., 2019). Overall, hormonal studies and consistency of attachment subgroup patterns remain limited.

Neural Activity Studies

Three papers measured neural responses (Strathearn et al., 2009; Groh et al., 2015; Groh et al., 2018). All three looked at maternal attachment and physiology. Please see table 6 for a summary of findings:

Author & Date	Attachment Categories	Main Findings
Groh et al., 2015.	High vs low secure base script knowledge (SBSK) (i.e., secure & insecure)	<i>Neural EEG</i> Those higher in SBSK showed greater right vs. left frontal EEG activation in response to infant crying (i.e., more rightward shift), reflecting more typical regulatory brain response. This shift was due to a larger decrease in left hemisphere activity during crying. No effects were found at parietal EEG. Those lower in SBSK showed smaller shifts in frontal EEG activity (less rightward activation), suggesting flatter neural response to infant distress. This was due to smaller decreases in left hemisphere activity. No significant changes found in parietal EEG. <i>Emotional/behavioural findings</i> Those high on SBSK reported larger drops in positive emotion upon infant crying (indicative of engagement) and less observed tension when listening to crying. Those lower on SBSK reported smaller drops in positive emotion (suggesting emotional disengagement or blunted response) and displayed greater observed tension to infant crying.
Groh et al., 2018.	High vs low secure base script knowledge (SBSK) (i.e., secure & insecure)	<i>Neural ERP findings</i> Those with higher SBSK showed smaller P3b brain responses when viewing their infant's distressed faces (vs. lower SBSK), suggesting less cognitive effort or more efficient processing of distress cues. No significant differences in brain responses between happy and neutral infant faces, or distressed verses happy (indicative of more balanced responses).

		Those with lower SBSK showed larger P3b responses to distressed infant faces, indicating greater neural resource allocation (possibly due to difficulty processing or increased cognitive demand). They also showed a greater difference in response between distressed and happy faces, possibly indicative of heightened reactivity to distress. However, there was no significant difference in response to happy or neutral faces. <i>Task performance</i> Those with higher SBSK were generally more accurate (fewer missed responses to infant's distress faces) & no significant difference in performance with happy expressions. Those lower on SBSK were less accurate (more missed responses), but also showed no significant difference between performance of distress & happy faces.
Strathearn et al., 2009.	Secure & Avoidant	For secure mothers: Greater activation in reward/social bonding areas (ventral striatum, orbitofrontal cortex, mPFC, hypothalamus) when viewing own infant's happy/sad faces. Higher hypothalamic/pituitary activity to own vs. unknown infant (linked to oxytocin release). Showed more left hemisphere activation (positive emotion, approach, emotional regulation). For avoidant mothers: Smaller oxytocin increases after infant interactions. Less activation in reward/bonding areas (ventral striatum). More dlPFC and anterior insula activity (cognitive control). Greater right hemisphere activation (associated with withdrawal/defensive behaviour). No significant activation to unknown faces or midbrain dopamine regions (suggesting blunted reward response).

--	--	--

Table 6: Neural Studies

Summary of Neural Activity Studies

Three studies assessed neural responses to infant cues in relation to parental attachment. Two used EEG and ERP methods to examine patterns linked to SBSK (Groh et al., 2015; Groh et al., 2018), while one used fMRI to compare securely and avoidantly attached mothers (Strathearn et al., 2009). Across studies, higher attachment security (or high SBSK) was associated with more modulated neural responses to infant distress, while lower security or avoidant attachment was linked to increased neural activation in regions associated with cognitive effort or emotional withdrawal. Aside from avoidant attachment, attachment subgroups were not explored, limiting further conclusions.

Patterns Across All Studies

Most studies analysed attachment using categorical classifications, typically comparing secure versus insecure groups (Groh et al., 2015; Groh et al., 2018; Koehler-Dauner et al., 2024; Krause et al., 2016; Xu et al., 2023). Some studies focused specifically on dismissing attachment in parents (e.g., Ablow et al., 2013; Hill-Soderlund et al., 2008; Strathearn et al., 2009), with Hill-Soderlund et al. (2008) also including infant data. One study (Strathearn et al., 2009) used the DMM model to assess attachment.

Disorganised attachment was examined in two studies (Leerkes et al., 2017; Nofech-Mozes et al., 2019), both looking at parent and infant attachment. Overall, physiological correlates of anxious and disorganised groups remain underexplored compared to secure and avoidant. Only one study (Groh et al., 2019) reported findings for anxious attachment.

Most research has focused on ANS responses, with relatively few studies examining hormonal, neural, or other parental physiological indicators in relation to attachment.

Secure vs Insecure

Secure attachment was consistently associated with more adaptive physiological responses compared to insecure attachment classifications. In terms of ANS responses, secure mothers, and mothers of secure infants, demonstrated greater RSA withdrawal, flexible RSA modulation across tasks (e.g., Hill-Soderlund et al., 2008; Ablow et al., 2013; Xu et al., 2023), lower resting heart rates (Koehler-Dauner et al., 2024), and greater cortisol reductions

during attachment-based tasks (Krause et al., 2016). Neural studies similarly indicated greater activation of reward-related brain areas and more regulated attentional processing in secure mothers (Strathearn et al., 2009; Groh et al., 2018). Hormonal responses (specifically, oxytocin) were more mixed: one study found secure mothers exhibited higher oxytocin during infant interactions (Strathearn et al., 2009), whereas another found no significant oxytocin differences by attachment category (Krause et al., 2016). Insecure attachment groups showed contrasting patterns, including blunted RSA responses, heightened SNS arousal, less flexible modulation, less pronounced cortisol recovery, and neural patterns associated with distress or cognitive hypervigilance (Ablow et al., 2013; Groh et al., 2015; Krause et al., 2016; Groh et al., 2018).

Avoidant vs Anxious

For ANS studies, findings suggest differing physiological profiles for avoidant groups. Avoidant attachment in both parents and infants was characterised by inhibited physiological reactivity, including blunted or smaller RSA withdrawal (Ablow et al., 2013; Hill-Soderlund et al., 2008; Groh et al., 2019), and higher SCL responses despite minimal behavioural engagement (Ablow et al., 2013). Only one study reported on infant anxious groups and found no significant differences between avoidant infants (Groh et al., 2019). Firm conclusions around patterns for avoidant compared to anxious groups are limited.

Some hormonal and neural findings suggest avoidant mothers demonstrated reduced oxytocin and greater activation in brain areas associated with negative emotional experiences during infant interactions (Strathearn et al., 2009). However, other findings reported no significant differences in oxytocin responses for insecure groups more generally (Krause et al., 2016). No neural or hormonal patterns specific to anxious attachment were reported within the included studies, thus it is difficult to draw specific comparisons between groups across these papers.

Disorganised Attachment

Preliminary findings for disorganised parents and infants suggest a pattern of physiological dysregulation, but are limited (Leerkes et al., 2017). In the ANS domain, disorganised attachment was associated with a combination of heightened SNS arousal

(elevated SCL) and poor PNS regulation (minimal RSA withdrawal) during mother-infant interactions (Leerkes et al., 2017). A hormonal study supported this, with disorganised dyads showing mismatched cortisol patterns between dyads, reflecting poor physiological synchrony and co-regulation (Nofech-Mozes et al., 2019). No neural studies reported on disorganised attachment and thus it is difficult to draw further conclusions.

Discussion

This review aimed to address a literature gap by systematically reviewing and synthesising studies post 1990 looking at the relationship between parental physiology and attachment within parent-child relationships, using non-self-report measures. This discussion is structured around key themes identified through the narrative synthesis and interpreted through embodied attachment theories.

As noted in the results, attachment classifications refer to *parental* attachment unless stated otherwise. Infant attachment findings, or studies examining both, are clearly indicated and interpreted as reflecting the bidirectional, relational nature of attachment.

Secure Attachment and Greater Physiological Regulation & Flexibility

A consistent finding across the review was that securely attached mothers, or mothers of secure infants, demonstrated more regulated physiology during attachment-related distress. In both ANS and neural studies, secure individuals showed lower heart rates, greater RSA withdrawal, more flexible RSA modulation, and greater activation in reward-related brain regions (Ablow et al., 2013; Groh et al., 2015; Groh et al., 2018; Hill-Soderlund et al., 2008; Koehler-Dauner et al., 2024; Strathearn et al., 2009; Xu et al., 2023). These findings mirror research looking at infant physiology, where secure infants displayed more regulated physiology (Borelli et al., 2023; Gilissen et al., 2008; Smeekens et al., 2010), supporting biosocial theories that emphasise the interdependence of biological and relational processes in development (Bronfenbrenner, 1979; Sameroff, 2009).

This aligns with embodied attachment theories, such as ANS models and PVT (Porges, 2007). While ANS theory emphasises balance between SNS/PNS systems, PVT posits that the ventral vagal complex supports social engagement during stress, allowing secure parents to remain present and attuned. Similarly, Schore's (2001) theory suggests that secure attachment emerges through synchronised, embodied parent-infant co-regulation, scaffolding the development of infant stress regulation. Whilst these theories differ in how they conceptualise physiology, they suggest that secure individuals can access adaptive physiological states that support better regulation.

Four studies (Ablow et al., 2013; Hill-Soderlund et al., 2008; Koehler-Dauner et al., 2024; Xu et al., 2023) suggested these well-regulated physiological states supported sensitive

caregiving, or infant regulation (Hill-Soderlund et al., 2008). This points toward a physiological mechanism for Bowlby's concept of IWMs transmitted intergenerationally, not just through behaviour or discourse, but via shared physiological experiences. These findings also resonate with embodied mentalisation, where parental physiological states scaffold their ability to mentalise and respond sensitively (Schore, 2001; Fonagy et al., 2002). This aligns with broader biosocial frameworks (Sameroff, 2009; Cicchetti et al., 2015), which propose early relational experiences and caregiver physiology interact to shape neurobiological development and emotional resilience.

Two studies suggested secure parents found infant distress less aversive, with perceived stress mediating the attachment-physiology link (Koehler-Dauner et al., 2024), and secure mothers rating infant cries less distressing (Ablow et al., 2013). Although not explicitly used in these studies, these findings align with the DMM, which conceptualises attachment strategies as methods of managing threat and protection (Crittenden, 2008). Secure parents may appraise infant distress as less threatening, preserving capacity to regulate.

Neuroimaging findings support this interpretation: Groh et al. (2018) found that secure mothers showed smaller, modulated neural responses to infant distress, but not in response to happy faces, suggesting that attachment-related physiological regulation is more strongly activated in threat contexts. Additionally, Strathearn et al. (2009) found secure mothers showed increased activation in brain regions associated with reward when viewing their infant's sad face. Thus, secure mothers may experience their ability to soothe infants as rewarding, supporting engagement. This has relevance for understanding attachment measures like the AAI or PDI, where secure narratives demonstrate curiosity, openness, and reflective capacity: traits that may be physiologically grounded in lower threat activation.

While findings were consistent for secure attachment in ANS and neural studies, hormonal findings were more mixed. Strathearn et al. (2009) found secure mothers showed elevated oxytocin levels when feeding and holding their infants, whereas Krause et al. (2016) found increases across all mothers, in fact with slightly greater reactivity among those classified insecure. Several methodological differences may account for discrepancies. Firstly, the studies used different attachment measures: Strathearn employed the AAI, coded using the DMM, while Krause used the ASA (targeting SBSK) which is more cognitive-based. These conceptual distinctions may have influenced classification. Secondly, the studies

differed in task type: Strathearn examined responses to infant images, whereas Krause used real-time mother-infant interactions, which may have greater emotional salience. Thirdly, oxytocin's short half-life makes timing of sampling critical (Carter et al., 2013), and variation may have influenced outcomes. Finally, Strathearn's smaller sample of first-time mothers' contrasts with Krause's larger, more diverse group, potentially affecting generalisability and inflating effect sizes.

Notably, Krause et al. found secure mothers showed steeper post-task declines in cortisol than insecure mothers, hinting secure parents may better regulate stress. This suggests oxytocin's effects are most meaningful when coupled with reduced cortisol, i.e., not just increased bonding, but also reduced threat. Again, this concept aligns closely with the DMM's concept of managing threat; suggesting secure mothers are less likely to feel threatened by infant distress. However, with only two hormonal studies and differing methodologies, firm conclusions remain premature.

In summary, the association between secure attachment and physiological regulation appears robust across ANS and neural domains. However, precise mechanisms remain underexplored, including the direction of effects (whether secure attachment promotes physiological regulation, or vice versa). Nonetheless, these findings support the conceptualisation of attachment as an embodied process.

Insecure Attachment and Distinct Dysregulation Profiles

Broader Dysregulation Patterns

Across studies comparing secure and insecure groups broadly, this review highlighted a pattern of physiological dysregulation associated with insecure attachment.

In neural studies, individuals lower in SBSK exhibited distinct brain activation patterns. These included increased right hemisphere frontal and parietal EEG activity, linked to withdrawal and heightened emotional arousal (Groh et al., 2015), and elevated P3b amplitudes to infant distress, suggesting increased cognitive effort or hypervigilance (Groh et al., 2018). This aligns with theoretical models that propose attachment is underpinned by distinct cognitive-affective processing biases (Crittenden et al., 2008; Main et al., 2000). These differences may reflect underlying disruptions in embodied regulation, as proposed by PVT and Schore's models (Porges, 2007; Schore, 2001). In ANS studies, Xu et al. (2023)

found insecurely attached parents showed flatter RSA and reduced physiological flexibility during parent-infant interactions, in distinct contrast to dynamic RSA modulation observed in secure parents.

Hormonal findings were less consistent. Krause et al. (2016) reported both secure and insecure parents showed post-interaction increases in oxytocin and decreases in cortisol, which differs from Strathearn et al., where differences were more distinct. However, subtle differences were noted in Krause's study: oxytocin increases were more prominent among insecure parents, while cortisol reductions were greater among secure parents. This suggests physiological variability across attachment classifications, though the mechanisms underlying patterns remains unclear.

While insecure attachment is broadly associated with distinct dysregulation relative to secure attachment, findings across studies suggest complexity. However, these results offer limited insight into variation across insecure subtypes. Subsequent sections will explore these distinctions in greater depth.

Avoidant (dismissing) Attachment

The most consistent insecure pattern investigated was avoidant attachment. Results showed less RSA withdrawal, increased activation in the insular cortex, associated with fear, disgust, or body awareness, and reduced oxytocin levels during interactions (Ablow et al., 2013; Groh et al., 2019; Hill-Soderlund et al., 2008; Strathearn et al., 2009). In studies assessing infant attachment (e.g., Hill-Soderlund et al., 2008; Groh et al., 2019), this was associated with altered maternal physiological responses, supporting the bidirectional nature of attachment. This fits with ideas around avoidant attachment as a deactivating or minimising strategy (Cassidy, 1994).

On the surface, it may make sense that, if suppressing their attachment systems, avoidants may feel less physiologically aroused during attachment-related distress, which could explain hesitance or reduced sensitivity (Cassidy, 1994). PVT offers one framework for understanding this. In PVT, the dorsal vagal system supports a 'shut down' response, associated with reduced physiological engagement or behavioural withdrawal (Porges, 2007). Thus, avoidant attachment may involve passive defensive strategies underpinned by dorsal vagal activation, consistent with physiological deactivation.

However, some findings across could suggest more complexity. Ablow and colleagues, who measured both RSA and SCL, distinct measures of PNS and SNS activity, found minimal RSA withdrawal but elevated SCL (Ablow et al., 2013). This suggests a paradoxical state, where both PNS (shut down) and SNS (fight/flight) is activated, whereas other studies looking at avoidant attachment only measure PNS activity (Groh et al., 2019). Thus, mothers may feel internally distressed without outwardly appearing so, which could explain appearing detached. This fits with dismissing mothers rating crying as aversive, or distressing (Ablow et al., 2013) and with neural findings, which show heightened activation in areas associated with pain or disgust. Strong aversion may lead to increased arousal (heightened SNS), even if this is later “suppressed” (shown by PNS activity in RSA studies).

Therefore, avoidant attachment may not be simply “deactivated”, but instead the result of more complex physiological responses involving both increased and decreased activation. This is consistent with Sameroff’s (2009) transactional model, which would interpret these co-occurring processes as dynamically shaped by relational feedback loops, i.e., avoidant strategies might emerge in response to misattuned caregiving, becoming embodied over time. Oversimplification as “deactivated” can perhaps be explained by physiological measurement differences.

While PVT accounts for deactivation as a protective mechanism, it may not fully explain this potential complexity. This points to the value of more nuanced models such as the DMM, which distinguishes strategies that appear similar on the surface, but serve different protective functions. This raises questions about the limitations of the Berkeley model, which tends to group individuals by surface behaviours without identifying function.

As studies use such different methodologies, these interpretations remain tentative. Nevertheless, they warrant further investigation using a variety of physiological indicators to better understand this group.

Anxious (preoccupied) Attachment

This review highlights a lack of data on physiological correlates for anxious groups. Only one study provided findings for this group (Groh et al., 2019). Greater infant anxiety was associated with mothers displaying neutral, rather than positive, facial affect during interactions, even after controlling for sensitivity. However, there was no significant

association between maternal RSA withdrawal and infant anxiety, and no evidence of physiological differences during non-distressing (play) contexts.

These findings suggest maternal emotional expression, rather than autonomic reactivity, may be more closely linked to attachment anxiety in infants. It remains hard to draw clear links between existing findings for this group and embodied attachment theories. However, it is possible inconsistent or emotionally neutral maternal signals contribute to infants' uncertainty, consistent with Solomon and George's (2008) characterisation of caregiving in Type C dyads as marked by uncertainty. This may explain why anxious infants in broader literature show heightened physiological arousal (Borelli et al., 2023).

Importantly, Groh et al. (2019) assessed RSA (PNS activity marker). While RSA is a valuable indicator, it is possible SNS indicators may better capture heightened arousal, if this is characteristic of anxious responses. The absence of group differences may reflect a limitation in the scope of physiological systems assessed, rather than true absence of autonomic dysregulation. Furthermore, no hormonal or neural studies offer specific findings for this group, thus a significant gap remains in understanding this pattern.

Interestingly, this review showed a pattern of excluding anxious groups due to sample underrepresentation. One study attributed this to lower prevalence of preoccupied attachment in the population (Ablow et al., 2013); however, this claim is debatable, and prevalence rates vary significantly. Instead, this could be due to variety in measures used. The AAI identifies fewer preoccupied individuals compared to self-report (Roisman et al., 2007). Thus, reduced representation of anxious groups could be partly due to exclusion of self-report measures in this review.

Low representation of anxious participants may also stem from recruitment strategies. Many studies recruited low-risk, middle-class, or first-time parents, which may skew towards other patterns. Furthermore, anxious parents may be inadvertently screened out due to criteria excluding mental health diagnoses or prioritising psychological stability. This could be particularly relevant given that preoccupied adults are more likely to seek diagnoses and support, potentially making them more visible in clinical samples (Wilkinson, 2004).

Methodological limitations, such as collapsing of insecure groups due to low statistical power, could further contribute to underrepresentation. Nevertheless, physiological profiles for anxious parents remain understudied.

Disorganised (unresolved) Attachment

Studies examining disorganised attachment (parent and infant) suggest distinct physiological dysregulation. Leerkes et al. (2017) found disorganised attachment was not predicted by sensitivity or autonomic measures in isolation (RSA or SCL), but by their interaction. Elevated maternal SNS arousal (SCL) predicted greater infant disorganisation only when PNS regulation (RSA withdrawal) was low. In contrast, high RSA withdrawal appeared to buffer the effects of high SCL. This supports theories proposing that autonomic imbalance may compromise maternal capacity for sensitivity (Bernston et al., 1993).

Complementing this, Nofech-Mozes et al. (2019) observed a pattern of physiological misattunement within disorganised dyads. While most dyads showed relatively parallel cortisol trajectories, disorganised dyads displayed coordinated but opposing responses. Moreover, there was no evidence of predictive attunement: maternal cortisol levels did not predict infant cortisol at subsequent timepoints, and vice versa. This aligns closely with Schore's (2001) theory, which posits attachment insensitivity arises when caregivers are unable to engage in reciprocal, co-regulation with infants. This also aligns with Cicchetti and Valentino's (2015) biosocial perspective, which emphasises early relational trauma can disrupt development of physiological regulation, potentially giving rise to disorganised patterns.

However, this contrasts with Hill-Soderlund et al. (2008), who reported no evidence of physiological attunement in either secure or avoidant dyads. Whilst it is possible physiological attunement looks different for disorganised groups specifically; other factors may explain this discrepancy. First, the physiological systems assessed differed; Hill-Soderlund focused on rapid ANS indicators, while Nofech-Mozes examined hormonal activity. It is possible physiological coordination (or dysregulation) emerges more clearly in slower-acting hormonal systems than in moment-to-moment ANS responses. Analytical processes also differed. Hill-Soderlund looked at whether mothers and infants had similar average physiological levels overall (e.g., both high or both low), while Nofech-Mozes looked at how their physiological responses changed in relation to each other over time. This may have allowed for detection of alternative patterns.

Although studies on disorganised groups remain scarce, these findings suggest they may exhibit distinct forms of dysregulation in attachment interactions. Given disorganised

attachment links with trauma, the exclusion of high-risk samples in this review, such as those with psychiatric diagnoses, may have reduced findings for this group (van IJzendoorn et al., 1999).

These findings raise important questions about the construct of disorganised attachment itself. Individuals classified as “disorganised” within the Berkeley model may represent distinct underlying strategies with differing patterns, some marked by heightened dysregulation, others appearing outwardly controlled (Hadiprodjo, 2018). This speaks to wider concerns about “disorganised” groups as a standalone category. Granqvist et al. (2017) highlighted disorganised attachment was never intended as a classification, but rather a coding index of behavioural conflict within the SSP. It has since been withdrawn as an individual category in many research contexts. Thus, reported findings from groups identified as disorganised must be interpreted with caution.

In contrast, the DMM proposes a more nuanced framework that differentiates between these varied responses, rather than grouping them together. Yet only two studies in this review employed the DMM (Strathearn et al., 2009; Groh et al., 2018), highlighting the model’s underuse. This may limit the field’s capacity to identify distinct strategies. Incorporating more physiological data may offer a way to distinguish between these patterns.

Disorganised and Anxious Attachment as Most Understudied

Despite emerging evidence of distinct physiological profiles for different attachment groups more generally, disorganised and anxious categories remain the most understudied. This gap is more apparent in parental attachment studies, although some evidence emerged examining infant attachment (Groh et al., 2019; Nofech-Mozes et al., 2019). However, preliminary studies on disorganised dyads highlight meaningful dysregulation and potential disruptions in parent-infant synchrony. Anxious parental physiology remains unclear, although studies focusing on anxious infant physiology point towards dysregulation patterns (Borelli et al., 2023). More research is needed to understand these parental groups, with attention paid to their meaningful inclusion and corresponding physiological mechanisms studied.

Underrepresentation likely stems from a combination of methodological limitations, including small sample sizes, collapsing of insecure groups, and recruitment strategies that exclude high-risk populations.

Physiology as an Independent Contributor to Attachment Outcomes

While most research uses behavioural sensitivity as a proxy for caregiving quality, a small number of studies suggest parental physiology may offer additional insight. Groh et al. (2019) found maternal RSA withdrawal during reunion predicted higher infant avoidance at 12 months, even after controlling for sensitivity. Similarly, Koehler-Dauner et al. (2024) reported insecure attachment was associated with elevated maternal HR mediated by increased perceived stress, suggesting a psychophysiological pathway not solely captured by observed behaviour.

Leerkes et al. (2017) found disorganised infant attachment was predicted by heightened maternal SNS arousal (SCL) and poor PNS regulation (RSA), but not by sensitivity alone. This supports the idea physiological dysregulation may impair caregiving capacity independently from observed interaction quality. Nofech-Mozes et al. (2019) likewise identified mismatched cortisol patterns in disorganised dyads that may reflect breakdowns in physiological co-regulation, further evidence of non-behavioural mechanisms influencing attachment.

These findings align with models of biosocial regulation and embodied attachment (Calkins et al., 2007; Porges, 2007; Schore, 2001), suggesting physiology processes contribute meaningfully to attachment. They also support theoretical perspectives viewing attachment as dynamic, relational, and shaped through the interplay of physiology and environmental experience (Bronfenbrenner, 1979; Sameroff, 2009).

Variability Across Physiological Systems and Measurement Contexts

This review highlighted notable variability in findings depending on the physiological systems measured, attachment tools, and measurements contexts. Additionally, there was heterogeneity in the attachment classification systems used, including whether attachment was measured in parents or infants. These differences may have influenced physiological

findings and contributed to divergent results. Measures of RSA were the most consistently reported and interpretable across studies, with clearer patterns emerging for secure and avoidant classifications.

Contrastingly, findings for cortisol and oxytocin were mixed, despite showing potential as markers of stress regulation and bonding. Inconsistencies likely reflect methodological variation, such as differences in sampling timing, task type, and attachment measures. While neural studies provided meaningful insights, these studies were few and tended to collapse attachment groups, suggestive of recruitment difficulties.

Task variation and design may have also contributed to divergent findings. For instance, differences in emotional salience of tasks, such as viewing infant images versus live interaction, child ages, separations versus reunions. Overall, huge variety underscores the need for better recruitment strategies, greater standardisation, and for studies that compare parental physiological responses across multiple systems in parallel to build more integrated understanding.

Strengths and Limitations of Included Studies

Studies included were generally of high methodological quality, employing validated tools for both physiology and attachment. Studies used gold-standard, interview-based or observational methods such as the AAI or SSP, reducing subjective bias and enhancing construct validity. Several studies utilised ecologically valid procedures, including live parent-infant interactions, increasing real-world relevance to everyday contexts.

Nonetheless, several limitations were evident. Firstly, all studies were conducted in Western contexts; specifically in just three countries (USA, Canada, Germany). While some studies attempted to recruit more diverse samples, most drew from White, middle-class, educated populations or did not clearly specify demographics. This limits cultural generalisability and may contribute to the ongoing critique of WEIRD (western, educated, industrialised, rich, democratic) bias and potentially exclusionary practices in attachment research (Henrich et al., 2010).

Secondly, many studies had relatively small sample sizes, which reduces statistical power and limited ability to explore subgroup differences. Thirdly, most included studies focused on ANS measures, particularly RSA as an index of PNS functioning. While valuable,

this narrow physiological focus may miss broader regulatory dynamics involving the SNS, hormonal responses, neurobiological, or other physiological processes. Crucially, there is a lack of studies looking in depth across physiological domains. Fourthly, there was considerable heterogeneity in attachment measures (e.g., AAI, , ASA), which may have introduced inconsistency and undermined cross-study comparability. Finally, the literature remains overwhelmingly mother-centric. No studies assessed paternal physiology, thus limiting insight into fathers' contributions to attachment processes.

Strengths and Limitations of Current Review

The review's focus on normative clinical populations offers valuable insight into typical attachment-related physiological processes without the confounding influence of high-risk factors. This approach is important given the relative novelty of research exploring parental embodied attachment, offering a baseline for understanding. By including a broad range of physiological and attachment measures, the review was able to synthesise findings from diverse studies and highlight emerging patterns across domains.

However, several limitations should be acknowledged. Exclusion of high-risk populations may have excluded studies that capture more complex attachment dynamics, such as trauma-related patterns. Furthermore, although the inclusion of diverse measures increased breadth, it also introduced considerable heterogeneity. This complicated cross-study comparisons and may have contributed to some ambiguity in findings.

While the exclusion of self-report measures was justified to prioritise depth and implicit attachment processes, this excluded studies which may have added additional interesting insight. Finally, including studies only measuring child physiology, in addition to those looking at parent physiology, may have increased insight into the bi-directional nature of attachment. Nonetheless, this review provides an important foundation for understanding the role of parental physiological regulation in an otherwise child-centric field.

Clinical and Research Implications

Findings support growing recognition attachment is not solely a behavioural or narrative construct, but also an embodied process rooted in the parent's physiological

regulation. It also invites curiosity that insecure attachment styles may have different physiology patterns which impact on caregiving. This has important implications.

Clinical Implications

This review highlights the need for parenting interventions to move beyond purely cognitive or behavioural focus and incorporate strategies addressing physiology. Body-based approaches could offer these parents alternative routes to developing sensitivity when verbal or cognitive insight is more limited. Understanding more about embodied attachment may help practitioners and researchers better understand this process, reducing stigma when working with parents who are struggling. Understanding this may help see the distress behind a parent who may otherwise appear disengaged.

Research Implications

This review highlights several important directions for future research. Firstly, there is a clear need for studies to move beyond the ANS and examine alternative physiological correlates of attachment, including hormonal, neural, and other emerging physiological indicators. These may offer additional insights into embodied attachment processes.

Secondly, future quantitative research would benefit from larger, more statistically powered samples, enabling exploration of physiological differences in attachment subgroups. Importantly, as all included studies were quantitative, this highlights the need for more qualitative research to add complementary insights. Additionally, the inclusion of populations with trauma histories may increase understanding of complex patterns.

Furthermore, inclusion of multiple physiological measures across domains within studies is recommended to gain comprehensive insights into embodied attachment processes. Such multi-system approaches may help capture the interplay between physiological systems. Additionally, standardising attachment measures or more clearly articulating how differences in methodology may influence physiological findings would enhance comparability and theoretical clarity across studies.

Further inclusion of diverse populations is crucial, including fathers and individuals from underrepresented cultural groups. This would not only improve the ecological validity

and generalisability of findings but also contribute to addressing WEIRD recruitment biases. There is also substantial potential for research examining interventions aimed at improving parental physiological regulation. For instance, future studies could assess whether interventions enhance physiological synchrony between parent and child, what enables change to occur, and how this is transmitted across generations.

Conclusion

This review aimed to rigorously and comprehensively synthesise findings since 1990 on the relationship between parental physiology and attachment in parent-child relationships, excluding self-report measures. Most studies investigated ANS responses, particularly RSA, with fewer exploring hormonal, neural, or alternative physiological indicators. Avoidant attachment was most frequently studied, while anxious and disorganised patterns remain underexplored. Findings indicated secure parental attachment was associated with greater physiological regulation and flexibility, whereas insecure attachment reflected distinct patterns of dysregulation. Emerging evidence suggested physiological regulation in parents may independently contribute to caregiving behaviour and infant attachment, offering insight into embodied transmission.

Considerable heterogeneity likely contributed to inconsistency across findings. Despite this, the review adds meaningful support to the conceptualisation of attachment as an embodied process. These insights have significant implications for the future of attachment theory, assessment, and intervention.

Future research should prioritise using standardised measures and protocols, incorporate multiple or alternative physiological systems beyond biometric indicators, increase sample sizes, or adding qualitative insights, and deliberately including underrepresented attachment subtypes. There is also a need to diversify samples, particularly the inclusion of fathers and those from diverse backgrounds, and to explore how these insights can inform interventions for parent-child dyads with co-regulation difficulties, especially those impacted by trauma.

Empirical Study

Method

Ethical Approval

Ethical approval was granted by the University of Hertfordshire Ethics Committee (Appendix C). All data were anonymised and stored in line with data protection and confidentiality guidelines (BPS, 2021). Informed consent was obtained, and participants were reminded of their right to withdraw at any time without consequence.

Given the potential for emotional distress, particularly among adoptive parents with histories of relational trauma, care was taken to minimise risk. As participants were already engaged in professional support, distress was not expected to exceed typical day-to-day experiences (NHS HRA, 2023). Nonetheless, participants were fully informed about the study beforehand, offered regular breaks, the option to pause or stop the interview, and signposted to appropriate support services if needed.

Design

This is a qualitative theory-building multiple case study design, guided by McLeod's theory-building framework (McLeod, 2010), which builds on work by Bill Stiles (Stiles, 2007). A qualitative design was most suitable as it allowed for in-depth exploration of complex phenomena, including relational strategies and subtle physiological regulation patterns (Denzin, 2011).

To enhance reflexivity and transparency, a reflective journal was maintained throughout all key stages of this study (see Appendix K for an illustrative extract). This journal documented analytic decisions, evolving interpretations, and the researcher's own responses, supporting critical examination of how personal perspectives might influence data collection and theory development.

This study employed abductive reasoning, moving between inductive and deductive processes in a circular, iterative, structured yet flexible fashion to refine theory across cases. This allowed for understanding of *how* these phenomena are related, rather than *if* they are related. The study combines discourse analysis of MotC interviews with physiological

arousal observations (SAI) to explore how attachment-related caregiving patterns correspond to autonomic regulation. This analytic approach incorporates elements of Fishman’s (1999) Pragmatic Case Study (PCS) model, particularly in its transparent use of illustrative case material.

Whilst other qualitative methods, such as Thematic Analysis (TA) or Interpretative Phenomenological Analysis (IPA) offer valuable approaches, these are limited in accessing relationally complex or defended material. TA is designed to explore patterns of meaning across participants’ accounts and is better suited to nomothetic approaches (examining commonalities across groups of people) rather than exploring individual cases in depth. IPA focuses on how individuals make sense of experiences but prioritises subjective, phenomenological accounts. As this was not a phenomenological study, this approach was less suited for integrating multiple data types (e.g., interview and behavioural observations) or investigating how different features interact.

Grounded Theory (GT), while idiographic (focused on understanding individual cases), is designed to be hyper-inductive and is less suited to refining theory. A theory-building case study design is uniquely suited to this aim, offering the capacity to explore, test, and refine theory while preserving contextual depth and within-case complexity. Paired with the MotC interview, this approach also enabled engagement with unconscious and relational meaning-making processes (Rustin, 2019).

Case-based methodology enables the study of processes, how different elements connect, rather than simple correlation. Unlike statistical or nomothetic qualitative methods, theory-building case study design supports identification of meaningful, person-specific patterns across multiple domains, which is important for this context. This design allowed for comparisons across caregiving contexts (both biological and adoptive) while preserving contextual richness needed to understand individual strategies. This is particularly important given current limited understanding of embodied-attachment within these contexts. Studying multiple cases increases explanatory power and transferability of findings (McLeod, 2010).

Please see Table 7 below for a summary of these steps. Clear theoretical assumptions are outlined in the introduction section of this paper and reiterated in the results section.

Steps	Summary and Application to Current Study
-------	--

1. Develop a theoretical starting point	This involved presenting clear theoretical ideas. This study is rooted in attachment theory and concepts of physiological regulation. It suggests that secure caregiving discourse (assessed via MotC), may be associated with more regulated physiological arousal (assessed via SAI coding), while insecure patterns may be associated with dysregulation or shut down responses.
2. Select a case	This step involved careful selection of cases. Both adoptive and biological parents were recruited, which allows for exploration of how attachment and physiology processes may differ across caregiving contexts.
3. Build a rich case record	This involved gathering multiple forms of data to ensure cases had enough depth to analyse data meaningfully. Each case includes a video-recorded MotC interview and transcript, as well as SAI coded arousal patterns. This data was then integrated to form a fuller understanding of the caregiving relationship.
4. Immersion in the case	This involved showing deep engagement with the material. Each case was explored in depth using MotC transcripts, video data, and arousal coding, supporting a rich understanding of how each parent talked about and regulated their caregiving experience.
5. Apply the theory to the case	Theory was used to inform how data was read and coded. Initial expectations from attachment theory and the MotC/SAI frameworks guided interpretation. For example, that emotionally balanced (secure) discourse would co-occur with regulated arousal, while parent-led (controlling) and child-led (unresponsive) discourse would align with SNS and PNS arousal patterns respectively.
6. Apply the case to the theory	The case was used to inform the theory. When data diverged from expectations, these divergences were used to challenge or refine theoretical assumptions, such as whether regulated arousal can coexist with non-sensitive discourse.
7. Refine the theory	This involved consideration of potential, tentative theoretical adaptations, to account for what the current theory does not explain.
8. Test the revised theory across multiple cases	This involved comparing refined ideas across cases to evaluate robustness and transferability. This step is

	where theory begins to be built, going from isolated insights to a theory with broader relevance.
--	---

Table 7: McLeod's steps

Epistemological Position

This study utilises a critical realist position, which recognises that while knowledge is inevitably shaped by perception, context, and interpretation, it remains possible to make meaningful claims about underlying relational processes. This position stands between positivism, which assumes that reality can only be known through observable, measurable phenomena, and constructivism, which views knowledge and reality as relative, shaped by subjective meaning and social context. It accepts that we cannot step outside of our theoretical lenses, but can seek the most plausible interpretations through transparent, theory-informed inquiry (Maxwell, 2012; Pocock, 2010).

This mirrors the position frequently taken in attachment research (DMM; Crittenden, 2008; Schore, 2001). Therefore, this position is particularly suited to the current study, where caregivers are understood to construct their own meaning of their relationship with their child through their subjective experiences and context, whilst acknowledging aspects of their discourse and physiology can also reflect observable attachment-related processes or defences. The study aims to explore how these domains, subjective meaning (MotC) and observable arousal regulation (SAI), interrelate within and across cases.

Furthermore, the MotC interview itself aligns with critical realism, offering a structured framework for interpreting parental discourse, without claiming fixed truths (Grey, 2025). Both the MotC and the SAI support critical realism by drawing from observable data across different domains of functioning, e.g., the different memory systems in the MotC and physiological processes in the SAI, whilst viewing these within the context they exist.

The DMM model looks not just at what people say, but what they may not feel able to say, reflecting Bowlby's (1980) concept of defensive exclusion, the idea that individuals may exclude from consciousness feelings that are too threatening. Relational meaning is often communicated implicitly, and must be interpreted in the context of the speaker's attachment strategies (Grey, 2025).

This epistemological stance also complements the use of McLeod's (2010) theory-building case study approach, which encourages continual refinement of theory in response to both expected and unexpected findings. This approach supports theory development grounded in evidence, whilst sensitive to individual meaning and reflexively open to complexity.

Participants

Overview

This study formed part of a wider research project examining child attachment and caregiving in adoptive and biological parent-child relationships. Although this study focused on parents, the initial ambitious aim was to recruit 15-16 dyads (parent-child pairs), with children aged between 5-7 years old. Eight dyads were to be recruited from adoptive families and eight from biological dyads.

Sample

Nine dyads were recruited (five adoptive, four biological). One dyad was later excluded because the child did not meet inclusion criteria regarding age and lack of clinical diagnoses. The interview was completed in recognition of participant time and effort, but was not included in the final analysis. The final number of eight dyads was deemed sufficient for within- and cross-case theory development in line with multiple case study methodology (McLeod, 2010), providing rich and diverse data.

Eligibility Criteria

To ensure consistency across cases and support meaningful comparisons, the study adopted specific eligibility criteria. The child needed to be between 5-7 years of age, an age range allowing for relatively stable adoptive placements and IWMs, while also aligning with the broader project's aim to incorporate both narrative and interaction-based child attachment assessments. The study excluded biological dyads with formal clinical diagnoses (likely to impact relational and regulatory processes) to support clear comparisons between contexts.

Participants lived in the UK and spoke English. For adopted families, children had lived with the family for at least one year (in practice, this was several years).

Recruitment

This study used purposive sampling, recruiting participants through a local Occupational Therapy (OT) clinic to ensure samples reflected both adoptive and biological contexts. This method is common and effective in qualitative projects which look at different groups (Etikan et al., 2016). Convenience and snowball sampling were used as secondary strategies, based on practical accessibility. All five adoptive dyads were recruited directly through the OT clinic, where families were already engaged in support. Biological dyads were recruited through local schools affiliated with the clinic or via word-of-mouth referrals from occupational therapists in the service.

Demographic information is presented in Table 9 in the results section.

Materials

Parent Development Interview (PDI)

An adapted version of the PDI interview was used to capture caregiver discourse (Aber et al., 1985). This is a semi-structured attachment interview, which explores how caregivers relate to their child through speech and parenting style. PDI interviews were conducted by the primary researcher face-to-face. In-person interviews were chosen as they were video-recorded for arousal coding, involving identifying subtle arousal indicators which an online interview may have missed.

The PDI is a widely used and validated tool for assessing parental caregiving representations in research and clinical settings (Slade, 2005). Compared to the AAI, the PDI is more directly relevant to understanding the caregiving context, and, by extension, their regulatory style. Furthermore, the research team had access to prior examples of successful PDI interviews coded using the MotC system, the intended analytic tool for this study, and there was potential for this data to contribute to the wider project.

The Meaning of the Child (MotC)

The MotC coding system was used to analyse interviews. The MotC is grounded in the DMM (Crittenden, 2008) and has been validated for use in research and practice (Grey et al., 2017). It is the only discourse-based caregiving tool that explicitly treats physiological regulation as integral to caregiving representations (Grey, 2025).

The MotC assesses not only what caregivers say, but how they construct meaning in their relationship with their child. Grounded in the DMM's focus on self-protective strategies and relational threat, the MotC identifies caregiving patterns such as *secure*, *controlling*, or *unresponsive*. However, it should be noted that, whilst the MotC assigns an overall caregiving classification, it also allows for the possibility of a mixed pattern when a parent shows significant features of more than one category. For example, *controlling-withdrawal* describes caregiving that blends elements of controlling and avoidant (unresponsive) strategies, while *sensitive-unresponsive* captures predominantly secure caregiving with some avoidant traits. These mixed designations acknowledge that caregiving can be more nuanced rather than fitting a single discrete type.

In this thesis, the terms controlling and unresponsive are referred to as *parent-led* and *child-led* respectively, where appropriate, reflecting applied practice terminology (Grey, 2025) and feedback from experts by experience. However, clinical terms are retained where necessary, for example when referring to specific subcategories or mixed patterns, such as *controlling-withdrawal*. A glossary of all terms is provided. This terminology aims to reflect more sensitive language, while remaining conceptually aligned with the MotC framework.

The MotC moves beyond categorical labels by examining caregiver use of memory systems, defensive processes, and emotional expression patterns (Grey et al., 2017). This allows for deeper understanding of relational strategies used in response to relational stress, making it particularly suited to the study's focus on attachment-related caregiving style and physiological regulation.

All MotC interviews were coded by trained and accredited practitioners (see appendix F for an example). This aligns with best practice for fidelity to the MotC method, which emphasises maintaining interpretive integrity rather than eliminating researcher subjectivity (Grey, 2025). Furthermore, undergoing full MotC training would have been challenging within this project's timescale. The primary researcher completed foundational MotC training

to support interpretation of findings. Where appropriate, coding decisions were discussed collaboratively to support reflexivity and analytic rigour.

Physiological Arousal Coding (SAI)

The SAI coding system assessed parental physiological regulation during the MotC interview. This system developed as part of sensory attachment interventions, a practice model integrating attachment theory and sensory processing, detailed in Bhreathnach et al. (2025).

The SAI involves frame-by-frame video analysis of interview segments (see appendix G for an example), examining subtle visual cues such as movement, breath, posture, and gesture, all of which reflect ANS activity. These subtle, often unconscious behaviours give insight into how parents manage their bodily arousal when mildly stressed (e.g., during an attachment-activating interview). The SAI coding identifies the presence or absence of high or low arousal behaviours, their regulatory function, and the overall pattern. This includes patterns of arousal that are lowered via the PNS or heightened via the SNS. Dominant patterns such as secure, controlling (SNS), or unresponsive (PNS) regulation are identified, enabling researchers to consider how well these align with MotC discourse patterns.

Coding was carried out by a trained SAI practitioner. The primary researcher undertook foundational training to support analytic interpretation. This ensured interpretation remained high quality while acknowledging time constraints required for full training.

Procedure

Parents of children aged 5-7 were asked if they wanted to participate in this study. Those who expressed interest were emailed the participant information sheet and consent form (see appendix D & E), which contained the researcher's contact details for queries. Willing participants were offered a choice of dates for the interview. For adoptive families, interviews were scheduled to coincide with existing appointments to minimise travel.

Participants then met the primary researcher at the clinic. They were re-familiarised with the study information, including aims, confidentiality, right to withdraw, and expected duration. Informed consent was obtained before commencing. Interviews were conducted in

private clinic rooms, where video equipment was in place. Interviews lasted between 50 and 90 minutes. Parents were offered breaks throughout.

Upon completion, participants were thanked for their time and escorted back to the office, where refreshments were provided and debriefing offered by the OT clinician. For adoptive parents, this was the clinician involved in their care. Participants were offered a small contribution towards travel costs and a £10 shopping voucher as a token of appreciation. All interviews were subsequently transcribed verbatim, with assistance from a transcription software *Otter*. All transcripts were manually corrected for accuracy. This was shared between the primary researcher and a secondary researcher working on the wider project. This process supported early data immersion and ensured familiarity prior to analysis.

Ethical Considerations

In line with ethical protocols outlined earlier, additional measures were taken to ensure confidentiality and responsible handling of material. Video recordings were stored securely. Initially recorded on an encrypted phone, they were immediately uploaded to the University of Hertfordshire OneDrive and transferred to an encrypted computer, before permanent deletion from the mobile device. Only the primary researcher, research supervisor, and SAI coder accessed the footage. All transcripts were anonymised and assigned pseudonyms prior to coding, consistent with the Data Protection Act (1998). Participants were informed via the participant information sheet of the data retention period, after which all identifiable material will be permanently deleted. All participants consented to use of sensitive video material.

Adoptive participants were recruited via a clinical setting where they were already engaged in professional support, helping ensure participation did not pose additional emotional risk beyond routine engagement. The primary researcher remained attentive to signs of discomfort, offered breaks, and ensured that interviews could be paused or terminated at any time.

Data Analysis

MotC Discourse Analysis

Interviews were analysed using the MotC discourse analysis procedure (Grey, 2025). Analysis focuses not just on content, but *how* it is said. The MotC analyses discourse across multiple memory systems (Crittenden et al., 2011), based on the idea relationship constructs and meaning-making are processed in different ways by the brain. Which systems are used or avoided gives insight into how caregivers construct their relationships. The MotC looks at five memory systems:

- Semantic memory (generalised, verbal knowledge).
- Imaged memory (information stored as “images” which are direct from the senses. Not just visual images but also auditory, tactile, and other sensory forms).
- Connotative language (affect memory, speech that evokes emotion).
- Episodic memory (autobiographical accounts of specific events and their emotional impact).
- Reflective integration (the ability to reflect upon and adjust perspective).

Data was analysed according to five stages: familiarisation, annotation, functional theorising, comparison with exemplars, and final classification (Grey, 2025). *Familiarisation* involved reading the transcript multiple times, to get an overall sense narrative style. *Annotation* involved highlighting key excerpts of the transcript that corresponded to the different memory systems. *Functioning theorising* involved interpreting the purpose of the discourse and how the caregiver’s language functions to protect from threat (e.g., to maintain distance or closeness for the self or child). *Comparison with exemplars* involved looking at other coded examples to support consistency, and position the narrative within other, well-established patterns. *Final classification* involved integrating these stages to identify an overall pattern. These classifications were then used in the broader analysis to explore how discourse-based caregiving patterns related to physiological regulation.

SAI Physiological Coding

SAI coding assessed how parents managed physiological arousal through close observation of sensory-motor behaviours that signal activation or regulation of ANS. Analysis of interview segments were conducted frame-by-frame using video footage of each interview. The focus was not only on identifying visible signs of arousal states (e.g., fidgeting, fist clenching) but on understanding the function of these behaviours in relation to broader regulatory style.

The arousal coding process considered types of behaviours, and whether they suggested attempts to; soothe, upregulate, downregulate, or maintain sufficient regulation to function. Behaviours were interpreted contextually and categorised according to their regulatory function (Bhreathnach, 2025). For example, brisk body movements might reflect attempts to stay alert (low arousal), or signal emotional dysregulation (higher arousal), depending on timing and intensity.

Key categories included:

- Self-Soothing (SS): e.g., stroking, sipping drink.
- Calming Behaviours (CB): e.g., sustained deep pressure, slow rotation of chair.
- Alerting Behaviours (AB): e.g., brisk movements, scratching.
- Postural Support (PS): e.g., leaning on arm of chair, supporting head.
- Narrative (what does this indicate about their physiological arousal).

Behavioural indicators were not viewed in isolation, but as part of a pattern. Coders considered general arousal pattern (e.g., tendency to maintain low arousal or escalate under stress), and how they responded to emotionally activating moments. For instance, low arousal (PNS) patterns often attempt to maintain low arousal through downregulation, whereas high arousal (SNS) patterns generally follow their activation into high arousal states, sometimes with brief moments of self-regulation.

Baseline arousal alone does not determine classification, but rather how the individual manages their arousal; whether they self-regulate in accordance with their pattern or counteract it in the context of relational stress (Bhreathnach, 2025). This interpretation allows for subtle distinctions between, for example, frightened but inhibited patterns versus

expressive and overt patterns. Final classifications (e.g., regulated, PNS-dominant, SNS-dominant) were integrated with MotC discourse classifications for comparison across cases.

The following stages describe how within- and cross-case analyses were conducted. Insights from the reflective journal were revisited throughout the within and cross-case analytic process to check interpretations, ensure consistency with the data, and refine emerging themes.

Within-Case Analysis

Each case was analysed by integrating information outputs from the MotC and SAI, looking for patterns of similarity or difference and organising these into a table (see results). The primary researcher revisited interview transcripts and video footage multiple times, to deepen interpretive understanding and identify illustrative examples supporting or diverging from theoretical expectations. This process is consistent with McLeod's (2010) theory-building case study framework, which draws on Stiles' (2007) model of iterative engagement between theory and data (Stiles, 2007; McLeod, 2010).

Deductive reasoning was used to apply theoretical expectations to the case (e.g., whether secure discourse aligned with regulated arousal), drawing from the theoretical foundation established in Step 1 (*Develop a theoretical starting point*) and applied in Step 5 (*Apply theory to case*). Inductive reasoning supported data immersion (Step 4) and helped identify patterns aligning with theory. Abductive reasoning was used to interpret aspects that diverged from theoretical expectations (Step 6: *Apply case to theory*). This analytic movement between theoretical assumptions and emergent insights supported both fidelity to the theory and openness to complexity (McLeod, 2010)

Each case was explored individually before cross-case comparisons. This approach aligns with McLeod's synthesis strategy, in which the first six steps of theory-building are completed for all cases before refining and testing theoretical ideas across the dataset (McLeod, 2010). This strategy was chosen as it supports the identification of broader patterns across cases, which is particularly valuable when the research area is relatively underdeveloped, and due to the heterogeneity of the cases.

Cross-Case Analysis

A cross-case analysis was conducted to explore patterns and divergences across the dataset. This stage of analysis followed Steps 7 and 8 of McLeod's method: refining insights and testing consistency across cases. A cross-case matrix was developed to systematically map similarities and differences, focusing on observed arousal and caregiving discourse patterns. This enabled structured comparison of how these elements interacted.

The analytical process combined deductive reasoning (testing whether findings aligned with existing theory) with inductive and abductive approaches to identify novel patterns or inconsistencies. Attention was paid to moments of divergence, as well as cases demonstrating complexity or ambiguity in either domain. This process allowed for emergence of key themes which were then interpreted considering related theories.

Rather than aiming for generalisability, this stage developed transferable insights into how caregivers use physiological regulation and relational meaning-making to manage emotional connection under stress. The cross-case analysis thus served to test and expand theoretical frameworks developed through individual case analyses.

Experts by Experience (EBE)

Although efforts were made to involve an adoptive EBE, this was not possible due to practical limitations and time commitments with the clinical referrer. However, a biological parent was recruited to support the write-up stage of this study. This individual took part in a 40-minute discussion with the primary researcher, answering questions on clarity, tone, and accessibility, and offered reflections on language and framing from a parent's perspective. Their insights contributed to enhancing sensitivity to wider caregiver audiences. Reflections from the researcher's own reflective journal were also considered alongside this feedback, helping to integrate EBE perspectives with an ongoing awareness of researcher assumptions and language choices.

Equity and Inclusion

Although efforts were made to involve participants from diverse cultural and socioeconomic backgrounds, recruitment through clinical and school-based networks limited

demographic variation. Nonetheless, families were drawn from various geographical locations, and the inclusion of adoptive parents, many of whom have experience with professional services, enhanced the diversity of caregiving perspectives. Uniquely, this study also included fathers and parents who identify as LGBTQ+.

To address wider attachment research critiques, this study, guided by the DMM and the MotC, adopts a relational, non-pathologising lens that attends to the adaptive strategies caregivers develop in the context of their histories and relationships (Crittenden, 2008). This supports a more inclusive, functionally oriented understanding of attachment. Maintaining a reflective research journal also supported reflexivity in considering equity and inclusion, encouraging attention to how the researcher's own positioning might shape these processes.

Results

Overview

This section presents an analysis of eight parent-child dyads, exploring how attachment-related discourse corresponds with physiological arousal. Drawing on embodied attachment theories, the analysis examines the extent to which caregivers' narrative aligned or diverged from physiology patterns.

The guiding theoretical framework proposes:

- Sensitive caregiving is typically associated with regulated physiological arousal, reflected in balance, mentalisation, and reflective integration.
- Parent-led caregiving tends to co-occur with sustained SNS arousal, characterised by activating behaviours (e.g., fidgeting), an emotionally intense tone, and efforts to control emotions, the child, or narrative. Attempts to mentalise may be distorted, overextended, or reflective of the parent's own projections.
- Child-led caregiving tends to co-occur with PNS dominance. This may present through low muscle tone ("floppy" muscles), efforts to suppress activation, and distancing discourse. Narratives may take a functional or procedural tone, with limited emotional elaboration and a sense of detachment, approaching the interview as a task rather than an opportunity for reflection.

Where such theoretical patterns were observed, they were interpreted as evidence of coherence between caregiving discourse and physiology. Where they diverged, these were examined in relation to context, topic, and momentary regulatory shifts. Such discrepancies offered opportunities to refine theory. As noted in the Method section, the MotC system can also identify mixed caregiving patterns when significant features of more than one category are present. These cases were analysed in the same way as others, and divergence was recorded only when the observed physiological state was at odds with the concurrent narrative within a given segment (for example, if a parent-led passage coincided with PNS dominance).

Findings are presented in three stages. First, an overall results table summarises patterns, coherence, and key observations for each case (table 8). This is followed by detailed

within-case analyses, and a cross-case analysis synthesising shared patterns and divergences across the dataset to explore broader implications for theory (table 10). Demographics are given in table 9. *Please refer to Appendix H for descriptions of the MotC caregiving classifications.*

Pseudonym (adopted/ biological)	Physiological Arousal Pattern	Observed Physiological Behaviour	Attachment Pattern	Discourse Features	Congruent?	Other Analytical Notes
Kurt (adoptive)	Low arousal (PNS)	Frequent calming, self-soothing, and alerting behaviours, indicating low arousal (e.g., hand rubbing, rocking chair, repositioning). Brief signs of high arousal (clenched fists, tension during talks of bullying/birth family), but these are quickly suppressed. Overall, efforts to maintain low arousal are effortful and consistent.	Unresponsive (child-led)	Overall reflects child-led caregiving: Sense of trying to get the interview right and difficulty mentalising. Uses distancing language and appears emotionally detached. Talks about parenting as a “job”, leans on cognition over feeling. Some parent-led features, e.g., unresolved resentment towards child, uses the interview to get across parenting difficulties. Coder notes this was difficult to code.	Yes	Both coders note a sense of helplessness and presence of high arousal/parent-led features as well as low arousal/child-led features. Coding broadly matches; yet appears to be more controlling features in the narrative compared to signs of high arousal. Most high arousal seems to be towards the end of the interview, possibly reflecting fatigue.
Tracey (adoptive)	High arousal (SNS)	Displays high arousal profile marked by frequent calming (e.g., deep pressure, stroking) alongside alerting behaviours (e.g., scratching). However, high SNS arousal is generally sustained across the	Controlling-withdrawal (parent-led)	Narrative reflects controlling-withdrawal: resentment, emotionally dismissive tone, unresolved anger, and focus on own struggles over child’s emotional experience. Minimal mentalisation and strong use of distancing language. Occasional child-led features (spectator stance, emphasis on physical rather than emotional needs).	Yes	Arousal and narrative generally align. Mother appears overwhelmed and uses distance/control to manage emotions. Increasing signs of dysregulation later in interview with fewer regulatory behaviours.

		interview. Thus, signs of downregulation likely reflect SNS collapse into PNS, i.e., high arousal overwhelm which has tipped into a low arousal “crash”.				Likely interplay of high baseline arousal with phases of physiological and emotional collapse (i.e., a tip into PNS overwhelm). However, narrative-physiology fit remains strong.
Toby (adoptive)	High arousal (SNS)	Frequent activating behaviours (e.g., fidgeting with glasses/ring, foot movement, hand slapping, clenched fists), with some, but limited, calming or downregulating behaviours (reflects SNS activation, with far less PNS regulation). Narrative references to high-energy coping with overwhelm (e.g., fast walk when distressed, loud singing) further support high arousal classification.	Controlling-withdrawal (parent-led)	Some early sensitivity, able to take some pleasure in child and is open, however, slightly emotionally distanced overall. Finds it difficult to understand or reflect on his own and his child’s emotions, relying on cognitive strategies and rule-setting to manage relational discomfort. Some unresolved resentment toward the child. Distanced language but emotion is present and held at arm’s length, suggesting he is working hard to control emotions rather than disengaged (as seen in parent-led strategies).	Yes	This case seems to fit clearly with theory and shows that high arousal aligns with parent-led caregiving patterns. However, some brief regulation attempts and sensitivity are still noted.
Fred (adoptive)	Low arousal (PNS)	Low muscle tone and postural collapse observed throughout.	Sensitive /unresponsive	Interview marked by an effort to “get it right” rather than push an agenda, aligning with a child-led	Mostly	This case mostly aligns with theory, showing that low arousal fits with child-

		Repeated use of leaning and postural support behaviours from early in the interview, with tone progressively decreasing. Movements appear low-energy and effortful rather than expressive. Frequent alerting behaviours present, but in context appear to function as attempts to remain engaged, rather than expressions of emotional intensity. Overall pattern consistent with a low arousal classification.	(secure with some child-led features)	pattern. Shows sensitivity through moments of openness, acknowledgment of difficult feelings, and attempts to mentalise, though he does not always stay with emotion for long. Narrative includes some distance and technical language; frequent “cutting off” (stopping before finishing that sentence) speech suggests avoidance of affect. No parent-led markers observed. Overall tone is reflective but somewhat emotionally reserved.		led attachment indicators in the narrative. However, this parent presents with <i>very</i> low arousal yet still demonstrates some sensitivity and reflective capacity and was overall more sensitive than child-led.
Nicky (adoptive)	High arousal (SNS)	Marked high arousal throughout interview, evident from the outset. Displays include fidgeting, foot movement, fisted hands, tense facial expressions, and expressed affect. Occasional attempts to self-soothe using deep pressure behaviours. A key moment of apparent shutdown appears to	Controlling-withdrawal (parent-led)	This parent finds it hard to experience joy in child. Subtle indicators of resentment towards child, projected mentalising (sees own feelings in child), and ventriloquism (using other voices to reinforce own point, typically associated with parent-led parenting). Some distanced or minimising language, but in context appears to function to manage her own feelings of overwhelm (parent-led feature).	Yes	High arousal closely mirrors the narrative tone: difficulty managing emotion, with repeated regulation attempts. Strong internal tension evident. Responses suggest caregiving is experienced as overwhelming. Narrative-physiology alignment fits classification.

		stem from overwhelm, rather than child-led caregiving.		Brief signs of reflective awareness present but not sustained.		
Sophie (biological)	Regulated	Generally regulated across the interview, shown by mild activation (e.g., fiddling with ring, pushing glasses) and occasional soothing gestures (e.g., cupping hand, stroking face). Some SNS behaviours noted (e.g., slapping thighs, flicking hair).	Controlling (parent-led)	Narrative primarily reflects parent-led caregiving, particularly through enmeshed dynamics and epistemic control (i.e., mothers' own perspective is given legitimacy over others). However, some sensitive markers appear, such as reflective functioning and awareness of child's internal states.	Not exactly	Physiology-discourse mismatch observed; parent-led discourse often co-occurs with physiological regulation rather than heightened SNS arousal. This may add complexity to current embodied attachment theories (explored further in the discussion section of this paper).
Molly (biological)	Low arousal (PNS)	Predominantly low arousal profile, characterised by calming and downregulating behaviours (e.g., lip pressing, eye closure, moulding into chair, seeking postural support). Some brief activating behaviours (scratching, repositioning, subtle leg/finger movement) noted in specific moments, but overall	Sensitive/controlling (secure with some parent-led features)	Narrative is warm, open, and emotionally attuned in places, with evidence of mentalisation and repair. Subtle parent-led markers (e.g., need for closeness, slight over-involvement). However, moments of passivity and minimisation also present.	Not exactly	Physiological and narrative pairing differs slightly: while arousal is predominantly low, Molly remains engaged and shows emotional availability. Some mismatch between classification and arousal, though internal alignment (low arousal with child-led features, small moments of activation with parent-led narrative features) is generally consistent.

		pattern is downregulating.				Possibly challenges theory by illustrating that low arousal does not preclude sensitive or subtle parent-led caregiving.
Winona (biological)	Low arousal (PNS)	Predominantly low arousal profile marked by muscle tone loss, postural support-seeking, and calming/soothing gestures. Occasional mild activation (e.g., brief foot movements), which may reflect engagement and sensitivity, but overall pattern is downregulating.	Sensitive/unresponsive (secure with some child-led features)	Narrative is warm, reflective, and sensitive at times, with evidence of mentalisation and emotional attunement. Some sections show passive or distanced language, minimal elaboration, and a tendency to minimise challenges, consistent with mildly child-led caregiving.	Mostly	Generally coherent match between low arousal and narrative style. Some moments of brief activation (e.g., when discussing emotions or being asked about self) but these are followed by regulation. No parent-led markers. Narrative perhaps indicates more sensitivity than physiology alone suggests, although moments of physiological regulation are noted.

Table 8: Results summary

Pseudonym	Approximate Demographics
Kurt & Kiara (adopted)	Male, in his 40s, White British, in a heterosexual couple, working class background. Kiara: female, 6 years old, White British.
Tracey & Edward (adopted)	Female, 40s, White British, in a heterosexual couple, working class background. Edward: male, 7 years old, White British.
Toby & Seth (adopted)	Male, 40s, White British, in a same-sex couple, working class background. Seth: male, 6 years old, White British.
Fred & Mitchell (adopted)	Male, 50s, White British, in a heterosexual couple, working class background. Mitchell: male, 8 years old, White British.
Nicky & Elsa (adopted)	Female, 40s, White British, in a heterosexual couple, working class background. Elsa: female, 6 years old, White British.
Sophie & Lily (biological)	Female, 30s, White British, in a heterosexual couple, working class background. Lily: female, 5 years old, White British.
Molly & Zara (biological)	Female, 20s, White Other, in a heterosexual couple, working class background.

	Zara: female, 6 years old, White Other.
Winona & Ivy (biological)	Female, 40s, White British, in a heterosexual couple, middle class background. Ivy: female, 7 years old, White British.

Table 9: *Demographics*

Case 1: Kurt & Kiara

Observed Patterns

A broadly child-led pattern, shown by frequent and sustained attempts to suppress arousal by engaging in calming and soothing behaviours, paired with distancing language, with a “task” like feel to his responses. When asked, “*could you describe [Kiara] for me?*”, Kurt responded:

“Happy, smiley, jumping around... generally, I'd say quite happy, bouncy girl is what I probably describe her as best. She sort of [brief pause] loves to be dancing, jumping around”

Kurt struggles with limited images of his daughter, making it hard get a sense of who Kiara is. The word “*happy*” is generalised and repeated, giving a surface-level feel to his response. He gives no specific incidences showing Kiara’s personality, suggestive of difficulty with mentalisation. Physiologically, Kurt was observed scratching his head and moving his feet up and down. Kurt keeps his hands in his pockets throughout most of the interview. Pockets feel “safe”, thus is typically classed as a soothing or calming behaviour (i.e., attempt to lower arousal), aligning with the child-led flavour to his discourse.

Furthermore, scratching is an alerting behaviour, that is, a behaviour performed to keep themselves alert during a conversation, again suggestive of low arousal. This is followed by movement of his legs up and down, typically associated with high arousal, particularly “flight” behaviour, often seen when someone wants to escape a situation but cannot. However, in the context of Kurt’s language and other arousal behaviours, this movement appears controlled, only moving in one small up and down motion at a time and is swiftly accompanied by sipping his tea (soothing behaviour). It is also consistently

accompanied with his hands in his pockets, sometimes even observed stretching them out (a calming pressure), all suggestive of frequent attempts to lower arousal, aligning with child-led discourse.

When Kurt is asked who his wife would say Kiara is closest to (and prompted as to why and how this made him feel), Kurt responded:

“She’d say her...because it’s the truth [laughs]. If Kiara had her way, she would live out of Hillary’s rib cage if she could possibly do it [laughs]. She, yeah again, because Hillary is there with her a lot of time...I don’t have a feeling on it really it is what, I felt like that with my mum and dad, but then the relationship changed as I got older... She’ll need something else from me in the future. It’s not a problem, it’s not”

Kurt denies his own feelings, even laughing on two occasions. This is at odds with the potentially painful topic, thus aligning with dismissal of emotions seen in child-led patterns. His comment *“because Hillary is there with her”*, uses cognition to explain their closeness rather than emotional reason, i.e., emotional attunement. This matches child-led reliance on cognitive explanations and reduced tendency to focus on emotions. The overall sense is disconnected from Kiara, one where he imagines she’ll need something far in the future.

Kurt has his hands into his pockets, pushing to stretch them, and then rotates his chair (soothing and calming), engaging in these behaviours at the exact points in which he describes Hillary and Kiara’s close relationship. Both the narrative and Kurt’s arousal paint a picture of someone who felt strong sadness (shown by his subconscious need to self-soothe), but was unable to attend to them, which is consistent with what we would expect in child-led patterns. Please see appendix I for additional examples of this.

However, there are smaller moments where both Kurt’s narrative and physiology appear to align more with a parent-led pattern. When Kurt is asked if Kiara not having a relationship with her birth father brought up feelings for him, he responded:

“He’s just a waste of space [brief pause]. Got no time for him whatsoever, wouldn’t meet us, wouldn’t, didn’t want to engage in social services...he wanted [birth mother] to get an abortion and things. You know, personal choices, whatever, but he didn’t want them...I couldn’t care less. Nothing at all”

Kurt is still dismissive of his feelings, but phrases like “*waste of space*” and words like “*wouldn’t*” meet, or “*didn’t*” engage, suggest Kurt is feeling angry under the surface. The language is not flat or distant, but emotionally charged and evocative, aligning more with language we would expect in parent-led patterns. Kurt moves his legs up and down and clenching his fist at the same as his speech emanates anger, behaviours which indicate a fight/flight response. Furthermore, Kurt’s fist remains clenched for one whole minute, not unclenching until he moves onto talking about how well Kiara gets on with her birth siblings, with little self-soothing behaviours observed. This contrasts with the consistent attempts to lower arousal seen previously by Kurt.

Divergence from Theory

Kurt’s patterns were largely congruent with each other, showcasing a dominant PNS pattern with smaller moments of SNS dominance. Yet there are points which appear to partially diverge from theoretical expectations. The MotC highlighted a higher density of parent-led indicators, while the physiological profile showed only brief (and generally quickly suppressed) signs of high arousal. When describing how Kiara’s behaviour can be difficult, Kurt responds:

“I said no no no no one book, it’s bedtime, one book. Books are thrown on the floor, scattered, stomping through the house, screaming...she’s throwing her arms and legs round”

This intense segment aligns with parent-led patterns of speech: highly emotionally charged, evocative words “*thrown*”, “*stomping*” and “*screaming*” being used to conjure an intense, negative image of Kiara’s behaviour. Despite no real low arousal indicators in his narrative, most of his physiological behaviours are calming or soothing (stroking his wrist, beard, rocking his chair). Although there are moments where he moves his legs, feet, and fingers up and down (SNS behaviours), this is followed by calming behaviours, such as pushing his feet into the ground (deep pressure). Furthermore, as he finishes the episode, he drops his arms and shoulders, indicative of “collapsing” associated with PNS-dominant physiology. This segment illustrates a broader pattern: although primarily child-led/low arousal, Kurt’s narrative more frequently signals parent-led/high-arousal indicators. In other words, Kurt’s narrative “leaks” anger that is not always fully captured in his bodily arousal.

This mismatch highlights divergence from theoretical expectations that parent-led discourse always co-occurs with elevated arousal. See appendix I for another example of this mismatch.

Case Summary

Kurt's case presented a predominantly child-led/low-arousal attachment and physiological pattern, marked by consistent self-soothing and distancing language. However, his narrative revealed a higher density of parent-led indicators than would be expected based on his physiological data alone, suggesting some divergence between verbal and physiological expression.

Case 2: Tracey & Edward

Observed Patterns

Tracey presents with heightened arousal, aligning with her use of a parent-led attachment strategy (controlling-withdrawal). This is evidenced in the form and content of her discourse. When describing feeling angry with Edward, she states:

“And I'm like, don't wave your arms about, because then she [dog] thinks you're wanting to play like that with her teeth...you're letting her bite you...then she thinks she can go around biting everyone else... he thinks it's funny, and I'm like, it's really not”

Tracey's focus is behavioural correction, with little reference to Edward's emotional experience. The framing of Edward's behaviour introduces subtle blame attribution. These features are common in parent-led strategies. Concurrently, Tracey displays indicators of SNS activation, including exaggerated facial expression, tongue protrusion, a sharp exhale, and a brief, but rapid, up and down leg movement. These behaviours serve as energy discharge mechanisms, indicating SNS mobilisation and aligning with the attachment strategy.

This alignment continues when Tracey is asked about the emotional impact of her anger on Edward:

“I think its frustrating because, we're constantly having to tell him..., we've got friends who has a younger daughter. I'm like, she's little, you know? How would you feel if Rover [dog]

had done that to her?”

Tracey’s response is framed in terms of her frustration and concern for others, again with minimal mentalisation or consideration of Edward’s emotional experience. Tracey continues:

“He’s not bothered. He’s not both- he doesn’t seem bothered, because he still will carry on”

This illustrates a struggle to access Edward’s emotional world, resulting in dismissal of his emotions. This is accompanied by matching markers of SNS arousal (scratches her neck, pulling a stern facial expression, rapidly circles thumbs). These behaviours suggest discomfort with Edward’s emotions, rather than simply not attending to them as with child-led strategies. Taken together, Tracey’s physiological presentation and discourse aligns with theoretical expectation that SNS arousal is paired with parent-led strategies (See appendix I for more examples).

Divergence from Theory

While Tracey’s narrative is marked by parent-led (specifically, controlling–withdrawal) features, including distancing language paired with behavioural control, there are moments in which her physiological responses suggest dominant PNS activation, associated with low arousal or child-led strategies. These instances appear to diverge from what theory suggests.

When asked to describe a time she felt patient with Edward, Tracey reflects on a period of intense stress:

“You try to hold down a job, part time, and then school clubs are telling you we can’t have him as long as you need him to be here for because we think it’s too long of a day for him....so I had that stress. So then I had to change my hours...I was like, I just can’t do this. So I had got signed off...it took me a year to kind of like, go, I can’t do it. Can’t do it”

The content retains a controlling-withdrawal tone (distancing “you try”, emotional overwhelm, repeated emphasis on incapacity), yet her physiology appears PNS dominant and self-soothing (pressing hand between thigh and chair, pressing lips, stroking thigh). In context

of chronic overwhelm, these responses may reflect a *PNS collapse* pattern, observed in individuals with sustained SNS arousal who move into hypo-arousal under emotional strain.

This pattern is echoed later, when Tracey is asked to describe herself as a parent. She initially replies, “*I hope I’m a good parent.*” When prompted for an example, she places her hands behind her back, suggestive of postural collapse (low muscle tone), before stating:

It’s hard [pauses]. I’m trying to think of everything, isn’t it like ...because I don’t have much confidence in myself...But no, I just hope I’m doing the right things for them. That’s all you can do, really”

Tracey rocks gently side-to-side and presses her tongue into her cheek (PNS behaviours), whilst her discourse reflects difficulty accessing episodic memory and limited mentalisation (controlling-withdrawal indicators). While this moment suggests temporary divergence from her dominant SNS pattern, they are perhaps more accurately interpreted as collapse under prolonged SNS strain, or a need to downregulate due to persistent high arousal, rather than evidence of an opposing pattern (see Appendix I for another example).

Case Summary

Tracey’s interview reflects a match between a parent-led strategy and SNS-dominant physiology. While moments appear to diverge from theory, these are suggestive of PNS collapse following prolonged SNS activation. While at first glance this appears to contradict theory, a more nuanced interpretation suggests these physiological shifts remain consistent with a high arousal, parent-led strategy under strain.

Case 3: Toby & Seth

Observed Patterns

From the outset, Toby displayed signs of SNS arousal, evidenced by rapid and repetitive behaviours such as spinning his ring, adjusting posture, laughing in a high-pitched tone, and checking his watch. These all occur in quick succession during a moment of low relational demand (i.e., while the interviewer adjusted the camera). This unprompted activation, paired with minimal use of self-soothing or calming behaviours, aligns with SNS-dominance.

This is further evidenced as the interview continues. When asked about how his worrying impacts Seth, Toby again engages in fast ring spinning and briefly sticks out his tongue, both SNS indicators. This occurs as he pauses to consider the question, suggesting the topic triggers physiological tension:

“I try to be sensible about the things I am concerned about... I will not allow Seth to see that I'm worried about those things or how it's affecting me. Instead, I'll wait until he's in bed...I'll kind of hold on to them until Seth's kind of asleep and out the way.”

As he speaks, Toby briefly rubs his eyes, rocks his chair side-to-side, and gestures sharply with his hands. The pace and firmness of these behaviours suggests they function as energy-discharge behaviours (SNS). The narrative supports this. Toby describes himself as “sensible” in his emotional approach: language that suggests an intent to manage and contain emotion, rather than process or share it. Emotions are treated as potentially disruptive, and Seth is positioned as someone who cannot witness them. This dynamic reflects a parent-led stance, where emotional control is prioritised over relational connection. Toby's reference to needing Seth “out the way” also perhaps reveals subtle resentment and distancing, characteristic of controlling-withdrawal, where anger is present but not acknowledged.

Toby later acknowledges emotional blind spots:

“But in honesty, that probably doesn't always happen... the selfish part of that is I'm probably too deeply concerned with the worries that I've got to actually know what it's doing to him.”

This admission shows some reflective capacity, characteristic of sensitive parenting. However, as he finishes this sentence, Toby glances toward the door and spins his ring even faster, fitting with SNS “flight” mobilisation. Although he can reflect, the process seems to provoke discomfort or overwhelm, suggesting for Toby, withdrawal functions to regulate affect in moments of relational intensity.

This pattern continues when Toby is asked to describe when he felt angry with Seth, recounting an incident on the way to school:

“He just resorted to sort of like, name calling and stuff like that, which started to wind me up a bit. And I think he knew it as well. And then he just decided to stand still and fold his arms and just wouldn't move. And at that point I was angry with him... we eventually overcame it... but in that moment I was, yeah, I was pretty cross.”

This passage reflects a controlling-withdrawal pattern, in which a parent subtly attributes blame while minimising emotional intensity. The phrase “*pretty cross*” softens what was likely a more significant emotional response. Conflict is described as resolved through functional closure, rather than emotional repair, suggestive of relational distancing to manage emotion. When he says, “*in that moment...I was pretty cross*”, Toby is observed frowning and tensing his fingers, indicating increased muscle tension, consistent with SNS-dominance and aligning with the parent-led narrative. Absence of soothing and calming behaviours add weight to this pattern.

Toby’s narrative and physiology demonstrate alignment between SNS and parent-led patterns. His bodily behaviours consistently indicate activation and containment, while his discourse reflects emotional distancing, suppression, and subtle blame attribution. These features suggest a strategy centred on managing internal emotional states through relational control and withdrawal, particularly when faced with emotionally threatening content. See appendix I for further examples.

Divergence from Theory

While the passages described above reflect alignment, Toby displays occasional moments of self-regulation and downregulation. When asked to describe a time he worried about doing enough as a parent, he responds:

“I got a message later on that night to say that Seth wasn’t welcome back to football again from his coach. And I kind of, I was really upset and really angry...I kind of questioned myself...did I give enough time to the coach to try and help the coach understand Seth’s, like, needs”

As Toby acknowledges difficult feelings, he presses his fingers tightly together (deep pressure) and strokes his hands (self-soothing), indicating an attempt to manage or reduce his arousal. However, this is immediately followed by SNS behaviours (rapidly spinning his ring, pulling it on and off repeatedly). This sequence, moving from emotional disclosure to a short-lived downregulation attempt, followed by a return to activating behaviours, suggests a transient effort to regulate, quickly overtaken by SNS-dominance. Elsewhere, Toby shows

other brief attempts to downregulate in response to emotionally loaded content (see Appendix I).

Case Summary

Toby's physiological arousal and attachment narrative are broadly congruent. His interview is marked by consistent SNS arousal and minimal soothing, alongside language that reflects efforts to manage emotion by keeping it at a distance (controlling-withdrawal, parent-led). Occasional moments of attempted downregulation emerge but are brief and quickly overridden by SNS activation. These findings support the theoretical link between parent-led strategies and SNS-dominance, while highlighting potential for momentary shifts in regulation under emotional pressure.

Case 4: Fred & Mitchell

Observed Patterns

Fred's overall physiology pattern was low-arousal (PNS-dominant). This was evident across several points when he was asked to describe emotionally charged situations. When describing how his relationship with Mitchell was "*tumultuous*", he stated:

"So there's these outbursts that have happened numerous times over the years. They often result in violence... so he broke the TV downstairs. He threw something at the TV...that was a real moment where I was really quite annoyed to say the least"

Fred crosses his arms and ankles (calming, pressure-seeking behaviours), and slides back into his chair, suggesting reduced muscle tone and postural collapse, consistent with PNS-dominance. As he continues, he sinks further into the chair, suggesting for Fred, strong emotional content triggers hypo-arousal, rather than the SNS activation.

When asked what he thinks motivated Mitchell's behaviour, Fred replies:

"he's just not in any way thinking rationally... sometimes, for me, it's really difficult to understand that, because I think he's acting out of malice, when he's not...it's all part of my learning and understanding him as well"

Fred self-soothes (stroking hands, continuing to sink into chair), reinforcing a low arousal pattern, particularly in emotionally demanding moments. While the narrative reveals an effort to mentalise for Mitchell (a feature of sensitive caregiving), Fred's admission that this is difficult suggests this mentalisation may be effortful, rather than his default response. This is supported elsewhere, where Fred's language retains a cognitive and emotionally distanced tone. When offering an instance of closeness, he states:

“During that holiday, there were certain times where we were just on the beach or chilling out, where we could actually communicate in a loving way, you know what I mean”

Use of vague temporal markers “*certain times*” and the framing of love professionally in terms of “*communication*” points to limited emotional elaboration, aligning with a more distanced, child-led pattern (see appendix I for more examples of his low arousal and matching attachment strategy). However, there are also several examples of more sensitive caregiving. This divergence will be explored in the next section.

Divergence from Theory

Fred demonstrates multiple instances of reflective, emotionally attuned parenting, including the ability to take pleasure in their relationship, mentalise, and acknowledge relational rupture and repair. These qualities are typically associated with sensitive caregiving. However, when considered alongside his physiology, this presents a partial divergence from expectations. Given his low arousal, we might anticipate a more uniformly child-led narrative style. Instead, Fred exhibits a “sensitive-unresponsive” profile, marked by emotional availability that appears effortful but genuine.

When discussing a time he and Mitchell “*faced off*,” Fred reflects:

“I can get triggered, and in the moment, I get angry...we both kind of face off to a degree, and then afterwards we come back together and we talk about what's happened.”

Fred articulates clear evidence of rupture and repair, recognising his own emotional responses while distinguishing them from his later behaviour. Yet physiologically, he responds by leaning back in his chair (seeking postural support), consistent with low arousal.

When describing a moment of pride, Fred states:

“I often feel proud of Mitchell when he’s in a social circle... he turns into this great leader... and I really, when I see that, I really feel like proud of him.”

Fred shows a combination of self-soothing (stroking hands) and postural support (head resting on hands), followed by a shift into an open, relaxed hand posture. This open gesture suggests calm, regulated engagement, indicating that emotional attunement is accessible, even in the context of ongoing hypo-arousal. This moment challenges assumptions low arousal always correlates with child-led caregiving patterns (see appendix I for more examples).

When considering Fred’s physiological trajectory across the interview, the depth of hypo-arousal becomes more pronounced. At seven minutes, he begins to slide back in his chair. By twenty-seven minutes, he rubs his eyes; by forty-five minutes, he leans significantly to one side, head tilted, eyes closed. These observations indicate significant PNS dominance, particularly during moments of emotional intensity. While Fred’s discourse reflects moments of engagement and reflection, his physiology remains markedly subdued, partially diverging from what theory would predict in parents displaying sensitive caregiving.

While Fred’s arousal is low, there is a notable instance of SNS activation. When describing Mitchell’s social difficulties and his own emotional response, Fred states:

“It makes me feel annoyed... he’s just such a great kid inside... and that’s really where we’re trying... to get him comfortable in school so he can learn as much as he can... it’s quite a lot to ask of a child.”

Fred’s right hand forms a clenched fist (SNS “fight” response), while his left hand engages in fine motor control (fingertip-to-thumb contact), suggesting cognitive processing and affect regulation. This asymmetrical gesture indicates internal conflict: Fred is emotionally activated but also working to regulate, or make sense, of that emotion. This represents a brief departure from his typical pattern, offering evidence child-led patterns may display flashes of SNS activation in areas of emotional importance.

Case Summary

Fred’s case presents low arousal physiology, aligning with some child-led attachment tendencies. His interview is marked by postural collapse, self-soothing, and subdued

engagement during emotional topics. However, his narrative also contains reflective capacity, mentalisation, and emotional openness, qualities typically associated with sensitivity. He also displays brief SNS activation. Whilst in broad alignment, these examples suggest subtle but meaningful nuance to theoretical expectations. His case highlights sensitivity can exist with low-arousal.

Case 5: Nicky & Elsa

Observed Patterns

Nicky presents using a parent-led attachment strategy (controlling-withdrawal) and her physiology strongly aligns with this classification. Prior to beginning, Nicky exhibits signs of SNS activation (rapid foot movement, darting eye gaze, biting her finger). Simultaneously, she presses her arm between her torso and the chair, leaning on her other arm, and stroking her chin (self-soothing). This combination of activation and immediate regulation suggests Nicky enters the interview in a heightened arousal state. As the interview progresses, SNS-dominance is consistently maintained and accompanied by matching, parent-led narrative.

When asked to describe herself, Nicky reflects on emotional demands of parenting:

“I feel like I'm always on a treadmill of life...the children, they require a lot of me...they've got a lot of needs. They want one to one attention all the time”

The metaphor of a “*treadmill*” conveys relentless exhaustion, while describing the children as requiring “*a lot*” suggests a feeling of intrusion and overwhelm. This framing is consistent with controlling-withdrawal, where parents experience neediness as burdensome and manage this by maintaining emotional distance. Physiologically, Nicky gestures firmly and rapidly. As she utters “*children*,” she clenches both hands into fists: a clear marker of SNS “fight” mobilisation in relation to caregiving.

When discussing her own parental relationships, Nicky describes longstanding resentment towards her mother:

“And I felt so angry.... how dare you blame dad... does that mean that, like, you know, you've just left it [her health] so bad? Does that mean you don't care about your husband, your kids, your grandkids?”

The anger in this passage is explicit, not only through Nicky's own labelling, but also through use of accusatory, morally charged language. This is accompanied by escalation in her physiological activation (gesturing firmly, pointing finger, taps foot, voice raises). These are consistent with SNS activation, mirroring the emotional content and reinforcing the connection between her attachment and physiology. See appendix I for more examples of Nicky's parent-led strategy and matching SNS-dominance.

Divergence from Theory

There are moments that show a temporary shift towards downregulation. These moments are typically associated with low arousal, child-led patterns and suggest brief efforts to suppress or contain affect. When asked about a time she and Elsa "clicked," Nicky reflects on their quality time:

"She sort of not gets pushed to the side. But it's kind of like, hang on a minute. I've got to deal with [sister]. So it's quite nice to have that time with her on a Tuesday where we can just, it's 100% her. It's all about her, you know, and it's what she wants to do. I ask her what she wants to do"

While this conveys warmth and attachment intention, the language remains subtly distancing. The phrases "*sort of*" and "*kind of*" reflect hesitancy, which may signal discomfort with directly acknowledging difficult relational dynamics, aligning with controlling-withdrawal. The generic phrase "*it's all about her*" lacks emotional and behavioural detail, suggesting limited mentalisation.

Nicky displays some activating behaviour (e.g., foot movement), but also demonstrates clear attempts to downregulate (interlocking fingers, applying pressure to wrist, repeated finger squeezing). These behaviours momentarily diverging from her parent-led narrative. See appendix I for another example.

When asked about the impact of her angry feelings on Elsa, Nicky responds:

"I think she sometimes...sort of feels a bit incompetent"

Again, the tentative phrasing "*sort of*" reflects emotional distancing. During this moment, Nicky holds her drink with interlocked fingers (self-soothing) before recounting when Elsa accidentally stained the carpet:

“I was like, oh, Elsa for goodness sake, like, and she was like, oh, sorry, mom. And I'm like...that's going to stain the carpet”

Nicky's posture visibly collapses (arm leaning, progressive slumping, head resting in hands). This suggests dominant PNS activation and appears at odds with her high arousal profile. However, it is perhaps best understood as PNS collapse following emotional overwhelm. Rather than reflecting a fundamentally mismatched pattern, this moment likely illustrates a shutdown response to emotional overload.

Case Summary

Nicky SNS physiology and matching parent-led strategy generally aligns with theoretical expectations. There is sustained SNS activation paired with a narrative that conveys emotional intensity and relational strain, managed by subtle distancing (controlling-withdrawal). While she occasionally attempts to downregulate, these moments appear secondary to overwhelm. This case offers a strong example of theoretical congruence between attachment and physiology, whilst also illustrating nuanced, dynamic regulation efforts that can emerge under emotional pressure.

Case 6: Sophie & Lily

Observed Patterns

Although Sophie presented with a parent-led strategy, her interview includes moments of sensitive caregiving, with signs of regulated physiology. When asked how her relationship with Lily influences her development, Sophie reflected:

“I feel that I give her time to be herself...I try really hard to think about what's happening underneath for her. So not just taking that behaviour as behaviour, but trying to work out or what's going underneath, why is she reacting”

Sophie demonstrates capacity to recognise Lily's individuality and interpret behaviour as communication, both characteristic of sensitive caregiving. Physiologically, she engages in a mild, controlled gesture (fiddling with her ring), suggesting light activation. The rest of her physiological remains regulated, with no marked signs of heightened or reduced arousal. She concludes by cupping her hand, a soothing behaviour indicative of containment.

When discussing challenges of parenting, Sophie states:

“Food is a huge area for Lily. I don't think for her, that's what she would see she has most trouble with, but for me as a parent, that's an area I have most trouble with”

Sophie evidences ability to differentiate her own perspective from Lily's, indicative of reflective functioning often associated with more secure caregiving. Concurrently, she exhibits both a soothing gesture (stroking) and a mild activating behaviour (pushing her glasses), indicating modest arousal. The absence of extreme physiological shifts, despite the topic's potential difficulty, supports emotional regulation.

However, Sophie's narrative and physiology also reflect some parent-led dynamics:

“talking to people is definitely an area she finds tricky...how to manage those feelings of embarrassment at her age often comes out in things like she might want to suck my finger...she definitely looks for like co-regulation...sometimes she surprises me, and really...blows those expectations out of the water; and she's fine”

Sophie framing of Lily's emotional responses, her emphasis on “*expectations*” and violent imagery of “*blowing [them] out of the water*” implies a fixed standard for Lily's emotions, suggesting an underlying need to manage her reactions (parent-led). The language also suggests suppressed discomfort (imagery), which is not acknowledged.

Sophie slaps her hands on her thighs three times (activating behaviour), strokes her face (soothing), and flicks her hair (activation). While self-soothing suggests attempted regulation, the dominance of activating behaviours aligns with the parent-led narrative. See Appendix I for another example.

Divergence from Theory

However, there are several instances where Sophie's regulated physiology co-occurs with parent-led narrative, diverging from theoretical expectations. When describing a moment of “clicking” with Lily, Sophie responds:

“She asked to come and sit on my lap...I was responding to a message to somebody, and I said, okay... she likes to lay kind of face forwards [gestures near Sophie's face]... yeah, I don't know, it's that feeling of almost just being one person when we do that”

This reflects potential enmeshment through both verbal and gestural communication. Her comment “*being one person*” signals blurred boundaries, a dynamic commonly observed in enmeshed, parent-led patterns. Despite this, Sophie’s physiology remains largely regulated (rests head on hand, gesturing gently how Lily lies on her). Her affect is soft, smiling as she notes Lily is “*very cuddly*,” highlighting a mismatch between narrative and her regulated state.

This is further reflected when Sophie uses three phrases “*emotional crutch*,” “*advocate*,” and “*very close bond*” to describe their relationship. Viewing herself as Lily’s “*crutch*” suggests possible emotional dependency, while emphasis on a “*very close*” bond, paired with her observation Lily finds it “*tricky*” when someone else puts her to bed (i.e., her father), implies limited capacity for other important relationships. In her role as “*advocate*,” Sophie states:

“They [other family members] see Lily as being difficult...professionally, working with similar children, I see, you know, I see that it's not that”

While this may reflect some sensitivity in wanting to understand Lily, it also suggests subtle epistemic control (parent-led). Sophie positions herself as the sole figure understanding Lily, where her interpretation holds primacy over others’ views. Sophie remains regulated throughout this twelve-minute segment, showing only minimal SNS behaviours (e.g., adjusting glasses, rubbing nose) and PNS indicators (e.g., resting head, stroking chin), which suggests mild engagement rather than significant arousal. This illustrates further divergence from theoretical predictions that parent-led strategies co-occur with SNS-dominance. See Appendix I for additional examples.

Case Summary

Sophie presents as regulated physiologically, yet her narrative reflects notable parent-led features, although some sensitivity is observed. While moments of attunement align with regulation, there are also instances, involving enmeshment and subtle boundary-blurring, where parent-led discourse emerges without corresponding SNS arousal. This mismatch represents meaningful divergence from theoretical expectations and adds nuance to the attachment-physiology relationship.

Case 7: Molly & Zara

Observed Pattern

Although Molly displayed low-arousal overall, moments in her narrative and physiology align with sensitivity, with some parent-led indicators (sensitive-controlling). When asked about frustration towards Zara, Molly responded:

“It's easy to say it because I'm an adult, but it's a bit frustrating when I have to repeat myself... She's convinced herself that her brother hates her...I get a bit frustrated when I'm trying to explain to her; it's not that it's autism”

Molly demonstrates some perspective-taking; acknowledging as an adult she understands differently, reflecting some mentalisation consistent with sensitivity. However, repeated reference to her “*frustration*” subtly centres her emotional experience. The attempt to rationalise Zara’s view (“*it's not that*”) suggests cognitive correction. This emphasis on managing the narrative rather than validating Zara’s experience reflects parent-led tendencies. Molly fidgets (shifts arms repeatedly), which may reflect activating behaviour, aligning with subtle SNS arousal. This pattern continues as she elaborates:

“I can find frustrating...other things, silly things. Don't want to do her homework. Zara, come on, we need to sit down. We need to do homework...doesn't want to do her spelling, things like that, doesn't want to sit down and have dinner”

Describing challenges as “*silly*” suggests some reflective distance, a recognition these difficulties are minor, consistent with sensitivity. However, repeated focus on compliance (“*sit down*”) and framing of Zara as oppositional, suggests parent-led features (e.g., rule-setting, positioning child as difficult). Physiologically, Molly engages in activating behaviours (scratches nose, tucks hair behind ear), matching the narrative tone.

While these moments highlight traces of high arousal features, they do not reflect a consistent match. Rather, they represent isolated features that, in the context of overall low arousal, may point to incomplete alignment. In other parts, Molly’s low arousal aligns more closely with subtle child-led narrative features. When asked about a time she felt joy in parenting, she replies:

“Daddy set a challenge. By the time I come home from work, I want to see you skipping...she was at it for hours and I woke up knowing nothing. She wasn’t [going to] stop. I had to tell her, stop. You’re all sweaty, it’s too hot”

Although this seemingly relates to pride, emotional expression is constrained. Molly offers little elaboration on her affective experience and instead centres physical caregiving, only acknowledging her own emotional response after later prompting. Her comment she *“woke up knowing nothing”* signals a degree of attentional and emotional distance. The phrase *“I had to tell her”*, reflects delayed engagement, resonating with features of child-led caregiving where emotional cues may be noticed but not acted upon promptly.

Physiologically, Molly demonstrates consistent matching low arousal (calming and soothing) during this passage (clasps, fingers, stroking chair, touching ear). At one point, her foot moves forward, suggesting mild activation, such as pride, but this is quickly retracted as she returns to clasping her hands (consistent with PNS-dominance). See Appendix I for further examples.

Although Molly’s physiological profile remains predominantly low throughout the interview, this does not appear excessive or dysregulating. She remains engaged without signs of significant collapse, suggesting capacity to sustain regulation within a lower range, even in absence of explicit regulatory behaviours.

Divergence from Theory

Other aspects suggest mismatch between her PNS-dominant physiology and attachment strategy. For instance, when describing not “clicking” with Zara, Molly responds:

“She thinks that I love him [brother] more...I’ll have to sit down and explain to her, it’s not this. It’s because...he’s got autism...so mummy has to be on top of him all the time...she’ll go quiet for a few minutes, but then she’ll come over... we’ll have discussion, sit down and talk. I’ll tell her she’s my favourite, and then it’s all gone”

Molly demonstrates clear effort to mentalise and attune to Zara’s emotions, responding with comfort and reassurance. Her language suggests intention to repair and re-establish connection. These markers are more reflective of sensitive caregiving than any parent-led strategy. Physiologically, Molly downregulates (grasps fingers, swallows,

interlocks hands, presses heel into floor). These are consistent with calming and self-soothing behaviours. The occurrence of low arousal with sensitive caregiving constitutes a notable divergence from theoretical predictions that low arousal is associated with child-led caregiving. Similar examples of this pairing recur (see Appendix I), suggesting this represents a broader pattern rather than isolated incidences.

Case Summary

Molly presents with PNS-dominant physiology, not fully aligning with her attachment classification (sensitive–controlling). While isolated moments reflect subtle activation and low-level parent-led caregiving, these do not amount to a consistent pattern. Instead, Molly’s low arousal tends to coincide either with sensitive caregiving (e.g., mentalisation, emotional repair) or child-led features (e.g., emotional distancing, minimal elaboration). Molly’s case also showcases the existence of low arousal alongside sensitivity. This will be explored further in the discussion section.

Case 8: Winona & Ivy

Winona presents with predominantly low arousal, which appears to align with subtly child-led features in her narrative. When asked when she and Ivy were “clicking,” she responded:

“We were making slime, um, which isn't my favourite thing [giggles]...but she is [into it]. I've sort of accepted that she is... it just kept going wrong. It just didn't make slime. So we ended up just putting more and more ingredients and getting messier and messier. And yeah, it was a lot fun”

Winona’s description suggests passive engagement (“*I’ve sort of accepted*”), conveying emotional distance and limited affect characteristic of child-led caregiving. Her selecting this experience as showcasing connection, despite acknowledging lack of enjoyment and without elaboration of any emotional experiences, hints at detachment. Use of the term “*fun*” appears incongruent with her apparent disinterest.

When prompted to expand on why it felt like “clicking”, Winona continued:

“We were communicating well, we were discussing and negotiating calmly and positively”

This emphasis on cognitive interaction, “*communicating*,” “*discussing*,” “*negotiating*”, rather than emotional connection reinforces emotional detachment. Physiologically, Winona displays low arousal, including self-soothing (stroking hair, holding ear, holding necklace), as well as low muscle tone (leaning back in chair, repeated hand flopping). Her foot rises slowly and is held briefly, indicative of containment, suggesting mild emotional activation and engagement consistent with regulated physiology. However, most arousal behaviours remain PNS-dominant (see Appendix I for further examples).

There is also evidence of regulation paired with sensitivity. When asked to expand on her description of their relationship as “*very close*,” Winona stated:

“So I think about, like bedtimes. I’ll sit with her until she falls asleep...she’ll set up all her favourite little teddy toys or teddies...we’ll snuggle up together or we’ll read a story, and then she’ll gladly drift off...like a physical closeness, but also an emotional closeness”

The narrative is warm and affectionate, hallmarks of sensitivity. Physiologically, Winona appears mostly regulated. She remains sitting back in her chair (perhaps indicative of slight low arousal), only moving and holding her foot in a slow, controlled movement (indicating engagement). She otherwise shows minimal signs of arousal modulation (a need to up or downregulate), indicating a calm, regulated state that matches the sensitive narrative.

Divergence from Theory

Although Winona’s overall physiology is low arousal, her narrative frequently reflects emotional attunement and reflective capacity (sensitive caregiving markers). When she is asked to describe when she and Ivy were not “clicking,” Winona recounts a bedtime interaction:

“Mum, I’ve just got to put the barbies to bed...and I’m not especially good at keeping an eye on the time, so maybe I didn’t keep on top...and I turned around and she’s opening the slime. And I am just like [brief pause] getting a little bit exasperated...but to her, it felt really important”

Winona demonstrates reflective awareness of her own role (“*I didn’t keep on top*”), as well as the ability to mentalise Ivy’s perspective (“*to her, it felt really important*”), core

features of sensitivity. However, her physiology suggests a low arousal state (leans laterally in chair, reaches to clasp ankle), indicative of reduced muscle tone and self-soothing. This represents a divergence between her attachment discourse and physiology. See examples Appendix I for further examples.

Additionally, there is a brief instance of increased physiological arousal that diverges, to some extent, from theoretical expectations. When asked about anger with Ivy, Winona replies:

“the initial reaction is kind of me flaring up and going grrr [imitates angry sound]. But then when she's really heightened, I know I need to calm down in order to help her...I am able to sort of bring myself down... kind of say things like, I can see you really angry right now. How about we, and then offer a solution. Or I'm feeling a bit wind up by this right now, I'm going to try and do some deep breaths”

The term “*flaring up*” is emotionally charged, suggesting brief shift into SNS activation. This is supported by her physiology (raised arms, tensed fingers, exaggerated facial expression with wide eyes and bared teeth), all classic signs of heightened arousal. However, this is immediately followed by narrative emphasis on regulation and containment. Winona describes using language and strategies to de-escalate (communication, deep breathing). Her physiology mirrors this shift (floppy arms, indicating muscular relaxation and return to baseline). Thus, this sequence reflects momentary divergence, quickly followed by regulation aligning with sensitivity. Rather than undermining narrative content, this pattern perhaps indicates effective emotional regulation following activation.

Case Summary

Winona presents with a predominantly low arousal pattern, broadly aligning with her attachment classification (sensitive–unresponsive). The narrative reflects subtle emotional distance and passive engagement, but also moments of sensitivity and regulation. However, there appears to be more sensitivity in the narrative than her arousal alone suggests. Brief instances of heightened arousal are followed by effective self-regulation and do not disrupt overall consistency of her arousal-narrative pairing.

Cross-Case Analysis

This section presents a cross-case analysis to explore patterns across cases, in line with McLeod's (2010) theory-building case study approach. Seven themes were derived through iterative comparison, beginning with dominant patterns and progressing toward more complex or theory-challenging features. The analysis aimed to test, refine, and extend theoretical understandings of caregiving regulation.

An example of how themes were developed is provided in Appendix J, illustrating the interpretive process used to generate cross-case insights. See Table 10 below for a summary of final themes:

Theme	Pattern Observed Across Cases	Illustrative Examples	Implications for Theory
1) Overall congruence between discourse and physiological arousal.	Most caregivers (6 out of 8 cases) demonstrated patterns where their attachment discourse mostly aligned with expected physiological arousal. Subthemes included: • High arousal with controlling withdrawal caregiving patterns. • Low arousal with child-led (unresponsive), or sensitive-unresponsive caregiving patterns.	Tracey, Toby, & Nicky (controlling-withdrawal discourse & high SNS arousal) Kurt, Fred, Winona (child-led elements of the discourse & low arousal)	Supports theory that attachment discourse reflects underlying regulatory strategies. Validates integration of MotC and physiology as convergent indicators of caregiving style.
2) Nuance within congruence.	Even in congruent cases, there were still examples of when attachment-physiology appeared not to match. Physiological spikes occurred during emotionally salient moments (e.g., conflict, burnout), suggesting that regulation is context-sensitive and topic-dependent.	Kurt: although predominantly uses low arousal and a child-led pattern overall, he shows more parent-led patterns in his discourse than his physiology would indicate in isolation, reflecting a partial divergence. Toby: despite a dominant SNS arousal pattern, he is observed to make some downregulation attempts which align more with PNS patterns (for example, when reflecting on whether he did	These findings suggest that caregiver regulation is dynamic and context-sensitive, rather than fixed or trait-like. Even in cases where attachment discourse and physiological regulation were broadly aligned, caregivers showed specific moments of divergence in response to emotionally charged topics such as guilt, rupture, or overwhelm. These mismatches may reflect limits in regulatory capacity, active suppression, or access to alternative

		enough to help his child engage in football club). Tracey & Nicky: both show notable changes into PNS dominance during emotionally difficult topics (e.g.) despite showing predominantly SNS arousal and matching parent-led discourse. Winona & Fred: there are several examples where their narratives reflect sensitivity whilst their physiological arousal remains low and this difference is particularly stark in Fred's case. In both cases, there is also a notable moment of SNS arousal, conflicting with their dominant patterns, although this is quickly suppressed.	caregiving scripts. In some cases, emotional intensity appeared more evident in the narrative than in the body, or vice versa. This complexity highlights the importance of examining how regulation fluctuates across the interaction, rather than assuming uniform coherence. Even when a dominant pattern is present, momentary mismatches may provide meaningful insight into the caregiver's regulatory strategies and emotional experience.
3) Mismatch between discourse and physiology is possible.	Two caregivers showed persistent mismatches between their attachment discourse and physiological arousal, suggesting the presence of layered regulatory strategies.	Sophie: Displays an enmeshed caregiving discourse, often associated with emotional intensity, yet shows consistently regulated physiological arousal, suggesting a distinct difference between narrative tone and physiological engagement.	These cases demonstrate that attachment discourse and physiological regulation do not always align in predictable ways. It suggests that the function of physiological regulation may differ across individuals and contexts, and that observable discourse patterns do not always reflect underlying

		Molly: Demonstrates both sensitive and slightly child-led discourse, but her consistently low arousal contrasts with her classification as sensitive-controlling: a pattern that would typically be associated with regulated or SNS high arousal patterns.	physiological processes. Regulation may serve different purposes or be achieved through different means, even among caregivers with similar attachment classifications.
4) Adopted parents showed more complex or amplified attachment-physiology patterns.	Most adoptive caregivers showed heightened or fluctuating physiological patterns and stronger attachment discourse styles, compared to more stable and subtle patterns in biological caregivers. Only 1 of 5 adoptive parents showed mostly sensitive discourse (Fred) compared to 2 of 3 biological parents (Molly, Winona).	Tracey, Toby, and Nicky (all adoptive) showed clearly pronounced attachment-arousal patterns, marked by sustained SNS arousal and parent-led or emotionally intense discourse. Tracey and Nicky also demonstrated possible parasympathetic collapse after periods of heightened arousal, suggesting significant emotional overload. In contrast, biological caregivers like Molly, Winona, and Sophie displayed more subtle or muted patterns, both in their narratives and in physiology. These profiles often required more interpretive work to identify regulatory strategies, with less overt	Adoptive caregivers appeared to display more amplified or easily identifiable regulatory patterns, which may reflect the greater emotional demands or identity-related challenges within adoptive caregiving contexts. These included pronounced discourse patterns, strong arousal responses, or clear shifts between activation and collapse. In contrast, biological caregivers tended to show more modulated or ambiguous regulation, requiring closer analysis to interpret. This difference may reflect variations in caregiving histories, emotional intensity of the caregiving relationship, or internalised caregiving scripts. These findings suggest that the adoption context

		behavioural or physiological expression. Kurt's case (adoptive) also demonstrated complexity. His discourse and physiology varied sharply across the interview, with child-led language and PNS dominance interrupted by intense SNS spikes and parent-led elements. This complexity made the case difficult to code for both arousal and discourse coders. The only adoptive exception was Fred, whose sensitive discourse and low-arousal profile were both consistent and more subtle.	may shape not only the attachment strategies caregivers use, but also the visibility and expression of their physiological regulation.
5) Sensitive caregiving can exist with low arousal.	Several caregivers showed low-arousal physiology alongside clear examples of sensitivity within their narratives.	Fred, Molly, and Winona consistently showed low physiological arousal while expressing warmth, reflection, and attunement, demonstrating subdued physiological tendencies alongside emotionally present caregiving.	Shows that sensitivity does not always require regulated arousal. Low arousal may serve to support calm attunement rather than necessarily always signal emotional disengagement.
6) Effortful regulation.	Some caregivers displayed attuned discourse while also showing signs of managing their own natural arousal tendency,	Fred often corrects himself if leaning towards a slightly child-led response at first; Molly shows small signs of engagement despite	Sensitive or attuned caregiving may require active self-regulation, particularly for caregivers whose overall discourse or physiological

	suggesting that staying emotionally present involved active regulation. This pattern was mostly noticeable in parent classified as predominantly sensitive (although there are elements of this which are also true for Sophie).	her low arousal when discussing conflict, i.e., leaning forward when asked about how she manages her stress; Winona talks about managing her breathing deliberately during conflict and adjusts her tone of voice when discussing her anger within the interview. All these examples suggest effortful self-regulation amongst these cases. Although Sophie's attachment strategy was overall parent-led, her interview contained moments of more sensitive discourse, particularly when discussing Lily's emotional needs. These segments coincided with a regulated arousal profile, suggesting that her sensitive responses may be the result of active containment or modulation, rather than being simply spontaneous or automatic.	profile is not spontaneously sensitive, such as those with parent-led discourse or child-led discourse, low-arousal patterns. In these cases, staying emotionally present may involve deliberate modulation of arousal, especially when discussing emotionally charged or conflictual topics. While this is evident in caregivers with low arousal in this sample, it is possible that caregivers with high arousal, who have access to some sensitive caregiving scripts, may also engage in similar regulatory effort, though this was not directly observable in the data.
7) Physiological collapse after strain.	In a few cases, PNS collapse (e.g., slumping posture, expressed overwhelm) followed periods of	Tracey slumped after discussing burnout; Nicky showed collapse discussing Elsa's emotional pain.	Sustained high SNS arousal may give way to moments of physiological shutdown or

	sustained arousal, often when discussing topics like burnout or emotional disconnection. Interestingly, these appeared to be obvious only in controlling-withdrawal patterns specifically.	Although Toby did not show clear behavioural signs of collapse during the interview, he verbally described needing to leave the room or house when overwhelmed by stress. This suggests a subjective experience of regulatory overload, which may indicate a tendency toward collapse in real-life caregiving moments, even if not captured physiologically in the interview setting.	withdrawal, a pattern not well accounted for in static models of arousal. These episodes reflect a limit in caregivers' regulatory capacity when emotional strain becomes too intense. This theme highlights that physiological regulation can shift dynamically, particularly under stress, mirroring the contextual flexibility seen in caregiving patterns under stress. It underscores the importance of considering both moment-to-moment fluctuations and longer-term vulnerability in caregivers' capacity to remain emotionally present.
--	--	--	--

Table 10: Cross-case analysis

Cross Case Analysis Summary

The cross-case analysis supports the idea that attachment discourse and physiological regulation often align, but also shift dynamically in response to emotionally salient content. It demonstrates that regulatory patterns are neither fixed nor uniform, but shaped by both overarching caregiving style and moment-to-moment emotional context. These findings lay the groundwork for the discussion that follows, where implications are considered in greater depth.

Discussion

This discussion explores how caregiving behaviour aligns, or misaligns, with physiological arousal, focusing on coherence between caregivers' attachment discourse (MotC) and observed physiological regulation (SNS/PNS behaviours). This study used a theory-building multiple case study (McLeod, 2010), informed by attachment theory and models of autonomic regulation, including biosocial models, PVT, and co-regulation frameworks (Berntson et al., 1993; Bronfenbrenner, 1979; Porges, 2007; Sameroff, 2009; Schore, 2001). Rather than testing fixed hypotheses, the study used qualitative data to build and refine theory through close analysis of case material.

The discussion follows McLeod's (2010) framework, using both consistent and unexpected findings to adapt or extend theoretical models. This study does not aim to make universal claims, but findings may be transferable to caregivers in similar contexts. Broadly speaking, theory suggests sensitive caregiving is supported by regulated arousal (flexible or moderate arousal), while parent-led or child-led patterns reflects SNS overactivation or PNS withdrawal respectively.

The following sections are structured around themes identified through cross-case analysis, exploring interactions and what these suggest for understanding caregiving as embodied. It also considers how these themes support, challenge, or extend existing theory, and future implications.

Theme 1: Overall Congruence Between Discourse and Physiological Arousal

Broad Coherence

Across six cases, there was generally strong alignment between attachment discourse and observed physiology. Three caregivers (Tracey, Toby, Nicky) demonstrated parent-led discourse patterns accompanied by SNS activation. One caregiver (Kurt) presented with child-led caregiving and PNS-dominance, and two caregivers (Fred, Winona) showed sensitive-unresponsive narratives broadly matched by PNS patterns. These findings broadly support theoretical assumptions that attachment strategies reflect regulatory processes (Berntson, 1993; Bronfenbrenner, 1979; Fonagy et al., 2002; Porges, 2007; Sameroff, 2009; Schore, 2001).

This coherence lends support to caregiving as an embodied process, that is, how caregivers' talk about and relate to their children is grounded in real-time physiological regulation. Nicky's case, for example, showed visible increases in SNS activity (clenched fists, rapid hand gestures) when speaking about emotionally taxing caregiving moments, aligning with her parent-led discourse. Similarly, Kurt's flattened affect, slumped posture and distanced narrative, was consistent with child-led caregiving and PNS-dominance. These cases support the integration of physiological coding with discourse-based assessments such as the MotC, highlighting them as converging indicators of caregiving style.

Applying Theory to Case

The data provides support for PVT (Porges, 2007), particularly in Fred and Winona's cases. While both exhibited PNS-dominance, they also demonstrated warm, emotionally engaged caregiving, evidenced by open body language, leaning forward, and reflective discourse. This suggests their regulation was supported not just by dorsal vagal withdrawal (shutdown), but by ventral vagal output (enabling calm, socially engaged states). These cases refine theory by illustrating low arousal does not always signify emotional disengagement. It can also support regulated sensitivity.

In contrast, Tracey and Nicky's cases reflect patterns aligned with sensory sensitivity models (e.g., Dunn, 2001). Both caregivers described feeling overwhelmed by caregiving demands, displaying behavioural markers consistent with physiological collapse following sustained arousal (slumped posture, increased self-soothing). These PNS "crashes" may represent regulatory overload, where prolonged SNS activation exceeds a caregiver's physiological capacity, prompting a drop into withdrawal. Importantly, these divergences were accompanied by corresponding shifts in narrative (e.g., references to burnout or helplessness), preserving overall coherence between physiology and discourse.

Applying Case to Theory

Consistency across these cases offers empirical support for models linking attachment and physiological regulation. However, it raises questions about limits to this coherence. While the dominant patterns aligned with expectations, regulation was not uniform and brief deviations occurred, often during emotionally salient topics. Fred and Winona showed

occasional SNS spikes during moments of rupture or guilt, while Nicky and Tracey's PNS "crashes" emerged following emotional overload.

These deviations did not undermine central patterns of coherence but rather emphasise their context-dependent, dynamic nature. As supported by models such as PVT (Porges, 2007), Schore's co-regulation theory (2001), and Sameroff's transactional model (2009), physiological responses are not static traits but moment-by-moment adaptations to relational cues. Momentary physiological shifts were accompanied by corresponding narrative changes, suggesting even when patterns shifted, body and narrative generally move in alignment. This underscores the importance of viewing regulation as contextually-embedded (Siegel, 2020; Thompson, 2016).

Refining Theory

These findings invite theoretical refinement. While dominant attachment strategies may map broadly with physiology, coherence appears to be situationally flexible, shifting in response to stress, guilt, or emotional salience. Rather than conceptualising this relationship as static, this theme supports models allowing for adaptive variation.

This has clinical relevance for recognising caregivers can exhibit both alignment and variability, potentially helping practitioners better distinguish between genuinely flexible regulation and surface-level coherence masking distress (explored further in theme 2).

Theme 2: Nuance Within Congruence

Momentary Incongruence

While most caregivers showed overall coherence between attachment discourse and physiology, closer analysis revealed moments of divergence within otherwise matched profiles. These were not always brief shifts into alternative matching attachment-physiology patterns, but genuine attachment-physiology theoretical mismatches.

For example, Fred and Winona offered mostly sensitive narratives, yet during the same segments, their physiology remained subdued (PNS dominant). This raises the possibility sensitivity can emerge even when arousal systems do not mobilise social engagement pathways, as predicted by PVT (Porges, 2007). Contrastingly, low-arousal states

may have supported their ability to remain reflective and emotionally present, suggesting that some individuals may use PNS-dominance as a stable base for regulated engagement rather than withdrawal.

In Kurt's case, the opposite divergence occurred. Kurt was largely PNS-dominant, suggesting disengagement or withdrawal. However, his narrative, particularly during interpersonal frustration, was more parent-led and emotionally charged than his physiology alone suggested. Narrative content may have exceeded bodily regulatory signals, indicating a decoupling of discourse and arousal.

Likewise, despite parent-led, SNS profiles, Toby, Nicky, and Tracey each showed some level of repeated and deliberate downregulation behaviours (postural shifts, increased soothing). Yet, these regulatory efforts occurred without parallel shifts in discourse style. The content remained focused on control, pressure, or overwhelm, suggesting an active attempt to manage internal arousal while maintaining a fixed attachment narrative. These are not simply shifts in style or tone, but misaligned discourse and physiology.

Applying Theory to Case

PVT proposes that sensitive caregiving emerges from activation of the ventral vagal complex (calm social engagement), while SNS dominance is expected to support mobilisation and defensiveness (Porges, 2007). Similarly, traditional ANS models assume that physiological states shape and reflect emotional and behavioural output (Berntson, 1993; Carlson, 2007). From this perspective, Fred and Winona's low-arousal sensitivity, Kurt's brief SNS physiology with more intensely charged narrative, and Toby, Nicky, and Tracey's efforts to downregulate without altering discourse, represent unexpected deviations.

These findings resonate with critiques that such models may overstate the determinism of physiological states and underestimate the role of top-down regulation, narrative identity, or defensive adaptation (Grossman, 2007; Gross, 2015; Thayer et al., 2009). Findings suggests attachment narratives can operate independently from concurrent physiological patterns.

Applying Case to Theory

One explanation is caregivers have access to multiple internal caregiving scripts (Bretherton, 1990), which can be flexibly drawn upon in different emotional contexts. Thus, Fred and Winona can enact sensitive discourse when their physiology remains subdued, perhaps because sensitivity is valued, or has been learned through life experience, even if not fully embodied. This is supported by research showcasing potential for “earned” attachment sensitivity through experience (Zajac et al., 2019).

In contrast, downregulation behaviours observed in Toby, Nicky, and Tracey, without shifts in parent-led discourse, suggests active containment or suppression, reflecting internal struggle between emotional overwhelm and desire for composure. These caregivers may have limited access to alternative scripts, resulting in physiological regulation attempts not matched by narrative openness. It is also possible, a degree of social engagement was required for the interview itself, prompting momentary attempts to downregulate to remain communicatively present, a pattern consistent with PVT’s proposal the social engagement system can be transiently recruited even amid underlying autonomic defence states (Porges, 2007).

Kurt’s use of parent-led discourse, in the absence of sustained or intense SNS arousal, may reflect a form of disembodied regulation, in which emotional intensity is conveyed more strongly through narrative than physiology. This could be shaped by context, for example, relational dynamics between Kurt and Kiara, suggesting greater capacity to suppress physiological arousal than narrative expression. These patterns challenge assumptions attachment-physiology states always align, instead pointing to complex layering of regulation, identity, and emotional expression.

Refining Theory

These deviations are momentary and do not necessarily “disprove” embodied attachment theories, but add nuance, suggesting a need to move beyond models of linear coherence. They highlight mismatches between discourse and physiology are not noise, but meaningful indicators of how caregivers adapt, suppress, or perform regulatory strategies in emotionally charged contexts. This has implications for theory and practice.

Theoretically, it supports a contextual model of embodied caregiving, in which physiological regulation and attachment discourse are related but not always synchronised,

particularly under stress, self-reflection, or relational complexity. Clinically, it encourages practitioners to attend not just to what is said or behaviour, but also discrepancies between modes of expression, as these may signal effortful regulation or hidden distress. Recognising divergences helps avoid overly simplistic categorisations of caregiving behaviour and supports a more nuanced, dynamic understanding.

Theme 3: Mismatch between discourse and physiology is possible

Genuine Mismatch

Although most caregiver profiles showed broad alignment, two cases (Sophie, Molly), presented with notable mismatches. Sophie's narrative displayed parent-led features, yet her physiology remained consistently regulated. Molly was classified as using a sensitive-controlling caregiving strategy, but her physiology showed sustained low arousal, more consistent with child-led caregiving. Importantly, mismatches occurred consistently across the interview and within the same segments, rather than temporary fluctuations, suggests a deeper layer of incoherence.

Applying Theory to Case

Both cases present challenges to models proposing direct, reliable correspondence between physiology and caregiving patterns. While PVT (Porges, 2007) suggests sensitive caregiving emerges from activation of the ventral vagal complex, parent-led strategies would typically correspond to SNS arousal. This challenges the assumption that physiological systems “propel” or “inhibit” attachment behaviours, suggesting regulation does not always facilitate sensitivity. Similarly, Molly's low arousal appears incongruent with mobilisation and engagement typically required for sensitive-controlling caregiving, which would likely involve regulation or SNS activation.

Together, these profiles suggest coherence cannot be universally assumed. They suggest embodied attachment models may overlook important context. Again, this raises important questions about the extent current models determine groups (Grossman, 2007), highlighting the need for flexible models.

Applying Case to Theory

One interpretation is the regulatory function differs across cases. Sophie's physiology may not reflect regulation in service of sensitive co-regulation, but a familiar internal state developed through early enmeshed caregiving: a kind of "functional dysfunction", where relational intensity is experienced as soothing. This is supported by the concept of IWMs, suggesting caregivers unconsciously reproduce early relational dynamics (Bowlby, 1969; Main et al., 1985). Notably, Sophie described difficulty with separation from Lily, and appeared most regulated when describing highly entangled relational dynamics, supporting this interpretation. Regulated physiology could reflect Lily's role as "co-regulator", with Sophie's system calming during intense relational focus. This suggests Lily may help regulate Sophie, rather than the other way round.

In Molly's case, cultural context may have influenced caregiving discourse and how this was interpreted by coders. Her description of their relationship as "*trusting*" because they keep no secrets, may reflect Spanish familial norms where close relational involvement is valued. It is possible that this, along with other parts, were misinterpreted as evidence of parent-led strategy. This may reflect confirmation bias, where initial impressions shape interpretation of data (Nickerson, 1998).

Furthermore, as Molly presented with some child-led features, it is plausible her overall caregiving pattern was misclassified as "sensitive-controlling", when it reflects "sensitive-unresponsive": a pattern more consistent with her physiology. Alternatively, Molly's reflection on her own father's emotional unavailability may suggest a corrective script (Byng-Hall, 1998), in which caregivers consciously attempt to parent differently. This could explain why her discourse reflects sensitivity, alongside mild parent-led features, despite subdued physiology.

Refining Theory

Although the minority, these cases suggest coherence between caregiving discourse and physiology is not universal rule, but rather an expectation shaped by context, culture, and individual history. While embodied models offer compelling accounts of how physiology supports caregiving, they may not account for layered, sometimes conflicting ways individuals express attachment. Physiology may be shaped more by learned familiarity than

by real-time relational demands, particularly when attachment is shaped by complex early dynamics or cultural scripts.

Rather than invalidating existing theories, these findings point towards a more flexible, integrative model, in which coherence is common but not absolute. They caution against interpreting either discourse or physiology in isolation, encouraging consideration of cultural context, narrative complexity, and developmental history when assessing caregiving.

Theme 4: Adoptive and Biological Caregiving Contexts

Differential Patterns

Across cases, different patterns emerged between adoptive and biological caregivers. Most adoptive caregivers (Tracey, Toby, Nicky, and Kurt) showed pronounced or complex patterns of attachment and arousal. These included sustained SNS activation, abrupt physiological shifts (e.g., PNS collapses), and overt parent-led, emotionally dysregulated, or withdrawing discourse styles.

In contrast, biological caregivers (Molly, Winona, and Sophie) presented with more subtle and modulated patterns, either through their arousal (Sophie) or narrative pattern (Molly, Winona). Generally, their narratives were less overtly parent-led or child-led and were accompanied by either regulated or low arousal. These cases often required more interpretive work to identify overall patterns. Additionally, two out of three biological cases were rated sensitive (66.6%), compared to just one in five (20%) for adopted cases (Fred).

Applying Theory to Case

These findings reflect wider trends in adoption literature, which suggest adoptive caregivers may face more emotional and relational challenges, influencing the attachment relationship (Juffer et al., 2005). Elevated arousal or “insecure” discourse styles amongst may be the product of heightened vigilance, past traumatic experiences, or unique psychological demands of adoptive parenting, including managing complex histories of loss, attachment disruptions, or post-adoption support needs (Neil, 2012).

This heightened pattern adds weight to attachment as a “threat” system (Crittenden, 2008), where attachment strategies become pronounced amongst high stress. It also fits with

theories of heightened bodily reactions in the context of trauma (van der Kolk, 2014). Taken together, it fits both attachment and physiology patterns are more pronounced in a group who is likely facing additional relational stressors in the context of complicated histories.

Applying Case to Theory

As the MotC was originally designed for helping struggling families, it perhaps has limited sensitivity in detecting less overt forms of caregiving quality, particularly when caregiving is subtle, nuanced, or not clearly insecure (Grey et al., 2017). This may explain why biological caregivers, whose attachment-physiology patterns were more subtle, were harder to analyse.

Although adoptive cases presented with more pronounced patterns, Fred's case is an important exception. On several occasions, Fred mentioned the influence of his supportive partner, who appeared to emanate sensitive traits, alongside experiences of receiving personal therapeutic input. Therefore, it is plausible Fred's apparent sensitivity may have been shaped by co-parenting dynamics and reflective processing. This aligns with recent theoretical models that conceptualise caregiving as "triadic" rather than "dyadic", influenced not only by the parent-child relationship, but also by a second parent (Feinberg, 2003; Cowan et al., 1992). Importantly, Fred's case illustrates how positive relationships and reflective self-awareness may buffer challenging adoptive contexts, even in caregivers with low arousal states.

Additionally, findings suggest sensitive caregiving may not always represent the most adaptive response in high-stress caregiving environments. In the context of threat, loss, or trauma, more controlled or defended strategies may serve a protective function, maintaining order or vigilance in a way that supports functioning. From this perspective, "sensitivity" is not inherently optimal but must be understood in relation to the caregiving context (Crittenden, 2008; Lyons-Ruth et al., 2008).

Refining Theory

Findings suggest caregiving context, particularly adoptive and biological contexts, may shape how attachment and physiological patterns are expressed. Adoptive caregivers

may be likely to display amplified or dysregulated profiles due to navigating unique relational histories and stressors. This invites a refinement to embodied attachment models, proposing that coherence between discourse and physiology may manifest subtly in biological caregivers and more overtly or variably in adoptive contexts. Future theoretical models would benefit from attending to these contextual factors when interpreting caregiving patterns.

Theme 5: Sensitive Caregiving Can Exist with Low Arousal

Observed Pattern

Three caregivers (Fred, Winona, Molly) were classified as predominantly sensitive. All three demonstrated reflective capacity, attunement, and emotional availability. However, each also presented with low-arousal physiology, including slumped posture, repeated soothing and calming behaviours.

Applying Theory to Case

At first glance, this pattern appears counterintuitive. Traditional models of autonomic regulation posit regulated caregiving arises from balance between SNS/PNS domains, enabling mobilisation and calm engagement. Sustained PNS dominance, particularly if associated with behavioural collapse, is linked to withdrawal or shutdown, rather than sensitivity.

This contradiction raises important questions about embodied models. PVT introduces the concept of a third autonomic branch: the ventral vagal complex, which supports calm, engaged states (Porges, 2007). From this perspective, it is plausible low arousal does not inherently signal disengagement (dorsal vagal withdrawal), but instead reflects ventral vagal activation, allowing caregivers to remain present and attuned from low arousal states.

However, PVT has also been criticised for a lack of empirical clarity around the ventral vagal pathway and for oversimplifying the mapping of behavioural states onto discrete autonomic branches (Grossman et al., 2007). Furthermore, findings from the accompanying SLR suggested low arousal is associated with less sensitive caregiving, particularly when it reflects disengagement or flattening, rather than regulated calm (Ablow

et al., 2013; Groh et al., 2019). However, these findings are drawn from studies observing parent-child interactions in real-time, which may involve different relational and physiological demands than reflective interviews. Nevertheless, the presence of attuned caregiving within these low-arousal profiles challenges the generalisability of such claims and calls for nuanced understanding of low arousal caregiving patterns.

Applying Case to Theory

Case-level analysis suggests low arousal does not operate in isolation from context or narrative. Each caregiver demonstrated some child-led attachment discourse, indicating access to multiple internalised caregiving scripts (Bretherton, 1990). Rather than viewing low arousal as uniformly indicative of disengagement, it may reflect a default physiological mode, with sensitivity emerging through effort, learned strategies, co-regulatory support (i.e., partner influence), or safe relational contexts (Thelen et al., 1994; Sameroff, 2009).

For Fred, these contextual influences appear particularly salient. Despite being an adoptive parent, a group which otherwise showed amplified patterns, he consistently displayed sensitivity alongside low arousal. His references to therapy and influence of a supportive partner suggests reflective processing and co-parenting dynamics may buffer dysregulation and scaffold sensitivity (Fonagy et al., 2002). For Winona and Molly, both biological caregivers, their relative relational stability may explain ability to remain attuned despite low arousal.

Refining Theory

These findings invite flexible conceptualisation of embodied sensitivity. Rather than equating low arousal with insensitivity, they suggest sensitivity may sometimes emerge from low arousal, particularly when contextual factors or internal scripts supports this. This may represent a “reorganised” caregiving strategy that is cognitively available, but not yet fully embodied. This supports a possible revision to PVT and traditional embodied models, highlighting PNS dominance is not inherently disengaged and may, in some cases, support attuned caregiving. Additional research is needed to say with more certainty.

These cases encourage a shift away from deterministic models of physiological activation. Instead, supporting more nuanced frameworks in which sensitivity is shaped not just by physiology, but also by history, internal narrative, and caregiving environment.

Theme 6: Effortful Regulation

Observed theme

Amongst caregivers classified as predominantly sensitive (Fred, Molly, Winona), sensitivity did not appear automatic but seemed to involve active regulatory effort. This was observable both cognitively, such as through deliberate reflective speech, narrative coherence, and active mentalising, and physiologically (leaning forward, deep breathing, postural engagement) when navigating emotionally difficult topics. These behaviours suggest sensitivity can be reached when consciously managed or modulated in real-time.

Applying Theory to Case

This theme challenges deterministic models of autonomic regulation, such as PVT (Porges, 2007), which, while dynamic in description of physiological shifts, may in application overly emphasise caregiving responses as emergent from dominant, involuntary physiological states. Instead, it aligns with research suggesting individuals can exercise top-down regulatory control to override or adapt their physiological tendencies (Gross, 2015). The earlier concept of earned security (Zajac et al., 2019) may also be relevant here. In such cases, regulation may not be intuitive but requires conscious effort, supported by internal or relational scaffolding. This perspective resonates with Schore's (2001) right-brain model, which emphasise relationally co-constructed physiological adaptation.

These findings extend insights from the accompanying SLR, which found secure attachment was linked to flexible and context-responsive physiological regulation, rather than a fixed "regulated" pattern (Ablow et al., 2013; Hill-Soderlund et al., 2008; Xu et al., 2023). In this light, sensitivity may not be defined by physiological ease, but by ability to stay emotionally present and attuned, even from a default less "ideal" physiological state. This supports understanding of secure caregiving as adaptive and effortful, rather than automatic or solely arousal-driven.

Applying Case to Theory

Two out of three caregivers referenced external sources of support, such as professional help or therapeutic experiences. They were also recruited via association with the OT clinic, known for reflective parenting work. This context raises the possibility their sensitivity represents a learned or co-constructed process. Sensitivity might reflect the active use of secondary attachment scripts, developed through therapy, co-parenting, or conscious effort, rather than automatic enactment of IWMs from childhood. This supports the idea secure caregiving can be acquired and maintained through relational and environmental support.

Refining Theory

This theme invites refinement by highlighting the role of conscious regulation and contextual learning in shaping caregiving. Rather than treating physiological patterns as fixed indicators of sensitivity or insensitivity, it suggests caregivers with PNS-dominant states can actively regulate or override their baseline arousal. Theoretically, this calls for a more dynamic and developmental understanding of attachment, in which secure caregiving is not only physiologically grounded but also reflectively sustained. It has clinical implications, reinforcing the value of interventions supporting reflective capacity in caregivers who may not possess intuitive or spontaneous sensitivity.

Theme 7: Physiological Collapse After Strain

Regulatory Limits

Two caregivers (Tracey, Nicky) displayed signs of PNS collapse following periods of sustained SNS arousal. These patterns were observed during emotionally significant moments and were marked by visible shifts in behaviour (slumped posture, increased self-soothing/calming behaviours). These were accompanied by discourse reflecting emotional exhaustion (Tracey during discussion about burnout, and Nicky while describing Elsa's emotional pain).

While Toby did not exhibit observable PNS collapse, his description of disengaging from conflict when overwhelmed suggested vulnerability. Notably, all three caregivers were classified as using controlling-withdrawal attachment strategies, suggesting a possible link between this attachment style and regulatory overload under stress.

Applying Theory to Case

These patterns align with neurobiological models of attachment and regulation, particularly PVT (Porges, 2007) and Schore's regulation theory (Schore, 2001). Both propose caregiving involves dynamic regulation of autonomic states in response to relational demands. Porges suggests that when sympathetic arousal fails to resolve a perceived threat, the system may shift to a dorsal vagal state: a shutdown mode linked to immobilisation. Schore similarly describes how overwhelming emotional stress, particularly without co-regulation, can exceed regulatory capacity, triggering hypoarousal.

This shift may reflect such a breakdown in self-regulation for Tracey and Nicky. Notably, its occurrence within controlling-withdrawal strategies suggests heavy reliance on emotional suppression and control may increase vulnerability to collapse under strain (Crittenden, 2008). All three cases were adoptive, aligning with literature highlighting heightened relational demands in adoptive contexts, including greater stress and mental health difficulties (Juffer et al., 2005).

These findings extend findings from the accompanying SLR, which focused primarily on static physiological states and offered limited insight into how autonomic systems interact over time. Observing transitions between SNS and PNS dominance offers a more dynamic lens, highlighting the importance of moment-to-moment shifts in understanding caregiver patterns.

Applying Case to Theory

Both Tracey and Nicky explicitly referenced mental health difficulties, suggesting these collapses may reflect longer-term stress exposure or depressive symptoms. The physical withdrawal observed may be a manifestation of emotional fatigue rather than immediate threat per se, reinforcing the importance of examining physiology not just as moment-to-

moment signals, but as reflective of broader relational and psychological strain. This highlights the importance of triangulating narrative, behaviour, and context when interpreting physiological patterns.

Refining Theory

Although findings are broadly compatible with neurobiological models such as PVT and Schore's theory, they also expose a gap between theory and application in the literature. Although both models conceptualise physiology as dynamic and responsive to context, the accompanying SLR revealed empirical studies often interpret physiological states in static or binary terms, categorising caregivers as "regulated" or "dysregulated" based on average arousal levels, without attending to how these states fluctuate dynamically over time.

This perhaps mirrors early attachment research, where attachment classifications were often treated as fixed traits (Rutter, 1995), without incorporating physiological nuance, despite Bowlby's original theory being grounded in evolutionary theory. In the same way attachment theory has been critiqued for overlooking embodiment, much of the physiological literature now risks ignoring narrative and context.

These findings call for a more integrative, temporally sensitive, interactive and dynamic approach: one that recognises how caregivers shift between regulatory modes depending on emotional load, relational context, and personal history. Clinicians and future research would benefit from attending to these dynamic thresholds, as they may reveal caregiver limitations and their implications for wellbeing and sensitivity.

Theory Refinement and Integration

This study set out to explore how attachment discourse and physiological arousal are related, whether they are coherent, and how such coherence unfolds across different contexts. Across most cases, there was strong support for the assumption attachment strategies reflect underlying physiological regulation, lending weight to embodied models of caregiving (Porges, 2007; Schore, 2001). However, closer analysis revealed this coherence was neither universal nor fixed. Instead, it appeared situationally responsive, shaped by emotional load, narrative processes, contextual support, and caregiver history.

Taken together, themes point towards a dynamic and context-sensitive model of embodied caregiving. While sensitivity often coincided with flexible or low arousal states, this frequently required effortful regulation, co-parenting scaffolding, or therapeutic learning. Similarly, high controlling-withdrawal narratives aligned with SNS arousal or collapse, but showed moments of containment or dissociation, suggesting presence of internal tension or thresholds of overwhelm. Mismatches between discourse and physiology, particularly for Sophie and Molly, further illustrate regulation cannot be reduced to linear, static models.

These findings support conceptual frameworks which frame attachment as grounded in neurobiological systems that adapt to relational stressors. Yet, they also expose divergence between theory and application in research. Many current empirical studies appear to apply these models in binary, categorically deterministic ways, without considering dynamic shifts or contextual nuance. This echoes earlier critiques of attachment theory, where early research often ignored embodiment and treated attachment as trait-like, despite Bowlby's emphasis on environmental and developmental plasticity (Bowlby, 1969).

Present findings call for refinement in how embodied attachment models are operationalised in research and practice. Embodied attachment systems should not be interpreted as fixed traits but understood as interactive and contextually flexible. Discourse and arousal must be examined in conjunction, and within context, to fully capture caregiving complexities.

Working Hypotheses

Several propositions are offered for future research:

1. Attachment-arousal coherence is dynamic, not fixed. Coherence may dominate overall profiles, but small divergences occur in response to emotional or relational triggers. These may tell us something about specific caregiver challenges.
2. Mismatch may reflect adaptive or learned regulation. Divergences between discourse and physiology are not always incoherence; they may indicate adaption to imperfect environments, learned scripts, or cultural variation.

3. Adoptive caregiving may involve amplified embodied caregiving patterns. These may reflect, not dysfunction, but the intensity and demands of parenting in complex relational contexts.
4. Sensitivity can emerge from low arousal, particularly when supported by reflective capacity, co-regulation, therapeutic or professional support. PNS-dominant caregivers can remain engaged and attuned.
5. Sensitivity may require conscious effortful regulation and may not always just emerge from “ideal” physiological states. This adds evidence for a top-down, learned nature to sensitivity.
6. Collapse may mark the edge of regulatory capacity. In highly-stressed caregivers, particularly those with controlling-withdrawal patterns, PNS collapse may follow prolonged arousal and signal burnout.

Together, these findings support a revised model of embodied attachment: one that is fluid, contextually responsive, and shaped by multiple interacting factors, rather than rigid or categorically defined.

Strengths and Limitations

This study offers several strengths. First, qualitative multiple case study design allowed for in-depth exploration of the attachment-physiology relationship, yielding insight not typically accessible in current literature on embodied caregiving, which remains largely dominated by quantitative approaches. The use of validated and reliable tools, such as the MotC (based on the well-established PDI), further enhances the methodological rigour of the study. Additionally, triangulating multiple analytic methods: MotC coding, behavioural arousal analysis, and structured within and cross-case comparisons using McLeod’s (2010) framework, provided a robust and nuanced understanding of caregiver embodied patterns.

A further strength lies in the study’s observational focus on dynamic behavioural indicators of arousal during narrative segments, rather than relying on single-time-point biometric measures. This approach captured regulation as an unfolding, relational process and allowed for identification of dynamic transitions that might not be detectable in previous,

static methodologies (e.g., Hill-Soderlund et al., 2008; Nofech-Mozes et al., 2019; Strathearn et al., 2009).

Inclusion of both adoptive and biological caregivers contributes valuable insight into how embodied attachment may manifest across different caregiving contexts. This is particularly relevant given the underrepresentation of adoptive families in the physiological literature and heightened relational demands of adoptive parenting (Juffer et al., 2005). The sample also included three fathers and one same-sex couple, marking a modest but meaningful step toward greater inclusivity in attachment research, often critiqued for limited demographic diversity (Henrich et al., 2010).

While not necessarily a limitation, suggestions from caregivers indicated some dyads in the sample may be neurodiverse. This could have shaped how attachment behaviours were expressed and interpreted. Existing literature suggests neurodevelopmental differences, including autism or ADHD traits, can influence relational dynamics, regulatory styles, and the way attachment is enacted or perceived (Rutgers et al., 2004; Teague et al., 2017). Although neurodevelopmental information was not formally assessed or analysed, this remains an important consideration when interpreting the data and highlights the need for future research to explicitly engage with neurodiversity in embodied attachment.

Study limitations should be acknowledged. The absence of biometric data (e.g., heart rate) meant that physiological inferences relied on behavioural proxies. While this enabled fine-grained, context-sensitive interpretation, triangulating behavioural and biometric measures may have allowed for even greater precision. Similarly, while interpretive approaches such as MotC coding and SAI analysis offer depth, they inevitably introduce subjectivity, particularly in identifying moment-to-moment coherence between discourse and regulation (Yardley, 2000).

Additionally, while behavioural coding was conducted using SAI protocols, coding focused on selected emotionally relevant segments, rather than the full MotC interview. This decision reflected pragmatic constraints and is consistent with broader SAI practice; however, it may have limited the ability to detect arousal shifts across the entire narrative. Including a full-interview analysis could have helped distinguish whether arousal responses are primarily driven by trauma, attachment activation, or sensory processing needs.

Another limitation is the MotC is based on a reflective interview, rather than a live parent-child interaction. While it elicits rich caregiving narratives, it may not fully capture

embodied dynamics of day-to-day relational exchange. That said, the MotC's theoretical and empirical roots in the validated PDI framework validate its use, and the broader project associated with this study did explore live interactions, offering an opportunity for comparative analysis. Furthermore, the small sample size may limit generalisability. However, this is sufficient and consistent with the aims of theory-building qualitative research (McLeod, 2010). While not statistically generalisable, the findings are theoretically transferable and valuable for future work.

Finally, recruitment was conducted entirely through a local OT clinic. All adoptive caregivers were engaged in professional support, which may have influenced patterns observed, amplifying physiological or narrative expressions, or contributing to the use of clinical language noted by coders. This does not undermine the value of findings, but should be considered when assessing their transferability to other adoptive and biological caregiving populations.

Clinical and Research Implications

Clinical Implications

This study contributes to a more dynamic and context-sensitive understanding of caregiving, with several implications for clinical practice. First, the observed coherence between attachment discourse and physiological arousal suggests caregivers' embodied states can provide meaningful insights into caregiving capacity. However, findings also demonstrate coherence is not fixed and may fluctuate in response to emotional load and relational stress. Clinicians should therefore avoid overly simplistic interpretations of "regulated" or "dysregulated" presentations and instead attend to the process of regulation, especially shifts that signal thresholds of overwhelm, effortful containment, or collapse.

Secondly, the presence of sensitive caregiving in low-arousal profiles, particularly when supported by therapeutic experience or co-parenting dynamics, suggests sensitivity may not always arise from "ideal" autonomic states. Clinical formulations should therefore incorporate narrative, relational, and developmental history alongside observable behaviour and physiological presentation. Interventions fostering reflective functioning and co-regulation, such as mentalisation-based approaches or relational parenting interventions, may be especially beneficial for caregivers whose regulation is effortful rather than intuitive.

Thirdly, the differences between adoptive and biological caregivers, including amplified arousal or more pronounced attachment strategies among the adoptive group, suggest that adoptive families may require tailored clinical support. These patterns likely reflect the cumulative demands of parenting in contexts of trauma histories and complex relational dynamics. Services should recognise and address these unique stressors and avoid pathologising embodied responses that may reflect adaptation under strain.

Research Implications and Future Directions

This study contributes to a growing body of literature on embodied attachment by highlighting the dynamic nature of coherence between attachment discourse and physiological regulation. While findings broadly support neurobiological models, they also challenge the field to move beyond static or binary interpretations of physiological states. Rather than viewing caregiving behaviour as direct reflections of fixed autonomic patterns, the study underscores the importance of context.

Methodologically, the study illustrates the value of integrating validated narrative tools (e.g., the MotC) with behavioural indicators of physiological regulation to capture this dynamic, unfolding process. This multimodal approach offers a nuanced understanding of how attachment strategies manifest and serves as a model for future qualitative research on parent-child relationships.

Please see Appendix L for details of how findings from the empirical study and accompanying SLR will be disseminated.

Future Directions

Several future directions emerge from findings:

- Physiological triangulation: Future studies could combine behavioural arousal coding with biometric measures to enhance the validity of arousal assessment. Specifically, they could consider combining these across different physiological domains to gain a more in-depth understanding (in line with findings from the accompanying SLR).
- Full interview and sensory profiling integration: Given that SAI coding in this study was based on selected interview segments, future research could code full interviews

to strengthen interpretive breadth. Incorporating structured sensory profiles of parents and children could also help clarify whether observed regulatory patterns are more attributable to attachment-related processes, trauma histories, or sensory processing differences.

- Real-time interactions: Observing physiological regulation during caregiver-child interactions could offer richer insight into co-regulation and embodied attachment in practice, especially in adoptive dyads.
- Cross-context replication: Researchers could test the transferability of these findings across diverse caregiving contexts and sociocultural backgrounds.
- Comparative studies: Researchers could compare coherence and mismatch patterns in other high-stress caregiving groups, such as foster carers, neurodiverse families, or caregivers of children with additional needs.
- Longitudinal approaches: Studies tracking attachment-arousal coherence over time could reveal developmental trajectories or shifts due to life events, therapeutic intervention, or co-parenting dynamics.
- Intervention research: Evaluating whether reflective parenting interventions or therapeutic input improve embodied-attachment flexibility could shed light on mechanisms of change and inform clinical practice.

Together, these directions support a shift towards more integrative, flexible, and developmentally sensitive models of embodied caregiving.

Conclusion

This study set out to examine whether and how caregivers' attachment narratives align with their physiological regulation during attachment-related discourse, aiming to shed light on embodied caregiving processes across both adoptive and biological contexts. A qualitative multiple case study design was carried out to examine eight caregiver cases, through validated attachment discourse coding (MotC) and behavioural indicators (SAI) of physiological regulation. Most caregivers showed strong attachment-arousal coherence, providing support for embodied models of caregiving. However, moments of divergence were also observed, including physiological collapse under strain, effortful regulation, and narrative-physiology mismatches.

Findings indicated that while dominant attachment strategies often reflect regulatory processes, this coherence is not static. Instead, it appears situationally responsive, shaped by relational context, emotional load, and caregiver history. For example, sensitive caregiving could emerge from low-arousal states, particularly when supported by co-regulation or reflective processing. Conversely, parent-led patterns were sometimes marked by underlying physiological collapse. Most adoptive caregivers showed more pronounced patterns of dysregulation overall, potentially reflecting complex relational demands of adoptive parenting. These findings add depth and context to those from the accompanying SLR, offering qualitative insight into how physiological regulation operates in caregiving relationships.

Although not widely generalisable, findings from this study offer transferrable and valuable contributions to conceptualisation of embodied attachment as a dynamic, neurobiological process. It illustrates how coherence between discourse and arousal fluctuates meaningfully across time and context.

Future research could triangulate narrative and behavioural arousal analysis with biometric measures, investigate real-time parent-child interactions, and test these findings across more diverse caregiver populations. Incorporating full-interview arousal coding and structured sensory profiling may help clarify the contribution of sensory processing versus attachment dynamics. Longitudinal and intervention studies may also help explore how embodied caregiving patterns may change over time with romantic partner influence, increased self-awareness, or therapeutic input. These insights have clinical relevance for

supporting caregiver regulation, particularly in high-stress or adoption contexts, and for informing attachment-based interventions grounded in physiological understanding.

Integrated SLR and empirical findings

This thesis set out to explore the physiological dimensions of attachment by integrating insights from an SLR and an in-depth empirical study. Both components were grounded in a shared theoretical foundation: that attachment is a fundamentally embodied process, shaped not only by behaviour and narrative, but also by patterns of physiological regulation.

The SLR synthesised eleven empirical studies examining the relationship between parental physiology and attachment in parent-child relationships, using non-self-report methodologies. The findings provided emerging evidence that secure attachment is generally associated with greater physiological flexibility and regulation, whereas insecure attachment tends to be marked by distinct patterns of dysregulation, potentially compromising co-regulation and sensitive caregiving. The studies focused exclusively on biometric indicators of physiology, with the majority targeting ANS domains, and fewer investigating hormonal and neural systems.

However, the review also identified significant inconsistencies across findings, likely stemming from methodological heterogeneity, limited use of standardised attachment measures, and small sample sizes that reduced statistical power. Few studies employed in-depth, discourse-based attachment frameworks, and none incorporated qualitative approaches or adoptive caregiving contexts. The review concluded future research would benefit from exploring alternative physiological systems beyond basic biometrics, incorporating more qualitative perspectives to enrich understanding, diversifying samples, and more closely examining attachment trauma or adoption, where difficulties in parental physiological regulation may play a significant role in the attachment relationship.

The empirical study responded directly to these gaps, offering a more nuanced, qualitative perspective. It combined discourse and observation-based methodologies to examine embodied attachment more dynamically in both adoptive and biological parent-child relationships. Findings suggested that integrating physiological arousal coding (SAI) with discourse-based attachment assessments (MotC) provides a richer understanding of implicit caregiving processes, and how these processes may vary across different relational contexts.

Together, the SLR and empirical study emphasise the importance of assessing attachment through an embodied, relational lens: one that moves beyond traditional behavioural or narrative frameworks to include co-regulatory and sensory-based processes.

These findings highlight the value of an integrated, multi-disciplinary, body-based approach in clinical practice and attachment research, particularly for families affected by trauma, sensory processing differences, or adoption-related relational complexity.

References

- Aber, J. L., Slade, A., Berger, B., Bresgi, I., & Kaplan, M. (1985). *The Parent Development Interview (PDI)* [Unpublished manuscript]. Department of Psychiatry, Albert Einstein College of Medicine.
- Ablow, J. C., Marks, A. K., Shirley Feldman, S., & Huffman, L. C. (2013). Associations between first-time expectant women's representations of attachment and their physiological reactivity to infant cry. *Child Development*, 84(4), 1373-1391.
- Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment: A psychological study of the strange situation*. Hillsdale, NJ: Lawrence Erlbaum.
- Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2009). The first 10,000 Adult Attachment Interviews: Distributions of adult attachment representations in clinical and non-clinical groups. *Attachment & human development*, 11(3), 223-263.
- Barone, L., Lionetti, F., & Green, J. (2017). A matter of attachment? How adoptive parents foster post-institutionalized children's social and emotional adjustment. *Attachment & human development*, 19(4), 323-339.
- Baskak, B., Kır, Y., Sedes, N., Kuşman, A., Türk, E. G., Baran, Z., ... & Munir, K. (2019). Attachment style predicts cortical activity in temporoparietal junction (TPJ). *Journal of psychophysiology*.
- Beck, L. A., Pietromonaco, P. R., Ge, F., Carnes, N. C., Laws, H., & Powers, S. I. (2023). Spouses' attachment orientations shape physiological responses to relational stress over time. *Journal of Social and Personal Relationships*, 40(10), 3121-3146.
- Berntson, G. G., Cacioppo, J. T., & Quigley, K. S. (1993). Respiratory sinus arrhythmia: Autonomic origins, physiological mechanisms, and psychophysiological implications. *Psychophysiology*, 30(2), 183-196.
- Bhreathnach, E., Breen, J., & Grey, B. (2025). The stress, arousal and regulation (SAI) coding system. In B. Grey (Ed.), *The meaning of the child: Assessment, formulation and intervention for adopted and at-risk children and families* (pp. 277–300). SAGE.
- Borelli, J. L., Gaskin, G., Smiley, P., Chung, D., Shahar, B., & Bosmans, G. (2023). Multisystem physiological reactivity during help-seeking for attachment needs in school-aged children: Differences as a function of attachment. *Attachment & Human Development*, 25(1), 117-131.

- Borelli, J. L., West, J. L., Weekes, N. Y., & Crowley, M. J. (2014). Dismissing child attachment and discordance for subjective and neuroendocrine responses to vulnerability. *Developmental Psychobiology*, 56(3), 584-591.
- Bourassa, K. J., Ruiz, J. M., & Sbarra, D. A. (2019). The impact of physical proximity and attachment working models on cardiovascular reactivity: Comparing mental activation and romantic partner presence. *Psychophysiology*, 56(5), e13324.
- Bowlby, J. (1969). *Attachment and loss: Vol. 1. Attachment*. New York, NY: Basic Books.
- Bowlby, J. (1980). *Attachment and loss: Vol. 3. Loss: Sadness and depression*. Basic Books.
- Bretherton, I. (1990). Communication patterns, internal working models, and the intergenerational transmission of attachment relationships. *Infant mental health Journal*, 11(3), 237-252.
- British Psychological Society. (2021). *Code of human research ethics* (4th ed.).
<https://www.bps.org.uk/news-and-policy/bps-code-human-research-ethics-4th-edition-2021>
- Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Harvard university press.
- Byng-Hall, J. (1998). *Rewriting family scripts: Improvisation and systems change*. Guilford Press.
- Calkins, S. D., & Hill, A. L. (2007). Caregiver influences on emerging emotion regulation: Biological and environmental transactions in early development. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 229–248). Guilford Press.
- Carlson, N. R., & Carlson, N. R. (2007). *Physiology of behavior*.
- Carter, C. S., & Porges, S. W. (2013). The biochemistry of love: An oxytocin hypothesis. *EMBO Reports*, 14(1), 12–16. <https://doi.org/10.1038/embor.2012.191>
- Cassidy, J. (1994). Emotion regulation: Influences of attachment relationships. *Monographs of the society for research in child development*, 59(2-3), 228-249.
- Cicchetti, D., & Valentino, K. (2015). An ecological-transactional perspective on child maltreatment: Failure of the average expectable environment and its influence on child development. In D. Cicchetti (Ed.), *Developmental psychopathology: Volume three: Risk, disorder, and adaptation* (3rd ed., pp. 129–201). Wiley.

- Comte, A., Szymanska, M., Monnin, J., Moulin, T., Nezelof, S., Magnin, E., ... & Vulliez-Coady, L. (2024). Neural correlates of distress and comfort in individuals with avoidant, anxious and secure attachment style: An fMRI study. *Attachment & Human Development*, 26(5), 423-445.
- Cowan, C. P., & Cowan, P. A. (1992). *When partners become parents: The big life change for couples*. basic books.
- Crittenden, P. M. (2008). Raising parents to raise children: The prevention of mental health problems. *The Psychoanalytic Study of the Child*, 63(1), 58–75.
- Crittenden, P. M., & Landini, A. (2011). *Assessing adult attachment: A dynamic-maturational approach to discourse analysis*. WW Norton & Company.
- Crowell, J. A., Fraley, R. C., & Shaver, P. R. (1999). Measurement of individual differences in adolescent and adult attachment. *Handbook of attachment: Theory, research, and clinical applications*, 2, 635.
- Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). *The Sage handbook of qualitative research*. sage.
- Diamond, L. M., Hicks, A. M., & Otter-Henderson, K. D. (2008). Every time you go away: changes in affect, behavior, and physiology associated with travel-related separations from romantic partners. *Journal of personality and social psychology*, 95(2), 385.
- Domic-Siede, M., Sánchez-Corzo, A., & Guzmán-González, M. (2024). Brain oscillations during emotion regulation and the two-dimensional model of adult attachment. *Biological psychology*, 189, 108793.
- Dunn, W. (1997). The impact of sensory processing abilities on the daily lives of young children and their families: A conceptual model. *Infants & Young Children*, 9(4), 23-35.
- Dunn, W. (2001). The sensations of everyday life: Empirical, theoretical, and pragmatic considerations. *The American Journal of Occupational Therapy*, 55(6), 608-620.
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4.
- Feinberg, M. E. (2003). The internal structure and ecological context of coparenting: A framework for research and intervention. *Parenting: science and practice*, 3(2), 95-131.
- Feldman, R. (2007). Parent–infant synchrony: Biological foundations and developmental outcomes. *Current directions in psychological science*, 16(6), 340-345.

- Feeney, B. C., & Kirkpatrick, L. A. (1996). Effects of adult attachment and presence of romantic partners on physiological responses to stress. *Journal of personality and social psychology*, 70(2), 255.
- Fishman, D. B. (1999). *The case for pragmatic psychology*. New York, NY: New York University Press.
- Fonagy, P., & Target, M. (2002). Early intervention and the development of self-regulation. *Psychoanalytic Inquiry*, 22(3), 307–335.
- Gander, M., & Buchheim, A. (2015). Attachment classification, psychophysiology and frontal EEG asymmetry across the lifespan: a review. *Frontiers in human neuroscience*, 9, 79.
- Gander, M., Karabatsiakakis, A., Nuderscher, K., Bernheim, D., Doyen-Waldecker, C., & Buchheim, A. (2022). Secure attachment representation in adolescence buffers heart-rate reactivity in response to attachment-related stressors. *Frontiers in human neuroscience*, 16, 806987.
- George, C., Main, M., & Kaplan, N. (1996). Adult attachment interview. *Interpersona: An International Journal on Personal Relationships*.
- George, C., & Solomon, J. (2008). The caregiving system: A behavioral systems approach to parenting. *Handbook of attachment: Theory, research, and clinical applications*, 2, 833-856.
- Gilissen, R., Bakermans-Kranenburg, M. J., van Ijzendoorn, M. H., & Linting, M. (2008). Electrodermal reactivity during the Trier Social Stress Test for children: interaction between the serotonin transporter polymorphism and children's attachment representation. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology*, 50(6), 615-625.
- Gounaridis, N. (2020). *A linked-series case study looking at the standardised assessment of adopted children with attachment and sensory processing difficulties and the outcomes of sensory integration after 8 sessions* (Unpublished master's dissertation). University of Roehampton.
- Granqvist, P., Sroufe, L. A., Dozier, M., Hesse, E., Steele, M., van Ijzendoorn, M., ... & Duschinsky, R. (2017). Disorganized attachment in infancy: A review of the phenomenon and its implications for clinicians and policy-makers. *Attachment & human development*, 19(6), 534-558. <https://doi.org/10.1080/14616734.2017.1354040>

- Grey, B. (2025). Analysing caregiving discourse: The MotC procedure. In B. Grey (Ed.), *The meaning of the child: Assessment, formulation and intervention for adopted and at-risk children and families* (pp. 139–158). SAGE.
- Grey, B., & Farnfield, S. (2017). The Meaning of the Child interview: The assessment of parent–child relationships as a dynamic conversation. In H. Steele & M. Steele (Eds.), *Handbook of attachment-based interventions* (pp. 139–158). Guilford Press.
- Grey, B. (Ed.). (2025). *The meaning of the child: Assessment, formulation and intervention for adopted and at-risk children and families*. SAGE.
- Groh, A. M., & Haydon, K. C. (2018). Mothers’ neural and behavioral responses to their infants’ distress cues: The role of secure base script knowledge. *Psychological Science*, 29(2), 242–253.
- Groh, A. M., Propper, C., Mills-Koonce, R., Moore, G. A., Calkins, S., & Cox, M. (2019). Mothers' physiological and affective responding to infant distress: Unique antecedents of avoidant and resistant attachments. *Child development*, 90(2), 489-505.
- Groh, A. M., Roisman, G. I., Haydon, K. C., Bost, K., McElwain, N., Garcia, L., & Hester, C. (2015). Mothers’ electrophysiological, subjective, and observed emotional responding to infant crying: The role of secure base script knowledge. *Development and Psychopathology*, 27(4), 1237–1250.
- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological inquiry*, 26(1), 1-26.
- Grossman, P., & Taylor, E. W. (2007). Toward understanding respiratory sinus arrhythmia: Relations to cardiac vagal tone, evolution and biobehavioral functions. *Biological psychology*, 74(2), 263-285.
- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological inquiry*, 26(1), 1-26.
- Grossman, P. (2023). Fundamental challenges and likely refutations of the five basic premises of the polyvagal theory. *Biological Psychology*, 180, 108589.
- Gunnar, M., & Quevedo, K. (2007). The neurobiology of stress and development. *Annu. Rev. Psychol.*, 58(1), 145-173.

- Hadiprodjo, N. (2018). *Clinical applications of the polyvagal theory and attachment theory to play therapy for children with developmental trauma* [Doctoral thesis, University of Roehampton]. University of Roehampton Research Explorer.
<https://pure.roehampton.ac.uk/portal/en/studentTheses/clinical-applications-of-the-polyvagal-theory-and-attachment-theo>
- Health Research Authority. (2023). *Communicating study findings to participants: Guidance*.
<https://www.hra.nhs.uk/planning-and-improving-research/policies-standards-legislation/research-transparency/informing-participants/communicating-study-findings-participants-guidance/>
- Health Research Authority. (2023). *Consent and participant information guidance*.
<https://www.hra.nhs.uk/planning-and-improving-research/policies-standards-legislation/data-protection-and-information-governance/>
- Helm, J. L., Sbarra, D. A., & Ferrer, E. (2014). Coregulation of respiratory sinus arrhythmia in adult romantic partners. *Emotion, 14*(3), 522.
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world?. *Behavioral and brain sciences, 33*(2-3), 61-83.
- Hill-Soderlund, A. L., Mills-Koonce, W. R., Propper, C., Calkins, S. D., Granger, D. A., Moore, G. A., & Cox, M. J. (2008). Parasympathetic and sympathetic responses to the strange situation in infants and mothers from avoidant and securely attached dyads. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology, 50*(4), 361-376.
- Jaremka, L. M., Glaser, R., Loving, T. J., Malarkey, W. B., Stowell, J. R., & Kiecolt-Glaser, J. K. (2013). Attachment anxiety is linked to alterations in cortisol production and cellular immunity. *Psychological science, 24*(3), 272-279.
- Joanna Briggs Institute. (2017). *Critical appraisal tools*. The University of Adelaide.
<https://jbi.global/critical-appraisal-tools>
- Juffer, F., & Van Ijzendoorn, M. H. (2005). Behavior problems and mental health referrals of international adoptees: A meta-analysis. *jama, 293*(20), 2501-2515.
- Kaniuk, J., Steele, M., & Hodges, J. (2004). Report on a longitudinal research project, exploring the development of attachments between older, hard-to-place children and their adopters over

the first two years of placement. *Adoption & Fostering*, 28(2), 61–67.

<https://doi.org/10.1177/030857590402800207>

- Kerley, L. J., Meredith, P. J., & Harnett, P. H. (2023). The relationship between sensory processing and attachment patterns: a scoping review. *Canadian Journal of Occupational Therapy*, 90(1), 79-91.
- Koehler-Dauner, F., Peter, L., Roder, E., Fegert, J. M., Ziegenhain, U., Waller, C., & Buchheim, A. (2024). A Pilot Study on the Influence of Maternal Attachment Representations on Maternal Heart Rate Mediated by Perceived Stress. *Brain Sciences*, 14(5), 412.
- Krause, S., Pokorny, D., Schury, K., Doyen-Waldecker, C., Hulbert, A. L., Karabatsiakakis, A., & Buchheim, A. (2016). Effects of the adult attachment projective picture system on oxytocin and cortisol blood levels in mothers. *Frontiers in human neuroscience*, 10, 627.
- Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 33(1), 159–174.
- Lefebvre, C., Glanville, J., Briscoe, S., Littlewood, A., Marshall, C., Metzendorf, M. I., Noel-Storr, A., Rader, T., Shokraneh, F., Thomas, J., & Wieland, L. S. (2022). Chapter 4: Searching for and selecting studies. In J. P. T. Higgins, J. Thomas, J. Chandler, M. Cumpston, T. Li, M. J. Page, & V. A. Welch (Eds.), *Cochrane Handbook for Systematic Reviews of Interventions* (Version 6.3). Cochrane. <https://training.cochrane.org/handbook/current/chapter-04>
- Leerkes, E. M., Su, J., Calkins, S. D., O'Brien, M., & Supple, A. J. (2017). Maternal physiological dysregulation while parenting poses risk for infant attachment disorganization and behavior problems. *Development and Psychopathology*, 29(1), 245-257.
- Lionetti, F., Pastore, M., & Barone, L. (2015). Attachment in institutionalized children: A review and meta-analysis. *Child abuse & neglect*, 42, 135-145.
- Lyons-Ruth, K., & Jacobvitz, D. (2008). Attachment disorganization: Genetic factors, parenting contexts, and developmental transformation from infancy to adulthood. In J. Cassidy & P. R. Shaver (Eds.), *Handbook of attachment: Theory, research, and clinical applications* (2nd ed., pp. 666–697). Guilford Press.
- Main, M. (2000). The organized categories of infant, child, and adult attachment: Flexible vs. inflexible attention under attachment-related stress. *Journal of the American Psychoanalytic Association*, 48(4), 1055-1096.

- Main, M., Goldwyn, R., & Hesse, E. (1998). Adult attachment scoring and classification system. *Unpublished manuscript, University of California at Berkeley*, 97.
- Main, M., Kaplan, N., & Cassidy, J. (1985). Security in infancy, childhood, and adulthood: A move to the level of representation. *Monographs of the society for research in child development*, 66-104.
- Main, M., & Solomon, J. (1990). Procedures for identifying infants as disorganized/disoriented during the Ainsworth Strange Situation. *Attachment in the preschool years: Theory, research, and intervention*, 1, 121-160.
- Main, M., Hesse, E., & Goldwyn, R. (2002). *Adult Attachment Scoring and Classification System, Version 7.2*. Unpublished manuscript, University of California, Berkeley.
- Maunder, R. G., Lancee, W. J., Nolan, R. P., Hunter, J. J., & Tannenbaum, D. W. (2006). The relationship of attachment insecurity to subjective stress and autonomic function during standardized acute stress in healthy adults. *Journal of psychosomatic research*, 60(3), 283-290.
- Maxwell, J. A. (2012). *A realist approach for qualitative research*. Sage.
- McLeod, J. (2010). Case study research in counselling and psychotherapy. *SAGE Publications*.
- Movahed Abtahi, M., & Kerns, K. A. (2017). Attachment and emotion regulation in middle childhood: Changes in affect and vagal tone during a social stress task. *Attachment & human development*, 19(3), 221-242.
- Munn, Z., Moola, S., Riitano, D., & Lisy, K. (2014). The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. *International Journal of Health Policy and Management*, 3(3), 123–128. <https://doi.org/10.15171/ijhpm.2014.71>
- Murray, L., Fiori-Cowley, A., Hooper, R., & Cooper, P. (1996). The impact of postnatal depression and associated adversity on early mother–infant interactions and later infant outcome. *Child Development*, 67(5), 2512–2526. <https://doi.org/10.2307/1131637>
- Neil, E. (2012). Making sense of adoption: Integration and differentiation from the perspective of adopted children in middle childhood. *Children and Youth Services Review*, 34(2), 409-416.

- Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of general psychology*, 2(2), 175-220.
- Niermann, H. C., Ly, V., Smeekens, S., Figner, B., Riksen-Walraven, J. M., & Roelofs, K. (2015). Infant attachment predicts bodily freezing in adolescence: evidence from a prospective longitudinal study. *Frontiers in Behavioral Neuroscience*, 9, 263.
- Nofech-Mozes, J. A. L., Jamieson, B., Gonzalez, A., & Atkinson, L. (2020). Mother–infant cortisol attunement: Associations with mother–infant attachment disorganization. *Development and Psychopathology*, 32(1), 43-55.
- Pace, C. S., Cavanna, D., Velotti, P., & Zavattini, G. C. (2014). Attachment representations of late-adopted children through attachment narratives: An assessment of disorganisation, mentalising and coherence of mind for adoption practice. *Adoption & Fostering*, 38(3), 255–270. <https://doi.org/10.1177/0308575914543488>
- 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>
- Paret, L., Bailey, H. N., Roche, J., Bureau, J. F., & Moran, G. (2015). Preschool ambivalent attachment associated with a lack of vagal withdrawal in response to stress. *Attachment & Human Development*, 17(1), 65-82.
- Petrowski, K., Beetz, A., Schurig, S., Wintermann, G. B., & Buchheim, A. (2017). Association of attachment disorganization, attachment-related emotion regulation, and cortisol response after standardized psychosocial stress procedure: A pilot study. *psihologija*, 50(2), 103-116.
- Pocock, D. (2010). “Wow!” but how do we handle the power of the DMM? *Clinical Child Psychology and Psychiatry*, 15(3), 419–425.
- Porges, S. W. (2007). The polyvagal perspective. *Biological psychology*, 74(2), 116-143.
- Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., Roen, K., & Duffy, S. (2006). *Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC methods programme*. Lancaster University.

- Powers, S. I., Pietromonaco, P. R., Gunlicks, M., & Sayer, A. (2006). Dating couples' attachment styles and patterns of cortisol reactivity and recovery in response to a relationship conflict. *Journal of personality and social psychology*, 90(4), 613.
- Pruitt, M. M., McKay, E. R., Lelakowska, G., & Ekas, N. V. (2020). The infant simulator paradigm with Non-Parents: attitudes, physiology, and observed caregiving. *Journal of Child and Family Studies*, 29(9), 2515-2529.
- Purvis, K. B., McKenzie, L. B., Cross, D. R., & Razuri, E. B. (2013). A spontaneous emergence of attachment behavior in at-risk children and a correlation with sensory deficits. [*Journal of Child & Adolescent Psychiatric Nursing*](#), 26(3), 165–172.
- Qu, J., & Leerkes, E. M. (2018). Patterns of RSA and observed distress during the still-face paradigm predict later attachment, compliance and behavior problems: A person-centered approach. *Developmental Psychobiology*, 60(6), 707-721.
- Roisman, G. I., Holland, A., Fortuna, K., Fraley, R. C., Clausell, E., & Clarke, A. (2007). The Adult Attachment Interview and self-reports of attachment style: an empirical rapprochement. *Journal of personality and social psychology*, 92(4), 678.
- Rustin, M. (2019). *Researching the unconscious: Principles of psychoanalytic method*. Routledge.
- Rutgers, A. H., Bakermans-Kranenburg, M. J., van Ijzendoorn, M. H., & van Berckelaer-Onnes, I. A. (2004). Autism and attachment: a meta-analytic review. *Journal of Child psychology and Psychiatry*, 45(6), 1123-1134.
- Rutter, M. (1995). Clinical implications of attachment concepts: Retrospect and prospect. *Journal of child psychology and psychiatry*, 36(4), 549-571.
- Sameroff, A. (2009). *The transactional model*. American Psychological Association.
- Schneider, M., Obsuth, I., & Szymanska, M. (2022). *Attachment-based parent–adolescent interaction linked to visual attention and autonomic arousal to distress and comfort stimuli*. *BMC Psychol* 10, 112.
- Schore, A. N. (2001). The effects of early relational trauma on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal: Official Publication of The World Association for Infant Mental Health*, 22(1-2), 201-269.

- Siegel, D. J. (2020). *The developing mind: How relationships and the brain interact to shape who we are*. Guilford Publications.
- Slade, A. (2005). Parental reflective functioning: An introduction. *Attachment & human development*, 7(3), 269-281.
- Smeekens, S., Riksen-Walraven, J. M., Van Bakel, H. J., & De Weerth, C. (2010). Five-year-olds' cortisol reactions to an attachment story completion task. *Psychoneuroendocrinology*, 35(6), 858-865.
- Solomon, J., & George, C. (2008). *The measurement of attachment security in infancy and childhood*. In J. Cassidy & P. R. Shaver (Eds.), *Handbook of attachment: Theory, research, and clinical applications* (2nd ed., pp. 383–416). Guilford Press.
- Solomon, J., & George, C. (Eds.). (2011). *Disorganized attachment and caregiving*. Guilford Press.
- Stiles, W. B. (2007). Theory-building case studies of counselling and psychotherapy. *Counselling and Psychotherapy Research*, 7(2), 122-127.
- Strathearn, L., Fonagy, P., Amico, J., & Montague, P. R. (2009). Adult attachment predicts maternal brain and oxytocin response to infant cues. *Neuropsychopharmacology*, 34(13), 2655–2666.
- Teague, S. J., Gray, K. M., Tonge, B. J., & Newman, L. K. (2017). Attachment in children with autism spectrum disorder: A systematic review. *Research in Autism Spectrum Disorders*, 35, 35-50.
- Thayer, J. F., & Lane, R. D. (2009). Claude Bernard and the heart–brain connection: Further elaboration of a model of neurovisceral integration. *Neuroscience & Biobehavioral Reviews*, 33(2), 81-88.
- 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.
<https://doi.org/10.1016/j.neubiorev.2011.11.009>
- Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. MIT press.

- Thompson, R. A. (2016). What more has been learned? The science of early childhood development 15 years after neurons to neighborhoods. *Zero to Three Journal*, 36(3), 18-24.
- Tufanaru, C., Munn, Z., Aromataris, E., Campbell, J., & Hopp, L. (2020). Chapter 3: Systematic reviews of effectiveness. In E. Aromataris & Z. Munn (Eds.), *JBIM Manual for Evidence Synthesis*. JBI. <https://doi.org/10.46658/JBIMES-20-04>
- Turner, K. A., Cohn, E. S., & Koomar, J. (2012). Mothering when mothers and children both have sensory processing challenges. *British Journal of Occupational Therapy*, 75(10), 449–455.
- Van Bakel, H. J., & Riksen-Walraven, J. M. (2004). Stress reactivity in 15-month-old infants: Links with infant temperament, cognitive competence, and attachment security. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology*, 44(3), 157-167.
- Van den Dries, L., Juffer, F., Van IJzendoorn, M. H., & Bakermans-Kranenburg, M. J. (2009). Fostering security? A meta-analysis of attachment in adopted children. *Children and youth services review*, 31(3), 410-421.
- van der Kolk, B. A. (2014). *The body keeps the score: Brain, mind, and body in the healing of trauma*. Viking.
- van IJzendoorn, M. H., Schuengel, C., & Bakermans-Kranenburg, M. J. (1999). Disorganized attachment in early childhood: Meta-analysis of precursors, concomitants, and sequelae. *Development and Psychopathology*, 11(2), 225–249. <https://doi.org/10.1017/S0954579499002035>
- Vorria, P., Papaligoura, Z., Sarafidou, J., Kopakaki, M., Dunn, J., van IJzendoorn, M. H., & Kontopoulou, A. (2006). The development of adopted children after institutional care: A follow-up study. *Journal of Child Psychology and Psychiatry*, 47(12), 1246–1253.
- Wilkinson, S. R. (2004). *Coping and complaining: Attachment and the language of disease*. Routledge.
- Xu, N., & Groh, A. M. (2023). The significance of mothers' attachment representations for vagal responding during interactions with infants. *Attachment & human development*, 25(1), 50-70.
- Yardley, L. (2000). Dilemmas in qualitative health research. *Psychology and health*, 15(2), 215-228.

Zajac, L., Raby, K. L., & Dozier, M. (2019). Attachment state of mind and childhood experiences of maltreatment as predictors of sensitive care from infancy through middle childhood: Results from a longitudinal study of parents involved with Child Protective Services. *Development and psychopathology*, 31(1), 113-125.

Appendices

Appendix A: Full systematic literature review search strings:

Database	Search String
Pubmed	attachment[Title/Abstract] AND (physiological[Title/Abstract] OR physiology[Title/Abstract] OR "affect regulation"[Title/Abstract] OR "physiological arousal"[Title/Abstract] OR psychophysiology[Title/Abstract] OR biobehavioural[Title/Abstract]) AND ((stress[Title/Abstract] OR cortisol[Title/Abstract] OR "heart rate"[Title/Abstract] OR "skin conductance"[Title/Abstract] OR "electrodermal activity"[Title/Abstract] OR "respiratory sinus arrhythmia"[Title/Abstract] OR behaviour[Title/Abstract]) OR (physiological[Title/Abstract] AND psychophysiology[Title/Abstract]))
Scopus	SUBJAREA(PSYC) AND (TITLE-ABS("attachment") OR "attachment strategy" OR "attachment behaviour" OR "attachment pattern" OR "insecurely attached" OR "securely attached") AND ((TITLE-ABS("physical") W/5 "attachment") OR (TITLE- ABS("physiological") W/5 "attachment") OR (TITLE- ABS("physiology") W/5 "attachment") OR "affect regulation" OR "physiological arousal" OR psychophysiology OR biobehavioural) AND ((TITLE-ABS("stress") W/5 "attachment") OR cortisol OR "heart rate" OR "skin conductance" OR "electrodermal activity" OR "respiratory sinus arrhythmia" OR ""))
PsycArticles	attachment AND ("psychophysiological response" OR psychophysiology OR "affect regulation" OR "physiological response" OR biobehavioural OR "emotional regulation" OR "self-regulation" OR "stress regulation" OR physiological OR physiology)

Appendix B: JBI critical appraisal tools (cross-sectional and cohort studies):

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS SECTIONAL STUDIES

Reviewer_____

Date_____

Author_____Year_____Record Number_____

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☐	☐	☐	☐
2. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	☐	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	☐	☐	☐	☐
5. Were confounding factors identified?	☐	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☐	☐	☐	☐
8. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

JBI CRITICAL APPRAISAL CHECKLIST FOR COHORT STUDIES

Reviewer_____

Date_____

Author_____Year_____Record Number_____

	Yes	No	Unclear	Not applicable
1. Were the two groups similar and recruited from the same population?	☐	☐	☐	☐
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	☐	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	☐	☐	☐	☐
4. Were confounding factors identified?	☐	☐	☐	☐
5. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	☐	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☐	☐	☐	☐
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	☐	☐	☐	☐
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	☐	☐	☐	☐
10. Were strategies to address incomplete follow up utilized?	☐	☐	☐	☐

11. Was appropriate statistical analysis used?

☐☐☐☐

Overall appraisal:

Include

☐

Exclude

☐

Seek further info

☐

Comments (Including reason for exclusion)

Appendix C: Ethical Approval from the University of Hertfordshire:



HEALTH, SCIENCE, ENGINEERING AND TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO [primary researcher]

CC [research supervisor]

FROM [redacted], Health, Science, Engineering and Technology
ECDA Chair

DATE 05/07/2024

Protocol number: **LMS/PGR/UH/05714**

Title of study: Attachment and arousal in early school age children and their parents

Your application for ethics approval has been accepted and approved with the following conditions by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

[redacted], a consultant OT and second supervisor
[redacted] at [redacted]

General conditions of approval:

Ethics approval has been granted subject to the standard conditions below:

Permissions: Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

External communications: Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Invasive procedures: If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and copies of your completed consent paperwork to this ECDA once your study is complete.

Submission: Students must include this Approval Notification with their submission.

Validity:

This approval is valid:

From: 05/07/2024

To: 31/12/2025

Please note:

Failure to comply with the conditions of approval will be considered a breach of protocol and may result in disciplinary action which could include academic penalties.

Additional documentation requested as a condition of this approval protocol may be submitted via your supervisor to the Ethics Clerks as it becomes available. All documentation relating to this study, including the information/documents noted in the conditions above, must be available for your supervisor at the time of submitting your work so that they are able to confirm that you have complied with this protocol.

Should you amend any aspect of your research or wish to apply for an extension to your study you will need your supervisor's approval (if you are a student) and must complete and submit form EC2.

Approval applies specifically to the research study/methodology and timings as detailed in your Form EC1A. In cases where the amendments to the original study are deemed to be substantial, a new Form EC1A may need to be completed prior to the study being undertaken.

Failure to report adverse circumstance/s may be considered misconduct.

Should adverse circumstances arise during this study such as physical reaction/harm, mental/emotional harm, intrusion of privacy or breach of confidentiality this must be reported to the approving Committee immediately.

Appendix D: Participant Information Sheet:



UNIVERSITY OF HERTFORDSHIRE

ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS (‘ETHICS COMMITTEE’)

FORM EC6: PARTICIPANT INFORMATION SHEET

1 Title of study

“How is attachment and caregiving discourse related to the physiological management of arousal in caregivers of adopted children when compared to normative relationships?”

AND

“Understanding how parental caregiving is related to child attachment in adoptive and normative relationships”

2 Introduction

You are being invited to take part in a study. Before you decide whether to do so, it is important that you understand the study that is being undertaken and what your involvement will include. Please take the time to read the following information carefully and discuss it with others if you wish. Do not hesitate to ask us anything that is not clear or for any further information you would like to help you make your decision. Please do take your time to decide whether or not you wish to take part. The University’s regulation, UPR RE01, ‘Studies Involving the Use of Human Participants’ can be accessed via this link:

<https://www.herts.ac.uk/about-us/governance/university-policies-and-regulations-uprs/uprs>

(after accessing this website, scroll down to Letter S where you will find the regulation)

Thank you for reading this.

3 What is the purpose of this study?

As data would be collected and used for both studies, there are two different purposes:

- 1) To look at how a parent of adopted and biological children thinks, feels, and makes sense of, their relationship with their child. This will be looked at through speech and bodily reactions.
- 2) To look at how children form attachments to their parents and how parents respond to their children's needs. We're interested in families with adopted children and also those with biological children. The goal is to use what we learn to help improve the psychological support which can be tailored to families.

4 Do I have to take part?

It is completely up to you whether or not you decide to take part in this study. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. Agreeing to join the study does not mean that you have to complete it. You are free to withdraw at any stage without giving a reason. A decision to withdraw at any time, or a decision not to take part at all, will not affect any treatment/care that you may receive (should this be relevant).

5 Are there any age or other restrictions that may prevent me from participating?

There are no age restrictions preventing you from participating. The only factor to consider is that you have a child aged between 5 and 7 years of age.

6 How long will my part in the study take?

The study should take no longer than around 90 minutes of your time.

7 What will happen to me if I take part?

A researcher will contact you to schedule an in-person meeting at a convenient time. We prefer face-to-face sessions for a more accurate understanding of your child-parent relationship than an online interaction would offer. On the day of the study, you'll meet two of our researchers. One will engage your child in playful storytelling activities, while the other will ask you some questions in a separate room, focusing on your experiences and relationship with your child. Both parts of this session will be video recorded. After completing the interview, you'll rejoin your child. To express our gratitude, each family will receive a small shopping voucher and the opportunity to take a themed family photo as a memento.

8 What are the possible disadvantages, risks or side effects of taking part?

(Note: should any circumstances arise that potentially results in the need for you to withdraw from the study, the investigator will discuss the matter with you.)

Due to the sensitive nature of talking about your relationship with your child, there is the chance that this could bring up difficult emotions for you. Support will be offered in terms of a debrief and you will be given the contact details of a member of staff, should you find yourself in need of further support. You will also be able to take breaks during the interview if required. However, as long as you feel comfortable discussing this, we do not anticipate any significant risk to cause harm.

Whilst you answer some questions about your relationship with your child, you will be apart from them for up to an hour. However, as children aged 5-7 are used to being

separated from their parents during the day, we do not anticipate any significant risks for your child in taking part.

9 What are the possible benefits of taking part?

By taking part, you play a pivotal role in advancing our knowledge of attachment and bonding in parent-child relationships, both for biological and adopted children. Ultimately, your participation has the potential to enhance occupational therapy and psychology support services, for families navigating relationship challenges. Should you currently be involved with any professionals at the clinic, findings from this study could help inform and enrich the care you receive.

10 How will my taking part in this study be kept confidential?

The information gathered during your interview will be transcribed and analyzed anonymously. Access to all data will be restricted to the team for research purpose only. The researchers will then to produce findings for research study that may be published to peer-reviewed journals. Throughout the writing process, no identifying information will be included to ensure confidentiality. Both you and your child will remain unidentifiable in any publications resulting from this study.

11 Audio-visual material

Video recordings will only be viewed by the researchers involved in this study. This is so they can watch this back to help assist them with their analysis. These videos will not be shared with any third parties and will be securely disposed of once the study is complete.

12 What will happen to the data collected within this study?

- Written data from interview transcripts will be anonymised prior to being written up.
- Video recordings of the interview and the interaction between you and your child will be uploaded onto a computer and deleted from the secure recording device. They will then be stored electronically, on a password-protected device and on a password-protected file, up until no later than 2 years after completion of the study in September 2027, after which time it will be destroyed under secure conditions.
- Consent forms collected will be stored as a hard copy by the researchers and placed in a locked cupboard up until no later than 2 years after completion of the study in September 2027, after which time it will be destroyed under secure conditions.

13 Will the data be required for use in further studies?

- The video recordings themselves will not be re-used after this study. However, the findings from the analysis may be re-used or subjected to further analysis as

part of a future ethically-approved study; the data to be re-used will be anonymised.

- The results of the study and/or the data collected (in anonymised form) may be deposited in an open access repository.

14 Who has reviewed this study?

This study has been reviewed by:

- The University of Hertfordshire Health, Science, Engineering and Technology Ethics Committee with Delegated Authority.

The UH protocol number is 05069.

15 Factors that might put others at risk

Please note that if, during the study, any medical conditions or non-medical circumstances such as unlawful activity become apparent that might or had put others at risk, the University may refer the matter to the appropriate authorities and, under such circumstances, you will be withdrawn from the study.

16 Who can I contact if I have any questions?

If you would like further information or would like to discuss any details personally, please get in touch with me by email: [redacted] or [redacted]

Although we hope it is not the case, if you have any complaints or concerns about any aspect of the way you have been approached or treated during the course of this study, please write to the University's Secretary and Registrar at the following address:

Secretary and Registrar
University of Hertfordshire
College Lane
Hatfield
Herts
AL10 9AB

Thank you very much for reading this information and giving consideration to taking part in this study.

Appendix E: Participant Consent Form



Study title: How is attachment and caregiving discourse related to the physiological management of arousal in caregivers of adopted children when compared to normative relationships?

AND

Understanding how parental caregiving is related to child attachment in adoptive and normative relationships.

Principle Investigators: [redacted]

**UNIVERSITY OF HERTFORDSHIRE
ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS
(‘ETHICS COMMITTEE’)**

**FORM EC3
CONSENT FORM FOR STUDIES INVOLVING HUMAN PARTICIPANTS**

I, the undersigned [*please give your name here, in BLOCK CAPITALS*]

.....
of [*please give contact details here, sufficient to enable the investigator to get in touch with you, such as a postal or email address*]

.....
hereby freely agree to take part in the study entitled [*insert name of study here*]

.....
(UH Protocol number ..05069.....)

1 I confirm that I have been given a Participant Information Sheet (a copy of which is attached to this form) giving particulars of the study, including its aim(s), methods and design, the names and contact details of key people and, as appropriate, the risks and potential benefits, how the information collected will be stored and for how long, and any plans for follow-up studies that might involve further approaches to participants. I have also been informed of how my personal information on this form will be stored and for how long. I have been given details of my involvement in the study. I have been told that in the event of any significant change to the aim(s) or design of the study I will be informed, and asked to renew my consent to participate in it.

2 I have been assured that I may withdraw from the study at any time without disadvantage or having to give a reason.

3 In giving my consent to participate in this study, I understand that video recording will take place and I have been informed of how/whether this recording will be transmitted/displayed.

4 I have been told how information relating to me (data obtained in the course of the study, and data provided by me about myself) will be handled: how it will be kept secure, who will have access to it,

and how it will or may be used, including the possibility of anonymised data being deposited in a repository with open access (freely available).

5 I understand that if there is any revelation of unlawful activity or any indication of non-medical circumstances that would or has put others at risk, the University may refer the matter to the appropriate authorities.

Signature of participant.....Date.....

Signature of (principal)
investigator.....Date.....

Signature of (principal)
investigator.....Date.....

Name of (principal) investigator [*in BLOCK CAPITALS please*]

.....

Name of (principal) investigator [*in BLOCK CAPITALS please*]

.....

Appendix F: Coded MotC Transcript Example:

The full MotC coding framework is not included due to copyright restrictions. A coded transcript example is provided to illustrate how the MotC system was applied (see below).

During the initial coding phase, attachment-related “markers” were identified directly on the transcript by the MotC coder. These markers were then summarised using an overall coding sheet, which mapped observed discourse features onto different memory systems (e.g., semantic, episodic, procedural). The dominant attachment strategy was derived from the frequency and patterning of these markers across systems using the process outlined in the empirical study Method section, in line with MotC principles.

The primary researcher subsequently reviewed the transcripts multiple times, alongside the recorded interview footage and physiology coding, to explore coherence and divergence. This informed the development of integrative case formulations. For further information see Grey et al., 2017.

Okay, thank you.

K: That's alright.

Erm. And can you tell me about when Kiara came to live with you. How did it feel for you? How were you thinking?

K: ~~Qoo, err~~ [2 second pause] that's... a difficult one. It was... quite surreal, erm [smacks lips] uncomfortable because...[sighs], speaking to friends of mine that had birth children ventriloquism, using an external source rather than personal experience [2 second pause] and obviously, as dads generalising, you're sort of outside of the loop a little bit because a lot of the changes aren't happening to you, they're not your changes. But there's a progression that they can see that there's, there's going to be an end point, and then you're going to be a dad. I felt...it was sort of...courses, interviews, forms, questionnaires, and there's lots of this going on tangible actions. And then, oh, by the way, we have a child unexpected? Oh, by the way, now you're taking her home. It felt quite...surreal that I'm that I'm now a dad. Has he accepted being her dad?

Mhmm

K: And it was very much like, the morning Kiara came home to us...err it was Friday the 13th of September, which should tell you all you need to know doomed? We went to pick her up from the foster carer's house, for the last time, and it was like we got home...and it was like, oh...oh, yeah, she's now ours. It was very [3 second pause] it felt quite binary. So, you are either are or you're not. Does that make sense? Flat affect, functional

Mhmm yeah

K: In a way...that's the best way I can sort of... describe that time. It took me, I'd say two or three days to sort of go, oh, right okay, this is, I am a dad then...Yeah, that was, it was a very surreal time for me, I think. And...yeah...[trails off] disconnected, out of body experience

You say it was surreal, it kind of took you, understandably, a couple of days to get your head around it. How would you describe what you were feeling?

K: I don't think...I don't think... I wasn't particularly feeling anything, really, because I was a little bit on autopilot I think [laughs]...as a lot of new dads are and a lot of new parents are I think generalizing – safer to feel like everyone else feels the same. that that's something I don't think actually, I don't think there's much of a difference really, between birth parents and adopted parents, that when you're when it's the first time you're doing it, you just don't know what you do, and you just try to keep this tiny person alive for a few days... you you literally are just like, what is it? what do they need? What do they need? Functional, parenting as a job And that's all it was for the first few days. And it wasn't till really, we were sat... obviously, I was on paternity leave, I was sat with Kiara, sort of asleep on me, and I was oh...right... yeah...like I am, this is me as a dad now-now. Rational realisation (rather than emotional connection or acceptance)

Appendix G: Coded SAI Transcript Example

Accompanying images have been removed to protect participant anonymity. The full SAI coding framework is not included due to copyright restrictions. A coded transcript example is provided to illustrate how this framework was applied (see below).

In the original dataset, transcripts were analysed alongside still images capturing caregiver physiological behaviours and a summary table of arousal patterns. Recorded interviews segments were reviewed frame-by-frame, and the coder annotated transcripts with observed physiological behaviours, supported by selected image stills. These behaviours were grouped into categories (e.g., *self-soothing*) and interpreted within the broader arousal system (e.g., SNS or PNS dominance), based on the balance and function of sympathetic and parasympathetic indicators.

Behaviours were considered in the context of the accompanying narrative. The primary researcher then revisited the video recordings and transcripts multiple times, alongside coded MotC transcripts, to identify segments that reflected coherence or divergence across the two coding systems. For further information on the SAI, see Bhreathnach et al. (2025).

I: Could you describe her [Kiara] for me?

K: Yeah, she's [2 second pause] *[sighs]*, she's quiet [1 second pause] a worried child at times. Err that will be my overriding thing. If she's secure where she is, like downstairs now, *(wipes nose, hand returns to pocket feet movement)* she she's [pause] more than secure down there. She'll be happy, laughing, smiling, jumping. [1.50] Err if it's a new situation, very, very anxious, very, very worried. Err which is something we've been trying to work on quite a lot over the last few years

scratches head . [1.59] hand returns to pocket an moves feet up and down.

But generally, if she's with either myself or my wife or any anyone she knows she's happy, smiley, jumping around, hurtling herself through things *[laughs]*. Yeah, so generally, I'd say quite happy, bouncy girl is what I probably describe her *(reaches for cup [2.18])* as best. She sort of loves to be dancing, jumping around. *Drinks [2.21] returns to both hands in pocket.*

I: Okay, thanks. And what about you, what kind of person would you say you are? How would you describe yourself?

K: Erm *[sighs]*, that's a difficult one. I'm quite laid back I suppose. *I don't like to let things get to me too much, (right foot goes up and down) if I can possibly help it.* Erm *[brief pause, smacks lips]*, it's not always easy with two young children, obviously *[interviewer laughs]*. But yeah, I tried to be quite laid back and quiet, and sort of...not just not going with the flow, that makes me sound a bit wishy washy. But I don't like to get worked up *(gestures with hands)*

in a situation unless I absolutely have to..there's no point, I don't think. But err yeh, **I try to be quite laid back and quite calm with things.(right foot moving) Um [brief pause, smacks lips]**, I like to try and help and help her where I can. Erm but, yeah, (intake of breath)I'd say that's probably the best description.

I: Okay, thank you.

K: That's alright.

I: Erm. And can you tell me about when Kiara came to live with you. How did it feel for you? How were you thinking?

Repositions self, hands in pocket and rotates chair.

K: Ooo, errr [2 second pause] that's... a difficult one. It was... quite surreal

rotates chairs strokes forehead 3.43

erm **[smacks lips]** because...[sighs], speaking to friends of mine that had birth children [2 second pause} and obviously, as dads, you're sort of outside of the loop a little bit, because a lot of the changes aren't happening to you, they're not your changes. But there's a progression that they can see that there's, there's going to be an end point, and then you're going to be a dad. I felt...it was sort of....courses, interviews, forms, questionnaires, and there's lots of this going on. And then, oh, by the way, we have a child. Oh, by the way, now you're taking her home. It felt quite...surreal that I'm that I'm now a dad.

Appendix H: MotC Classification Definitions (Grey et al., 2017).

Sensitive: The caregiver demonstrates an attuned, reflective stance towards the child. Their narrative feels emotionally open, balanced, and coherent, showing a capacity to acknowledge both the child's and their own emotions. There is a sense of mutual regulation, relational joy, and adaptability. The caregiver is neither overwhelmed nor detached from the relationship, and the child is held in mind as a separate individual with needs that are met sensitively.

Unresponsive (child-led): The caregiver minimises the emotional importance of the relationship, often presenting a flat or emotionally distant narrative. The tone may feel detached, overly factual, or dismissive of emotional nuance. Affect is downplayed or denied, and the child is often described in functional or behavioural terms rather than relational ones. This suggests a defensive deactivation of attachment needs, potentially limiting co-regulation and emotional availability. Caregivers may be simply unaware of the child's (and their own) emotional needs.

Controlling (parent-led): The caregiver adopts a dominant or overly responsible stance, often with a heightened focus on managing or shaping the child's (or their own) behaviour and emotional responses. The narrative may feel tense, effortful, or rule-bound, with limited space for the child's autonomy. This strategy functions to maintain the caregiver's internal sense of control (managing), often compensating for underlying anxiety, distress, or relational unpredictability.

Controlling-Withdrawal (parent-led): Control is maintained not through active direction, but through emotional absence or disengagement. The narrative may feel emotionally flat or distant, with minimal elaboration, yet affect is clearly present and tightly constrained. The caregiver appears unavailable either mentally or emotionally. This strategy often reflects unresolved trauma, helplessness, or overwhelm, and functions to shield the caregiver from emotional risk by withdrawing from intimacy or dependence. On the surface, a distanced tone might look similar to unresponsiveness, but it functions to control. The caregiver remains attuned enough to anticipate and manage relational demands by pre-emptively withdrawing. In other words, there is intent behind the disengagement, rather than simple lack of awareness or capacity.

Sensitive-Unresponsive (child-led features): The narrative shows elements of reflective functioning and concern for the child, but these are inconsistent and include moments of detachment or minimisation. The tone can feel uneven, warm in some areas and emotionally restricted in others. This may indicate underlying conflict or ambivalence in the caregiving system, where sensitivity is expressed but not consistently enacted or integrated.

Sensitive-Controlling (parent-led features): The caregiver shows thoughtfulness and concern for the child, but this is paired with an undercurrent of control, responsibility, or subtle dominance. The narrative may feel warm but slightly anxious or over-invested, with a sense that caregiving is tied to identity or worth. This strategy reflects a complex effort to remain connected and responsive while managing internal insecurity or relational anxiety through control.

Appendix I: Supplementary Interview Quotes Supporting Analysis

Participant	Context/Question	Quote	Observed Physiology Behaviour	Interpretive Comment
Kurt	Interviewer asks how Kurt was feeling with Kiara came to live with them	<i>“Speaking to friends of mine that had birth children...there’s a progression you can see...it was sort of, courses, interviews, forms, questionnaires, and there’s lots of this going on. And then, oh, by the way, we have a child. Oh, by the way, now you’re taking her home. It felt quite, surreal that I’m that, I’m now a dad... Yeah, that was, it was a very surreal time for me, I think. And, yeah.”</i>	Strokes hands, floppy wrists, closes eyes, rubs hands.	Example of parent-led discourse pattern and matching physiology. The use of the word “ <i>progression</i> ” to describe having a child is quite cognitive. There is also a sense of distance and passivity, evident from use of phrases “ <i>by the way</i> ” and the word “ <i>surreal</i> ”. He trails off at the end instead of elaborating on his feelings, suggesting a tendency to not attend to these. At the same time, his physiology suggests PNS responses (soothing, low muscle tone) and “cutting out” (closing eyes) as he says, “ <i>surreal that I’m that, I’m now a dad</i> ”, indicative of avoidance of emotional intensity.
	Interviewer asks who Kiara reminds him of	<i>“She’s a little bit of an amalgamation, really. Oddly, and this is completely bizarre. When she was young, a lot younger, she looks very, very similar to my sister-in-law... but as she’s got older, she sort of lost that”</i>	Puts hands in pockets, rotates chair, rubs forehead, strokes beard, rubs hands.	Example of matching child-led discourse and low arousal physiology. The word “ <i>amalgamation</i> ”, “ <i>oddly</i> ”, and “ <i>bizarre</i> ”, all suggest a felt distance between Kurt and Kiara, a strangeness. Additionally, his reference to her having “ <i>lost</i> ” any familiarity, suggests a possible feeling of grief for Kurt that he is not able to attend to. There is no reference to any of

	Interviewer asks Kurt to give an example of what he meant when he described him and Kiara's relationship as "sometimes difficult"	<i>"From a lot of people we've spoken to over the years, because she's, she knows that me and Hillary, we're her team and her unit, we get the backlash for what happens during the day [when Kiara is struggling at school]"</i>	Moves feet up and down, flops hands on thigh, strokes thigh, moves foot back so that it presses against chair leg.	his feelings, all of which aligns with a sense of passive distance and struggle to attend to emotions, common in child-led patterns. This is paired with PNS physiology behaviours (calming, soothing behaviours). Example of divergence from theory, when Kurt's narrative suggests a more parent-led markers than his physiology indicates. The use of the word "<i>backlash</i>" hints at underlying resentment towards Kiara and is emotionally charged, aligning with parent-led strategies. The phrase "<i>a lot of people we've spoken to</i>" aligns with "ventriloquism" often seen in parent-led patterns, which is a tendency for a speaker to use the voices of others to reinforce their point and persuade listeners. Whilst he does move his feet up and down (SNS), this is relatively controlled, suggesting SNS arousal with some attempt to bring it down. This is then followed by several PNS physiology behaviours (loss of muscle tone in arms, soothing and creating pressure). These behaviours are slightly at odds with the parent-led markers in the narrative. Ventriloquism is also notable at another point where Kurt states, "<i>speaking to friends of mine</i>"
--	---	---	--	--

				<i>who have had birth children</i>” it is common for dads to be “<i>out of the loop</i>”, reinforcing his point it is normal for there to be distance between him and Kiara. Both incidences together are suggestive of a pattern of ventriloquism which aligns with parent-led strategies, again, at odds with Kurt’s dominant low arousal pattern.
Tracey	Interviewer asks about what her relationship was like with her own family growing up Interviewer asks what Edward typically does when he is upset & then	<i>“Complicated...mum lost five babies and then finally had my sister... she was premature by 15 weeks, so that was hard. Erm and then I had my dad, till I was about 16, and then we cut him off”</i> <i>“He erm, just he cries a little bit, but it's not like a full on streaming cry, but it was when he hurt the dog,</i>	Tilts head, pulls stern face, foot moving up and down, fidgeting behaviours (scratching, pulling top down, twirling thumbs), rolls eyes. Shakes foot up and down, turns ring round finger, scratches.	Example of matching high SNS arousal physiology and parent-led narrative. Whilst tilting her head suggests a temporary loss of muscle tone (low arousal behaviour), most of Tracey’s physiology behaviours indicate high arousal (muscle tension, energy discharge/fidgeting, mild irritation). This fits with her cognitive description of challenges she faced growing up, without much emotional elaboration (distancing, aligns with controlling-withdrawal), yet reference to cutting her father out suggests unresolved, emotionally-loaded anger towards her father. Example of matching high arousal SNS physiology (fidgeting, activating behaviours) and parent-led narrative (limited mentalising, does not stay with or mentalise Edward’s

	prompts for what Tracey is feeling when he becomes upset.	<i>because we'd already said to him about the dog... well within five minutes, he'd forgotten completely what we'd said. He then trod on her...I was a little bit frustrated because we'd literally just told him"</i>		emotions. Slightly blaming for his own distress (due to not listening).
	Interviewer asks how Tracey felt when Edward wanted her to take him into class first before his sister (an example of when they weren't "clicking").	<i>"A little bit sad, because then I'm torn between the two but he also has to understand I can't just leave him standing there... I should be able to, but I just can't, because he will just wander off... So, I just had to explain it to him and stay stand with it, you know, and not let him push me over. Then, then this other one kicking off [laughs] and I'm like arhhh [makes exasperated sound] torn between the two of them"</i>	Strokes thigh, strokes fingers, grasps fingers with other hand.	Example of divergence from theory. Dominant PNS arousal behaviours (soothing, calming) paired with parent-led markers in the narrative (steers away from vulnerable feelings, focusing instead on frustration towards Edward. Subtle blame. Use of the phrase "<i>kicking off</i>" and the exasperated sound are both emotionally-loaded, indicating fight/flight SNS arousal. Again, in the context of Tracey's overall patterns, this likely reflects a need to downregulate due to high arousal or PNS collapse.

Toby	Interviewer asks for a time he and Seth “clicked”	<i>“Err [5 second pause] last week is probably a bad example, because it's been a very busy week and we haven't seen a lot of each other, unfortunately. Erm [brief pause] but an example of when we've really clicked [sighs] [5 second pause]. Hmm. I mean, we click a lot, so. Just trying to think of, of what's happened.”</i>	Fiddles with ring, taps feet, briskly rubs fingers, removes ring, clasps hands into fisted position.	Toby’s physiological behaviour shows sustained activation in response to a question about emotional closeness. Foot tapping, fast hand rubbing, and removal of his ring suggest SNS arousal, while clasping hands into fists may reflect emotional tension or containment. The long pauses, sigh, and vague response suggest internal discomfort and possible avoidance of affect. This supports the theoretical link between parent led attachment (specifically, controlling-withdrawal) and high arousal, particularly in emotionally intimate contexts.
	Interviewer asks what he thinks Seth was feeling during a moment they “clicked”	<i>“I think he really enjoyed it as well, the smile on his face kind of gave it away, to be honest.”</i>	Fidgeting in chair, slaps hand on thigh, rubs nose, moves feet and fingers, looks down, brief frown when interviewer looks away	Despite the positive content of the response, Toby displays multiple SNS-linked behaviours, such as fidgeting, hand slapping, and gaze aversion, indicating internal activation. This supports the theoretical expectation that parents using a parent-led strategy show high arousal in moments of relational intensity, even when those moments are positive. His physiological tension during a moment of emotional closeness suggests that arousal regulation is used to manage affective discomfort.

	Interviewer asks about times Seth has more trouble with	<i>“I would say getting ready for the school is it is a struggle. Erm, bed times are very difficult... But then also at meal times, being able to get through a meal. So they, a meal can like meal time can take an hour for him in terms of like, his ability to concentrate on what he's doing so it can be quite lengthy. So yeah, I would say his biggest struggles are, he loves going to school, so that's not an issue for him, but yeah his biggest struggles are meal times and bedtimes.”</i>	Rubs nose, pushes up glasses, rotates chair, supports head with arm, rubs chin, fiddles with ring, slaps hand on thigh, pronates foot, rotates chair	Toby displays multiple signs of SNS activation (e.g., slapping thigh, fidgeting, upward foot position), particularly when describing Seth's concentration and meal times. However, he also briefly engages in downregulation attempts (rubbing chin, supporting his head). This represents a subtle divergence from the theoretical expectation that parent-led patterns are characterised by consistent high arousal, and suggests that even within a high arousal profile, momentary efforts to regulate may surface during emotionally neutral but demanding topics.
	Interviewer asks what Seth does when he's upset and how Toby responds	<i>“We used to try and battle through it... whereas now, when he has that moment, we will stop and we will just say, right well, when you're done and when you're ready, we'll go. So then we'll just let him have his moment, and then he usually comes to us when he's ready”</i>	Fisted right hand position whilst drinking from cup.	Displays both SNS (fisted hand) and PNS soothing (drinking) behaviours. Narrative reflects a more regulated, reflective stance (“we let him have his moment”), suggesting brief emotional attunement. Slight divergence from theory, showing momentary regulation within an otherwise high arousal, parent-led profile.

Fred	Interviewer asks Fred what impact his angry feelings have on Mitchell	<i>"I do wonder about his ability to, receive. So if we're getting angry with him and trying to dress him down... cognitively, he's not taking any of that message in, and only afterwards, once he's come back down and he's in a window tolerance"</i>	Rotates chair, rests his head on his arm (postural support), strokes his thigh.	Example of child-led indicators in the narrative and matching low arousal physiology. His use of the words <i>"receive"</i> , <i>"dress him down"</i> , <i>"take the message in"</i> and <i>"window of tolerance"</i> suggests subtle intellectualising (cognitive understanding only) that distances Fred from the relational or emotional elements of the interaction. There is a lack of attending to his own or Mitchell's feelings. This is paired with low arousal physiology behaviours (soothing & postural support).
	Interviewer asks about his relationship with his own mum	<i>She was a great mum. Looked after as well...gave us the discipline where we needed it, gave us the support when we needed it. Worked really hard, always home, cooked good food, cleaning, do all of that stuff, which I appreciate now obviously, as a parent myself"</i>	Presses fingers together, rotates chair, strokes hand, strokes thigh.	Example of parent-led markers in narrative and matching low arousal. Sticks to quite a role-based and impersonal example of his mother's parenting, note use of the word <i>"we"</i> instead of <i>"I"</i> (slightly distancing) and limited inclusion of his own emotions or feelings. This paired with low arousal physiology behaviours (deep pressure, rocking, stroking: all examples of soothing and calming behaviours).
	Interviewer asks about a time he and Mitchell "clicked"	<i>"Abby [wife] had taken Noah [brother] out to deliver or run some errands...I said to Mitchell what do you want to</i>	Strokes back of head, leans back, clasps hand and	Example of sensitive attachment in the narrative, paired with low arousal calming physiology behaviours (stroking, postural support, deep pressure), demonstrating how

		<i>do, I don't want to watch TV. He said let's play operation again. So we did that, and then, we, we don't really do this very often. Then we played Pairs, and then we played Uno. So we had a really good hour's-worth of game time. And we, I felt like, we laughed together, he was comfortable...because I gave him time and, and was being present without any other external influences"</i>	presses down on head.	this can deviate from the theoretical expectation that low arousal is correlated only with child-led caregiving patterns. Fred's narrative is specific, warm, detailed, and genuine (voice breaks slightly with emotion as he recalls it).
	Interviewer asks for a specific example of when Fred has found it easier to "get into Mitchell's mind"	<i>"And he's got a great heart Mitchell, and he's got a lot of empathy, underneath this shell that he's got, that's difficult to get through"</i>	Strokes hands, interlocks fingers.	Example of sensitive attachment in the narrative, paired with low arousal physiology behaviours (stroking, deep pressure), counteracting theoretical expectations and showing low arousal can exist with sensitive patterns. Fred demonstrates an ability to see both the good (his heart, empathy) and bad (his tough shell) in Mitchell. It is objective, not blaming, and there is a hint of warmth to his tone.
Nicky	Interviewer asks what emotions Nicky was feeling	<i>"I felt sort of a bit angry and frustrated and just that, for God's sake, yeah, I'm trying</i>	Clenches fists, taps feet, frowns.	Example of high arousal behaviours and matching parent-led narrative. Clenched fists and frowning reflect muscle tension, whereas

	when her and Elsa weren't "clicking"	<i>to get on with this, like, why are you just bombarding me with these questions? So, yeah, angry and frustrated at the time, and then just afterwards, when I sort of reflected back, it was more like guilt and remorse"</i>		tapping feet reflects discharged high energy. The narrative mirrors this intensity, with emotionally-charged words such as "for God's sake" and "bombarding".
	Interviewer asks what Nicky finds herself worrying about most in relation to Elsa	<i>"if they're going to be able to have a normal relationships with people. Whether they're sort of attachment and constantly seeking connection, constantly needing that attention... I just kind of think, like, you know, will people tolerate like a romantic partner, whoever that is, will they tolerate it?"</i>	Constant movement of the feet, coughing, repositioning in chair.	Example of high arousal behaviours and matching narrative. Repositioning, foot movement and coughing all examples of activating behaviours, subtle ways to discharge energy and interrupt intensity. Use of the word "normal" in this context is loaded and suggests Nicky wonders if her daughter is 'abnormal'. The word "constantly" is repeated to convey intensity of Elsa's neediness. Here, Nicky projects her own unresolved feelings of resentment towards Elsa, a feature of parent-led narratives.
	Interviewer asks Nicky what she thinks Elsa is feeling when Nicky was angry with her	<i>"Maybe be rejection. I don't know. I don't know, I don't know. She just knows that she wants something, but...I don't really know. I don't really know what that would be, that feeling"</i>	Moves feet repeatedly, presses lips, looks down, closes eyes, seeks postural support (leans head on hands).	Example of Nicky displaying several downregulating behaviours. Whilst foot movement is considered an SNS behaviour, Nicky presses her lips (calming behaviour), loses muscle tone (seeks postural support) and "cuts out" to avoid the emotional intensity by looking down and closing eyes. All these

				behaviours are generally associated with low arousal PNS activation. However, the narrative is consistent with a parent-led pattern. Repeated phrase “<i>I don’t know</i>” suggests difficulty mentalising that is emotionally charged, suggesting Nicky is feeling intensely rather than absence of arousal entirely, which would be typically child-led in pattern. In the context of Nicky’s pattern overall, this suggests Nicky’s baseline high arousal has tipped over into PNS shutdown due to intensity, rather than reflective of a dominant PNS arousal pattern.
Sophie	Interview asks about times Lily has most trouble with Interviewer asks her to describe a time	<i>“We took quite a while to conceive Lily...it felt like we were waiting for her for a long time...it was all very low arousal, mood lights, music, that kind of thing, that kind of environments really important to me for my sort of stress levels, I suppose, or for me to be able to control my stress levels”</i> [Getting ready for school in the morning]	Scratches nose, pushes glasses up, moves fingers rapidly. Leans head on arm, shifts briefly and	Example of parent-led narrative paired with high arousal SNS behaviours (activating behaviours). Sophie describes needing to control her internal state and a preference for a tightly managed atmosphere, indicative of slightly parent-led caregiving (i.e., a need to manage emotions). Example of parent-led discourse paired with regulated arousal, showing only mild activation

	her and Lily “weren’t clicking” Interviewer asks her to describe what kind of person Lily is	<i>“Everything has to be on her terms...that can be quite frustrating for me. And I think Lily you know, sometimes finds that quite amusing...I think watching me kind of get a bit stressed...she finds that quite amusing”</i> <i>“She’s very, headstrong...kind of feral...likes to make her own rules...likes to be in control of situations a lot”</i>	returns to arm resting position, laughs. Rests chin on hand, grasps forearm.	through brief movement and laughing, along with providing herself with postural support (resting head). This is in contrast to the narrative, which shows subtle parent-led features (child as a persecutor, child in control). Example of parent-led discourse paired with regulated arousal (calming, postural support). Subtle parent-led narrative indicators through the way Sophie positions her daughter as defiant and unruly (e.g., “feral,” “likes to make her own rules”), framing her autonomy as problematic. By repeatedly emphasising the child’s desire to “be in control,” Sophie subtly positions herself in opposition, implying a need to reassert or maintain authority, a dynamic often seen in parent-led caregiving where the child’s independence is perceived as something to manage or contain.
Molly	Interviewer asks if Molly thinks Zara ever feels rejected	<i>“Not by us, not by us. The reason I say that is we’re quite cautious of the whole glass child thing. So if anything, Zara, obviously Andy [brother] gets a lot of</i>	Lip pressing, strokes mouth and chin, leans back into chair.	An example of sensitive caregiving narrative paired with low arousal. Here, Molly displays concern and caution for Zara’s feelings and can mentalise what Zara might feel when her attention is divided, all indicators of more sensitive caregiving. Her physiology

		<i>my attention, but from daddy she is showered with attention... in my head, I'm thinking, Andy is upstairs. He's gonna smash his head against the sink...so I'm never 100% engaged, which I think bugs her...whereas daddy...she gets 100% of his, which she loves and deserves"</i>		behaviours are a mixture of soothing, calming and seeking postural support, all of which align with a dominant low arousal pattern in the face of emotionally arousing content.
	Interviewer asks what Molly thinks Zara is feeling when she craves attention from the adults around her	<i>I think...it's the me having to give him [brother] so much attention. She's worried that everyone else is gonna do the same. I think she doesn't want to get left out"</i>	Crosses legs, slight movement of legs up and down, clasps fingers, presses lips.	Example of sensitive narrative paired with predominantly low arousal. The narrative is not blaming and Molly can mentalise and think why Zara might crave attention, signs of secure relating. At the same time, most of her physiology behaviours (crossing legs, clasping fingers, pressing lips) are calming and soothing behaviours. Whilst very brief up and down leg movement is noted (SNS), this is minimal and appears controlled, fitting with a dominant low arousal, rather than high arousal pattern.
	Interviewer asks Molly what kind of person she is	<i>"Um, like what? [giggles]"</i>	Interlocks fingers, presses thumbs	Example of child-led narrative pattern and matching low arousal physiology. Reflects child-led attachment through emotional

	Interviewer asks Molly about a time she felt like she needed someone to take care of her (she gives an example of when she opened her business)	[interviewer clarifies the question] <i>“Me, I don’t know. I’m just a bit reserved. I’m very, I don’t like to share too much with people...as a family...we’re quite reserved. I just like to banter”</i> <i>“To be honest, not really. I’ve always taken care of myself...when we first opened, I was losing hair, I was losing weight, everything”</i> [Interviewer prompts how Molly handled her stress in this situation] <i>“I just kept doing what I needed to do...now that I’ve got the staff and stuff, it’s all good”</i>	together, lip pressing. Sits forward in chair, rubs hands, squeezes hands, clasps fingers.	distancing and limited self-disclosure. Molly initially deflects the question with laughter. Her preference for "banter" over emotional expression suggests a tendency to avoid vulnerability. This is paired with calming and soothing physiology behaviours, indicating matching low arousal. Example of child-led narrative paired with low arousal physiology. Molly’s response that she takes care of herself, paired with her tendency to just keep going, rather than rely on others or ask for help, are hallmarks of child-led attachment strategies. Additionally, her comment “it’s all good” suggests a tendency to minimise how difficult it was for her. This is paired with predominantly low arousal behaviours (calming and soothing). Whilst sitting forward in a chair, if done rapidly, could be a sign of an SNS behaviour, the slow speed in which Molly does this suggests a subtle engagement behaviour (regulation) rather than an SNS (high arousal) behaviour.
Winona	Interviewer asks how she would	<i>“I try to be, hands off and laid back and let them, for</i>	Clasps hands for duration of answer.	Example of child-led caregiving in narrative paired with low arousal clasping hands

	describe herself as a parent	<i>example, letting them experience risks so they learn about danger. So for example, I'm not the parent who stands at the bottom of the climbing frame in the park going, be careful, be careful. Don't go any higher. I'll just let them figure it out for themselves"</i>		(calming behaviour). Winona's description of herself as a parent aligns with "let them be" parenting, common amongst those with more child-led caregiving patterns.
	Interviewer asks what gives her the most joy in being a parent	<i>"Just seeing them happy and having a good time with them"</i>	Leans head on arm, maintains leaning back position.	Example of child-led narrative paired with low arousal behaviours (seeking postural support, low muscle tone). Winona's concise and vague response of "just seeing them happy", suggests a tendency to minimise emotional responses, a feature of child-led strategies. Additionally, the use of the word " <i>them</i> " implies a slightly distanced tone.
	Interviewer asks for an example of when Winona felt pain or difficulty being a parent.	<i>"She's [Ivy] struggling to go to school at the minute...kind of disappearing within herself, sort of hiding a bit, and she just sort of looks washed out and tired and worn out, and I can see she's not getting a lot of</i>	Strokes chair, tucks hand in-between legs, loss of muscle tone in facial expression.	Example of low arousal (calming, soothing, low muscle tone) paired with more sensitive narrative. Winona is aware of and appears able to identify Ivy's current struggles, whilst also reflecting on what that experience is like for her as her mother to witness. This attunement and reflective ability aligns with sensitivity.

	Interviewer asks what impact Winona thinks her angry feelings have on Ivy	<i>enjoyment...that's hard to watch"</i> <i>"They probably didn't help [brief pause]. They probably, they did make the situation worse, um, because then she sort of feels more stressed and wound up so then digs her heels in more"</i>	Eyes down, leans back in chair, arms become floppy against chair.	Example of low arousal paired with sensitivity. Winona is able to reflect on how her own actions might contribute or worsen a situation with Ivy and is not at all blaming, a clear demonstration of sensitive caregiving. At the same time, her physiology showcases low arousal (emotionally "cutting out" by looking down, low muscle tone).
--	--	---	--	--

Appendix J: Development of Cross-Case Analysis Themes

Cross-case themes were developed through iterative engagement with the full results table (see Table 8), which included detailed physiological and narrative data for each case. An additional column (“Observations”) was added to this table, which was later developed and used to record emergent observations, patterns, and interpretive notes across cases. This column was refined through repeated review of the data, drawing on both coder annotations and the researcher’s own reflective insights. Emerging patterns were discussed with the SAI coder and the primary research supervisor (who was involved in the development of the MotC) to support reflexive interpretation and enhance analytic rigour. As the analysis progressed, recurring patterns were grouped into provisional thematic categories, which were refined in light of relevant theory and developed into the final themes presented in the main text cross-case analysis table (see Table 10). The process was abductive and theory-informed, aiming to ground themes in observed case-level variation while also identifying broader regulatory dynamics across the dataset.

Please see below an example of the additional column “Observations” from the results table used to support cross-case analysis.

Fred’s Case (emergence of theme 5: “sensitive caregiving can exist with low arousal”)

Fred’s profile mostly fits with theory. Although he moves around during the interview, the movement is slower and less controlled, compared to the quick, sharp movements seen in Toby’s case. He is almost "floppy," suggesting low muscle tone and subdued arousal. His physiology sits at the low end of the arousal spectrum throughout.

Comments from the MotC coder suggest he shows moments of being child-led but then backtracks and is able to show sensitivity. It is interesting that low arousal and sensitive caregiving might co-occur. I wonder whether Fred is naturally more child-led but has developed a more sensitive caregiving style through support or co-regulation from his partner. The context of the child also feels important here. Mitchell has high support needs, and perhaps an element of Fred’s unresponsiveness acts as an armour to help him cope (echoing Crittenden’s idea of attachment as a functional protection strategy).

Appendix K: Reflective Journal Extract (empirical study)

23rd October 2024

What?

I had a meeting with my supervisor where we reviewed a practice MotC interview I had conducted. Together, we discussed how to code the transcript and interpret the caregiving style. I also received feedback on my interviewing technique. While some aspects were positively received, there were moments in the interview where my supervisor felt I could have probed further. For example, in response to the question, “*Can you tell me three words or phrases to describe your relationship with your child?*”, the participant provided three words but offered limited elaboration. Although I followed the prompt sheet and asked for a specific memory and associated feelings for each descriptor, the responses remained vague. My supervisor highlighted that, in this instance, it would have been appropriate to return to the prompt again, to gently encourage further reflection and emotional elaboration.

So what?

This prompted reflection on why I had accepted the surface-level answer and why I did not pursue deeper enquiry. Through supervision, I became aware that I may have felt a subtle urge to “rescue” the participant, having noticed signs of discomfort or emotional activation. I had perhaps unknowingly prioritised the participant’s immediate emotional ease over the aims of the interview. In doing so, I may have inadvertently avoided an opportunity to fully observe how the participant navigated difficult emotional material when supported, which is a central feature of MotC coding.

This led me to reflect on my own attachment style and relational tendencies, particularly my inclination to avoid causing distress in my interactions. Writing about psychotherapy, Wallin (2007) discussed how therapists may sometimes “collude” with client defences, thereby missing opportunities for emotional growth. While his reference point is clinical, I found this applicable to my role as a researcher in this context, where I may have similarly avoided discomfort and inadvertently missed valuable data. The experience highlighted how the research interview is also a relational space, and that my own relational dynamics and assumptions can influence the data gathered.

Now what?

Moving forward, I will remain more mindful of the balance between emotional attunement and the MotC interview process, to maintain research rigour. While sensitivity to participants' wellbeing remains crucial, I now better understand that avoiding discomfort can sometimes limit insight into attachment-related processes. In the real MotC interviews, I will aim to maintain a containing stance while using prompts more confidently to encourage deeper reflection. I have also recognised the value of post-interview supervision to enhance my reflexivity and to consider how my internal responses may shape the interview process. This learning has strengthened both my interview technique and my appreciation of the relational complexities inherent in attachment-based research.

Appendix L: Dissemination of Findings

Research

This thesis will be submitted to the University of Hertfordshire as part of the requirements for the Doctorate in Clinical Psychology. The project will also be prepared for submission to peer-reviewed journals to contribute to the academic literature on attachment and physiological regulation in caregiving. The findings will be shared with researchers involved in the project, including the SAI coder and the primary research supervisor.

Clinical Practice

Study findings will be shared with the Occupational Therapist at the clinic where participants were recruited, who intends to use the insights to inform therapeutic work with the adoptive families who participated in this study. Findings may also be relevant to other clinicians working with adoptive or biological caregivers and will be disseminated through professional discussions.

Participants

A lay summary of the empirical findings will be offered to all participants (both adoptive and biological) who expressed interest in receiving study outcomes. This aligns with best practice guidance on participant feedback (Health Research Authority, 2023).