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Nature and Functions of Scripted Attachment Knowledge Assessment, Cognitive Processes, and Neural Correlates

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2026

Document Version:
Publisher's PDF, also known as Version of record

[Link to publication](#)

Citation for published version (APA):
Han, G. (2026). *Nature and Functions of Scripted Attachment Knowledge: Assessment, Cognitive Processes, and Neural Correlates*. [Doctoral Thesis (compilation), Department of Psychology]. Lund University.

Total number of authors:
1

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Nature and Functions of Scripted Attachment Knowledge

Assessment, Cognitive Processes, and Neural Correlates

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DEPARTMENT OF PSYCHOLOGY | FACULTY OF SOCIAL SCIENCES | LUND UNIVERSITY



Nature and Functions of Scripted Attachment Knowledge

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Assessment, Cognitive Processes, and Neural Correlates

Gizem Han



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DOCTORAL DISSERTATION

Doctoral dissertation for the degree of Doctor of Philosophy (PhD) at the Faculty of Social Sciences at Lund University to be publicly defended on the 5th of June at 10.00 in Edens Hörsal, Allhelgona kyrkogata 14, Lund

Faculty opponent
Marian Bakermans-Kranenburg

Organization: LUND UNIVERSITY

Document name: DOCTORAL DISSERTATION

Date of issue: June 5, 2026

Author(s): Gizem Han

Sponsoring organization:

Title and subtitle: Nature and Functions of Scripted Attachment Knowledge: Assessment, Cognitive Processes, and Neural Correlates

Abstract:

Close relationships are fundamental to human wellbeing. Attachment theory posits that early caregiving experiences shape how individuals come to understand themselves, others, and the world. Through repeated caregiving interactions in situations of distress, children develop script-like mental structures (i.e., attachment schemas). Attachment schemas, thus, hold implicit knowledge about availability of close others, viability of support-seeking, and how events are most likely to unfold in stressful situations. They are assumed to guide relational expectations when in distress, and regulate attention, largely outside of awareness, with influence extending from cognitive and defensive processes to relationship dynamics and overall wellbeing. Given this broad scope, this dissertation investigates how implicit script-like attachment knowledge can be reliably assessed, how its functions manifest in cognitive and neurophysiological processes, in relation to regulating attention and guiding relational expectations, and whether defensive patterns associated with attachment insecurity are amenable to change.

Study I examined whether the traditional interview-like assessment of scripted attachment knowledge can be replaced by more flexible, digital settings, in the absence of an interviewer/listener. Findings indicated relative modality-invariance, providing initial evidence that scripted attachment knowledge can be assessed outside traditional interview context, with implications for large-scale and more cost-efficient research. Study II investigated whether attachment security priming can reduce avoidance-related attentional defenses. As expected, high attachment avoidance was associated with attentional disengagement from social stimuli, reflecting avoidance-based attentional defenses. Security priming did not alter this attentional pattern. While low avoidance individuals reported a decrease in positive affect following the priming, those high in avoidance remained unaffected, suggesting that they may have disengaged from the priming task itself. These findings highlight the complexity of experimentally influencing avoidant defenses and raise questions about what form of priming may be effective. Study III used electroencephalography (EEG) with ecologically valid, narrative stimuli to investigate neural correlates of attachment-schema-congruent predictions of support. Findings supported expected patterns: attachment security was associated with expectations of support in distressing situations as well as a greater capacity to visualize such scenarios, while this association was absent among individuals with insecure attachment. Taken together, the three studies make complementary contributions to the understanding of nature and functions of attachment schemas, as well as attachment field in a broader sense. Key strengths of this work include methodological diversity in terms of experimental paradigms and ecologically valid stimuli, complementary measurement of attachment-related constructs and novel findings on alternative assessment techniques, and neurophysiological evidence for fundamental assumptions in attachment theory.

Key words: attachment schemas, secure base scripts, narrative-based assessment, digital assessment, attentional biases, attachment security priming, event-related potentials, expectation of support

Classification system and/or index terms (if any)

Supplementary bibliographical information

Language English

Number of pages:71

ISSN and key title:

ISBN: 978-91-8104-998-5 (print)

Recipient's notes

Price

Security classification

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Date 2026-04-23

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Assessment, Cognitive Processes, and Neural Correlates

Gizem Han



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Paper 2 © 2025 The authors. Published by Taylor & Francis (open access article, licensed under [CC BY 4.0](#)).

Paper 3 © 2026 The authors (Manuscript unpublished)

Cover images by Erhan Öksüzali & Irem Han

Published by:

Department of Psychology

Faculty of Social Sciences

Lund University

Lund 2026

ISBN 978-91-8104-998-5 (print)

ISBN 978-91-8104-999-2 (electronic)

Printed in Sweden by Media-Tryck, Lund University,
Lund, 2026



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MADE IN SWEDEN 

To my family

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Acknowledgements

Even though it has been a long journey, I feel like I only had five minutes to write this dissertation. I guess time flies – and stretches out – in strange ways when you are riding the roller coaster of a PhD. And I am deeply grateful to everyone who has been a part of it, this work is the result of the joint effort put in it.

I would like to thank my supervisors (in the order of appearance) Elia Psouni, Yunhwan Kim, and Inês Bramão, whose guidance and support have been instrumental through this process. Elia, your passion and dedication for what you do have been an inspiration since I first sat in your class. I feel lucky to have had a chance to learn from your expertise. Also, thank you, as principal investigator of the project “Evidence over Conviction”, which made this research possible with financing from the Swedish Research Council (2019-02787 / Principal Investigator Elia Psouni). Yunhwan, thank you for your kindness, patience and all the (moral) support you provided (somehow almost always accompanied with fika), for whatever issue I turned to you with. Also, thank you for your fantastically clear feedback especially during Kappa-writing period. Inês, it has been such an enriching experience to work with and supervised by you. Your sharpness, energy and expertise have been invaluable to push through the challenges of Study III. And also, a sincere thank you for encouraging me to own my work! Thank you to other colleagues who contributed to this work with their valuable feedback: Roger Johansson, Katarina Bernhardsson, and Fredrik Björklund for your input and suggestions at my halftime seminar. And thank you, Pehr Granqvist, for a very interesting and inspiring discussion, and insightful questions at my final seminar.

In addition, thank you to the (previous and current) study directors of the PhD program, Åse Innes-Ker and Eva Hoff, and examiners Fredrik Björklund and Daiva Daukantaitė, for your work and support. An additional thank you, Eva, for your efforts to improve the program and the PhD students’ experience. Finally, my sincere gratitude to our head of department, Sofia Bunke. Sofia, thank you for your kindness, support, and leadership!

I feel so lucky to have been a part of such an amazing group of PhD colleagues! Amanda K., Benjamin, Laura G., it has been so lovely to study/work with you since around 2015! Amanda thank you for your warmth, friendship, and fun conversations over lunches. Benjamin, thank you for organizing great applied “research” seminars :) Laura, thank you for being such a caring and considerate colleague and friend. My PhD siblings and office-mates, Laura C. and Martina: Laura, thank you for your support (with a lot of things!), always listening and being there for me, and of course for the fun parties and trips too! Martina, despite operating on practically different time zones, I immensely enjoyed our brief overlaps and amazed by how quickly we could get into such deep conversations! And thank you, to Hussein and Amanda A., my most recent office-mates. Thank you, Hussein, for your wisdom, humor, and

calm energy. Amanda, our rather brief encounters when we quickly catch up on each other's updates at the office have always been so pleasant. Thank you, Nate, your wittiness, humor and sympathy have been such fun to be around. Thank you, Mia, for our episodes of getting into super-interesting discussions on things we didn't even know we had in common (WVI!), and being such a good listener. Thank you, Linn, for your energy, humor, and support even when we were both in a similar situation. Thank you to everyone else my path crossed with, that I may be failing to mention here, please know that I appreciate all of you! Thank you all for sharing the joys and sorrows of (academic) life and being so supportive during times when a simple "how are you?" became a loaded question. A heartfelt thank you to Patric, for a lot of things, from inspiring discussions to all the moral support, thank you for your patience and kindness, and making sure I survived this. Last but not least, my deepest gratitude to my family: my sister Irem, thank you for our 3-hour-long cathartic video calls over the years, and for your efforts on the cover pictures. Thank you Hazal for your suggestions on a part of the text, and for essentially accompanying my academic journey through my texts over the years. Finally, thank you to my parents: sevgili annem ve babam, bugüne kadarki emekleriniz, maddi manevi tüm destekleriniz için sonsuz teşekkürler!

Abstract

Close relationships are fundamental to human wellbeing. Attachment theory posits that early caregiving experiences shape how individuals come to understand themselves, others, and the world. Through repeated caregiving interactions in situations of distress, children develop script-like mental structures (i.e., attachment schemas). Attachment schemas, thus, hold implicit knowledge about availability of close others, viability of support-seeking, and how events are most likely to unfold in stressful situations. They are assumed to guide relational expectations when in distress, and regulate attention, largely outside of awareness, with influence extending from cognitive and defensive processes to relationship dynamics and overall wellbeing. Given this broad scope, this dissertation investigates how implicit script-like attachment knowledge can be reliably assessed, how its functions manifest in cognitive and neurophysiological processes, in relation to regulating attention and guiding relational expectations, and whether defensive patterns associated with attachment insecurity are amenable to change.

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Taken together, the three studies make complementary contributions to the understanding of nature and functions of attachment schemas, as well as attachment field in a broader sense. Key strengths of this work include methodological diversity in terms of experimental paradigms and ecologically valid stimuli, complementary measurement of attachment-related constructs and novel findings on alternative

assessment techniques, and neurophysiological evidence for fundamental assumptions in attachment theory.

Populärvetenskaplig Sammanfattning

Nära relationer är avgörande för människors välbefinnande. Anknytningsteori utgår från att tidiga erfarenheter med omsorgsfigurer (oftast föräldrar) under uppväxten formar hur individer lär sig förstå sig själva, andra och omvärlden. Genom upprepade interaktioner med omsorgsfigurer i situationer präglade av distress utvecklar barn mentala bilder som liknar ett manuskript, som innehåller implicit kunskap om närvaro och tillgänglighet av nära personer, huruvida signaler när man förmedlar behov av stöd tas emot, och hur situationer sannolikt löses. Dessa implicita mentala bilder kallas för anknytningsscheman och anses styra relationella förväntningar i situationer av stress och reglera uppmärksamheten, till stor del utanför medvetandet. Deras inflytande sträcker sig således från kognitiva och defensiva processer till relationsdynamik och övergripande välbefinnande. Med tanke på denna breda räckvidd undersöker denna avhandling hur implicit, manusliknande anknytningskunskap (anknytningsscheman) kan bedömas på ett tillförlitligt sätt, hur dess funktioner manifesteras i kognitiva och neurofysiologiska processer, i relation till reglering av uppmärksamhet och styrning av relationella förväntningar, samt om försvarsmönster associerade med anknytningsotrygghet är mottagliga för förändring.

Detta syfte undersöktes i studie I om den traditionella intervjubaserade bedömningen av anknytningsscheman kan ersättas av mer flexibla, digitala modaliteter, utan någon testledare eller lyssnare. Resultaten visade på en relativ modalitetsinvarians, vilket ger initiala belägg för att implicit kunskap om anknytning kan bedömas utanför den traditionella intervjumiljön, med konsekvenser för forskning i större skala och med lägre kostnader. I studie II undersöktes om priming av anknytningstrygghet kan minska undvikande-relaterade uppmärksamhetsförsvar. Resultaten bekräftade förväntade mönster, att högt undvikande som ett anknytningsdrag var förknippad med att man vände bort blicken från emotionell information i form av ansiktsuttryck, vilket speglar undvikande-baserade uppmärksamhetsförsvar. Priming av trygg anknytning påverkade inte detta uppmärksamhetsmönster. Och medan personer med lågt undvikande rapporterade minskad positiv känsla efter primingen, var personer med högt undvikande opåverkade, vilket tyder på att de kan ha kopplat bort sig från själva priming-uppgiften. Dessa resultat belyser komplexiteten i att experimentellt påverka undvikande strategier och väcker frågor om vilken form av priming som kan vara effektiv i detta ändamål. Studie III undersökte neurala korrelat till anknytningsschema-kongruenta förväntningar på stöd med hjälp av elektroencefalografi (EEG) och ekologiskt valida, narrativa stimuli som följde en manusliknande struktur. Resultaten gav neurologiska och beteendemässiga belägg för förutsägbara mönster som stämde överens med anknytningsteorin. Trygg anknytning var kopplad till förväntningar om stöd i krissituationer samt en bättre

föreställningsförmåga av dessa situationer, men detta samband fanns inte hos personer med otrygg anknytning.

Sammantaget bidrar de tre studierna på ett komplementärt sätt till förståelsen av anknytningsschemats natur och funktioner, liksom anknytningsteorins forskningsfält i vidare bemärkelse. En särskild styrka i detta arbete är den metodologiska mångfalden vad gäller experimentella paradigmer och ekologiskt valida stimuli, kompletterande mätningar av anknytningsrelaterade konstruktioner och nya rön om alternativa bedömningstekniker, samt neurofysiologiska belägg för grundläggande antaganden inom anknytningsteorin.

List of papers

This dissertation is based on the following papers, also referred to as Study I, Study II, and (manuscript based on) Study III.

- I. Han, G., Kim, Y., Cheshire, C., & Psouni, E. (2026). Assessment of implicit attachment-related knowledge: Investigating context invariance in word-prompted narrative-based attachment script assessment in adults. *Assessment*, 0(0).
<https://doi.org/10.1177/10731911261419649>
- II. Han, G., & Psouni, E. (2025). Primed into security: can attachment security priming affect attachment-related biases on early attention? *Journal of Cognitive Psychology*, 37(2), 144–156.
<https://doi.org/10.1080/20445911.2025.2450114>
- III. Han, G., Bramão, I., & Psouni, E. (2026). Secure Attachment Schemas Guide Expectations of Support: Electrophysiological Evidence [under review in *Biological Psychology*]

Abbreviations

AAI	Adult Attachment Interview
ASA	Attachment Script Assessment
ECR	Experiences in Close Relationships
ECR-R	Experiences in Close Relationships – Revised
EEG	Electroencephalography
ERP	Event Related Potentials
IWMs	Internal Working Models
LPP	Late Positive Potential
RT	Reaction Time
SBST	Secure Base Script Test

Introduction

Close relationships are undeniably crucial to lifelong wellbeing. Being socially connected positively influences physical, emotional, and mental health and overall longevity (Holt-Lunstad & Smith, 2012; Pietromonaco & Beck, 2019). Beyond just connectedness, well-functioning relationships provide support systems that buffer the negative consequences of adversity and encourage exploration and personal growth (Feeney & Collins, 2015). Secure relationships in which one feels seen, appreciated, and has a sense of confidence to explore life's opportunities with the trust that close others will be there when needed, are central to such support systems.

To this end, attachment theory provides a framework for understanding development in the context of early close relationships. It suggests that early close relationships shape how people come to understand themselves, others, and the world around them (Bowlby 1969). Through repeated experiences with caregivers, children gradually develop implicit expectations about whom they can rely on. For example, a child whose basic needs are met consistently and sensitively (enough), whose presence is welcomed with joy and warmth by close others, and whose needs for play and exploration are allowed, supported, and encouraged will grow up feeling worthy of love and care, expecting others to be helpful and supportive when needed, and viewing the world as a safe place to explore. These early experiences teach the child that seeking support in difficult moments can help restore balance (i.e., strategies for how to cope with stressors), and foster the confidence to explore independently (i.e., view of self as competent, world as a safe place to explore), knowing that support will be available if things go wrong (i.e., view of others as trustworthy and helpful) (Bretherton & Munholland, 2008).

Over time, the patterns of repeated caregiving experiences are thought to be internalized in the form of mental models. These models are thought to hold views and beliefs about the self, others, and the world, as well as implicit knowledge about how events are likely to unfold in times of distress. This knowledge is considered *implicit* in nature, because it was learned through sensorimotor experiences (e.g., being held, fed, played with, soothed from pain, etc.), and during a time before language and episodic memory processes are fully developed (Psouni & Apetroaia, 2014; Waters & Waters, 2006). Thus, the contents of this knowledge are not necessarily available to conscious access that can be verbally articulated or reflected upon (e.g. explicit knowledge) but rather are reflected through behaviors and choices.

It is suggested that the core components (or a “skeleton”) of repeated events are summarized in mental structures called “event schemas” or “scripts” (Nelson, 1986; Schank and Abelson, 1988) which involve knowledge about characters present in specific situations and causal relation of events. For example, eating out at a restaurant usually follows a typical sequence of events, such as going to a restaurant, looking at the menu, ordering to the waiter, eating, paying, and leaving (Schank & Abelson, 1988), thus, forming a “restaurant script”. Similarly, young children can form such “scripts” for events they repeatedly experience. For example, they can describe that birthday parties involve getting cake and ice cream, some clowns and paper hats, singing “happy birthday to you”, getting some presents and playing with them, and at the end people going home (Nelson, 1986; Snow, 1987).

When interactions with caregivers follow generally stable and predictable event sequences, for instance in situations of distress (e.g., an infant crying due to pain/discomfort, a caregiver interpreting the signal (crying) accurately and meeting this need with care and soothing, and helping the infant to return to a balance), similar script-like cognitive structures develop regarding situations of distress and subsequent response. These script-like cognitive structures in relation to such attachment events encompass knowledge about what happens and what to expect (e.g. from others) when one is in distress. Internalization of external events and interactions with caregivers into mental models are thought to form via this process of implicit associative learning (constructing script-like structures) (e.g. Bretherton, 1987).

The patterns held within scripted knowledge of attachment also manifest in cognitive processes, such as biases in attention and memory (see Dykas & Cassidy, 2011 for a review). For example, an individual whose needs for support in times of distress were not met may tend to focus on memories of times when they managed without support, and augment reliance on themselves alone, in an effort to regulate difficult emotions and achieve a sense of psychological equilibrium. The biases in such cognitive processes and emotion regulation tendencies have implications on a range of aspects from cognitive task performance to resilience, help seeking behavior, and quality of interpersonal relationships. Attachment related patterns contribute to wellbeing and development of psychopathology through, for example, underpinning emotional regulation strategies and capacity to form and maintain supportive relationships (Cassidy, 1994; Pietromonaco & Beck, 2015; Taylor et al., 2015) To reiterate, the implicitly held, script-like attachment related knowledge grounds our core beliefs about ourselves, other people, and the world, but also the way we process social and emotional information, and how we regulate emotion and stress. So, when we better understand the nature and functions of implicitly held scripted knowledge of attachment, we can also make better predictions about how their structures may or may not be susceptible to change, and how to bring about such change.

A note on the use of terminology

Several terms have been used interchangeably to refer to implicitly held script-like knowledge of attachment, both in literature and throughout this dissertation, such as (*implicit*) *scripted knowledge of attachment*, *attachment scripts*, *attachment schemas*, *implicit knowledge of attachment*. These have also been called in the literature ‘secure base scripts’ (SBS; e.g., H. S. Waters et al., 1998), secure base script knowledge (SBSK, e.g. T. E. A. Waters et al., 2015), scripted secure base knowledge (e.g. Psouni et al., 2015), scripted knowledge of attachment (Psouni, 2019). Thus, the reader can safely assume that such variations of this terminology are used interchangeably and refer to the same construct. Similarly, *attachment representations* and *internal working models (IWMs) of attachment* are also used interchangeably but they are not synonymous with implicit scripted knowledge of attachment, as IWMs are thought to encompass both implicit and explicit attachment-related components (as will be introduced in the next sections).

However, the terms *script* or *script-like* have different connotations within other narrative-based measurement systems (such as the Adult Attachment Interview/AAI; Main et al., 1985). In such context, a “script” may refer to producing “general memories” that may not indicate specific, lived experiences but rather a stereotypical image or a description of individuals (e.g. parents) or situations. It is important to note this distinction, such that within the frame of this work, *script-like* refers to the recognizable patterns in causal sequence of events (event schemas) and does not indicate lack of authenticity. I would like to thank Pehr Granqvist for bringing this issue to my attention.

Aims of the dissertation

This dissertation focuses on the nature and function of internal working models of attachment, particularly their implicit components, and is organized around two themes. First, with specific attention to the implicit, script-like cognitive structures of attachment related event schemas (attachment scripts), it investigates the possibilities of assessment of this knowledge in various novel ways (Study I). Second, it aims to investigate cognitive/behavioral and neurophysiological patterns that parallel the functioning of the working models, with specific focus on regulating attention and guiding expectations (Study II and III), while examining the possibility for flexibility/malleability of regulatory functions through priming (Study II).

Structure of the dissertation

The introduction of the dissertation consists of three major parts. The first part introduces attachment theory as the theoretical context for the three empirical studies, along with relevant constructs of interest. The second part dives deeper into the script-like structure of attachment knowledge, elaborating its nature and functions as well as measurement methods. This background is of particular relevance for Study I. Then, the third part summarizes the empirical literature on attachment-related cognitive and neural processes; the empirical background that is specifically relevant for Study II and Study III. The Methodology section describes and elaborates methodological approaches used in the three empirical studies included in the dissertation. Then, the studies are summarized in the next section, with presentation of a brief background, method and procedures implemented, main findings, discussion and conclusions. In the final section, I provide an extended discussion with reflections on how the findings from the studies relate and contribute to the existing literature as well as their limitations and suggestions for further research.

Theoretical Context: Attachment theory

Attachment theory provides a framework for explaining aspects of interpersonal relationships, thought patterns, behaviors, and emotion regulation, as well as individual differences in these aspects. Bowlby (1977; 1982) suggested that the strong emotional bonds humans make with significant others (e.g. caregivers) initially serve a survival function, since human infants are dependent on caregivers. Infants, therefore, employ innate attachment behaviors, especially in times of distress, to maintain proximity with their caregivers, to be protected, and to feel secure. Through development, patterns of caregiving interactions are thought to be internalized and represented in memory, guide future behaviors, and are implicated in many outcomes across lifespan (van IJzendoorn & Bakermans-Kranenburg, 1996; 2024). This section aims to introduce attachment theory as the theoretical framework of this dissertation and elaborate relevant attachment concepts and measurements.

Origins of attachment (theory)

Attachment theory was developed as a response to questions about how early relationships shape emotional and social development. Its origin lies in John Bowlby's theoretical work (Bowlby, 1969, 1973, 1980) and Mary Ainsworth's empirical methodology (e.g., Ainsworth et al., 1978) that enabled testing theoretical

ideas and expanded the theory (Bretherton, 1992). Bowlby was intrigued by the influence of prolonged separation from caregivers or deprivation on later development, through his observations of hospitalized and institutionalized children. Integrating insights from these observations with ethology, developmental psychology, cognitive science, and psychoanalytic thinking, Bowlby highlighted the importance of close familial relationships and caregiving in healthy development.

One of the major propositions of attachment theory is that infant behavior is essentially motivated by keeping proximity to one or more preferential¹ caregivers to ensure security and survival. As such, behaviors such as clinging, sucking, following, crying, and laughing, are to be understood to function to establish proximity and bonds between the infant and the caregiver. This set of infant behaviors is regulated by the so-called attachment behavioral system, with a main goal to elicit appropriate caregiving responses that meet attachment needs and enable exploration. When threat that creates distress is perceived in the environment, proximity seeking behaviors help initiate and maintain contact with the attachment figure (e.g. caregiver) and reach “felt security” (Sroufe & Waters, 1977). When there are no signs of threat and the caregiver is available, felt security enables exploration while also monitoring whereabouts of the caregiver (as summarized in Bretherton, 1987).

During the interplay between the child’s needs for exploration and safety, the caregiver takes a role of a “secure base” for the child to explore the environment from, and a “safe haven” that a child can return to when feeling threatened or scared and in need of comfort (Ainsworth et al., 1978). Indeed, the back-and-forth (or circular) shift between the child’s needs of attachment and exploration, and the caregiver’s role are pedagogically illustrated in the Circle of Security model (Marvin et al., 2002). Based on the core concepts and ideas of attachment theory, the circle of security emphasizes the secure base role of the caregiver as attending to the child’s needs in supporting their exploration, watching over them, and offering help, as well as enjoying the play and exploration with the child. When the child returns to the caregiver for comfort and safety, the safe haven role of the caregiver is defined as welcoming the child’s return, protecting and comforting the child and help organizing and regulating the child’s feelings. In both directions of this circle, the caregiver is portrayed as showing delight in the child. The emphasis on delight in the child signifies the importance of emotional interactions besides the instrumental functions of problem solving.

In this sense, Ainsworth’s empirical work not only supported the theory initiated by Bowlby but also extended it. In her Strange Situation Paradigm (SSP, Ainsworth et al., 1978), she enabled systematical observation of attachment behaviors of infants

¹ Preferential caregiver refers to caregiver(s) who repeatedly attend to infant’s needs and whom the infant selectively direct their attention to.

and presented links to the caregiving experiences at home. The strange situation paradigm is constructed with eight situations consisting of separation and reunion episodes which allow for observation of infants' behavior patterns of exploration and proximity seeking. Based on the behavior patterns of infants, such as using their caregiver as a secure base to explore the environment from, their distress and protest behavior upon separation (e.g. mother exiting the room), and proximity seeking to their caregiver upon reunion, three main classifications were identified.

A secure classification (Group B) was organized around a behavior pattern of infants who were relatively comfortable with exploring the environment, using their caregiver as a secure base, who show signs of distress as an intensified attachment behavior upon separation, and importantly seek proximity and interaction with their caregiver upon reunion. An insecure-avoidant classification (Group A) was formed with the pattern of little display of infant distress upon separation and avoiding or ignoring the caregiver upon reunion. In contrast, insecure-resistant/ambivalent classification (Group C) referred to intense distress in separation episodes and yet angry or resistant response to the caregiver upon reunion despite wanting to be held. A fourth classification, Disorganized (Group D), was introduced by Main and Solomon (1986; also see Granqvist et al., 2017) for a group of infants whose contradictory, fearful, and confusing behavior did not clearly fall into any of the organized insecure classifications (Granqvist et al., 2017), and its validity has been established (van IJzendoorn et al., 1999).

Home observations of infant-caregiver interactions also revealed visible patterns in mothers' caregiving behaviors (Solomon & George, 1996). Mothers² of secure infants were observed to be more sensitive, accepting, cooperative, and accessible and their interactions during feeding, holding, and play were rated to be more harmonious, affectionate, and pleasurable compared with the patterns in the two insecure groups. Caregiver responses to infants classified as avoidant were characterized by rejection while acceptance-rejection was more inconsistent in caregivers of resistant/ambivalent infants. These links imply that individual differences in infants' behaviors are mainly rooted in variations of caregiver responses³. Thus, the classifications of attachment based on the strange situation paradigm reflect the complementary links between infant behavior and caregiver response. In other words, an infant's tendency not to show signs of distress is linked to those signals not having been sensitively responded to in the past, leading to the

² Early attachment theory and research reflect a monotropic, hierarchical model - where attachment is considered primarily to the mother, but since later research has not supported this view, the present thesis will refer to (parental) caregivers considering mothers, fathers, and other individuals consistently providing care to the child.

³ It must be noted that the infant characteristics (e.g. temperament), and other contextual factors (e.g. life situations) also contribute to the interplay between the infant and caregiver interactions (Ainsworth 1979, Bretherton 1987). Influences between caregivers are also evidently an important contextual factor (Han et al., 2023; Psouni, 2019).

formation of a mental model of the caregiver as unavailable or unhelpful. In a similar line, a child with a history of sensitive caregiving would extract from their sensorimotor experiences a pattern of being met with affection and comfort if/when they encounter stressful situations.

Shift from behavior to representation: Internal Working Models

In parallel to the separation and reunion episodes of the Strange Situation Paradigm (Ainsworth et al., 1978), situations where attachment needs take precedence over exploration, due to distressing interference, are central for the child to learn, or extract, the patterns of caregivers' behavior in response to their attachment behavior (e.g. proximity seeking). These patterns include how available, responsive, and helpful the caregiver is, and how the child's signal is received by the caregiver, and whether it resulted in experiencing comfort and security (e.g., Mikulincer et al., 2001). Over time, recurring experiences of caregiving are internalized and organized into "mental representations" or "internal working models" (IWMs) of self and others as attachment figures (Bowlby 1969, Bretherton 1987). These models hold complementary representations – for example, viewing the parent as loving and protective, and self as loved and secure (Bretherton & Munholland, 2008). Moreover, security (vs. insecurity) characterizing these mental models further predict children's (mal)adaptation in socioemotional development (Groh et al., 2017), social competence with peers (Groh et al., 2014), adaptive response to distress (Psouni & Apetroaia, 2014).

Indeed, with age and development, children start spending more time away from their caregivers (e.g., in middle childhood period), and thus, the expectations learned from early caregiving interactions are assumed to help the child cope with distress also in the absence of physical proximity to caregivers. With development of children's perspective-taking skills and their increasing understanding of parents' motivations and communications, a more collaborative dynamic becomes more prominent over complete reliance on parents for problem solving. Such that, they become able to tolerate separation from their parents as long as they know that the parents would be available and accessible when needed (Kerns & Abtahi, 2017). Additionally, during this time, with children's increased emotional maturity, expansion of their social world, and involvement of more people in their lives (e.g., peers and teachers), these new relationships may become important sources of support in the absence of their primary caregivers (Psouni & Apetroaia, 2014; Seibert & Kerns, 2009). While the knowledge learned from early experiences with caregivers (attachment representations) is presumably being consolidated and generalized, it serves as a template for such new relationships in middle childhood (Di Folco et al., 2017; Psouni & Apetroaia, 2014; Psouni et al., 2015), adolescence (Dykas et al., 2006), and adulthood (e.g. Mikulincer & Shaver, 2007).

Attachment in adulthood

Influence of generalized representations of early relationship experiences continues into adulthood, laying the foundation for close (peer/romantic) relationships to develop on. Similarly, these representations or IWMs continue monitoring the environment for cues of (symbolic) threat, regulating emotion and behavior in response to such threats (e.g. Zimmermann, 1999; Mikulincer & Shaver, 2003). In adulthood, IWMs are thought to encompass beliefs, attitudes and expectations of situations in close relationships, attachment goals and needs and strategies for how to attain them (e.g. Gillath et al., 2016, Chapter 4, p. 77). Here, the attachment theoretical field is divided into two main traditions that differ in how adult attachment is conceptualized and measured. Both traditions are related to the work of Bowlby and Ainsworth but focus on different components of the IWMs of attachment, operating at different levels of awareness (e.g. Simpson & Rholes, 1998). The developmental psychology tradition is concerned with the representational level of attachment (i.e. implicit) such as “state of mind” and (in)flexibility of attention with regards to attachment experiences involving attachment figures, whereas the personality/social psychology tradition focuses on how individuals generally tend to feel and behave in close relationships and their declared (i.e. explicit) views and beliefs of how relationships work (Duschinsky et al., 2024).

Developmental psychology tradition

Given that IWMs are understood not only in terms of their reflection in behaviors and feelings but also in terms of regulating cognitive processes such as attention and memory, individual differences in IWMs would be evident not only in behavior patterns but also in language and structures of mind (Main et al., 1985, p.67). Based on this proposition, a semi-structured interview (Adult Attachment Interview; AAI, Main et al., 1985) was developed to assess adults’ “state of mind” with regards to their early attachment experiences. During the interview, interviewees answer questions about their parents (or parental figures), their relationship with them, specific experiences regarding separation or loss, and their general views of how such experiences influenced their development (Hesse, 2008). Their narratives are evaluated in terms of coherence, such as the extent to which the narrative provides (episodic) evidence for the claims made, the extent to which it remains focused on the topic, as well as the extent to which it is complete and clear (i.e. Grice’s maxims, Hesse, 2016, p.558). Importantly, the AAI reveals individual differences in IWMs in terms of organization of attachment-related experiences, ideas, and feelings, and the limits of their accessibility (Main et al., 1985), manifesting as attentional (in)flexibility, which is factored in for evaluations of the interview transcripts (Hesse, 2016). Taken together, organized narratives⁴ are then assigned into one of

⁴ “Organized” classifications refer to a state of mind that is characterized by relatively consistent and recognizable strategies for managing attachment related emotions, memories and stress (Main,

three classifications for “state of mind” with respect to attachment (Main et al., 1985; Hesse, 2008, 2016).

The secure-autonomous (F) state of mind classification is assigned to transcripts in which individuals can coherently talk about their attachment relationships, openly reflecting on positive and negative aspects of their experiences without becoming stuck on particular details or avoiding certain queries. They tend to acknowledge the value of attachment relationships and easily shift their attention between recounting early attachment experiences and evaluating the influence of those experiences. In contrast, narratives classified as insecure states of mind are characterized by incoherence, attentional inflexibility and defensive exclusion. In narratives classified as insecure-dismissing (Ds) attention is inflexibly turned away from attachment events and their influence. There may be a mismatch between how attachment figures and relationships are described (e.g., as loving or warm) and instances of experiences recalled to support the descriptions, either through claims of not remembering or memories with content that contradicts the descriptions given. Such idealization of parents is interpreted as a strategy of defensively excluding negative or painful childhood experiences from processing. Similarly, influence of attachment relationships and events may be minimized or dismissed by individuals with insecure-dismissing state of mind. The defenses characteristic of the insecure-preoccupied (E) state of mind appear as excessive anger toward a parent or about particular events involving them and fixated focus on one’s pain. Narrative coherence in this classification tends to be low due to deviating from the topic of questions or providing indecisive or contradictory evaluations of parents and events.

A notable resemblance emerges between adults’ state of mind with regard to attachment, as assessed by the AAI, and their children’s Strange Situation classifications (e.g., van IJzendoorn, 1995). For example, an adult with a secure-autonomous state of mind flexibly shifts attention between topics and perspectives relevant to the interview questions. Similarly, a secure-classified infant alternates between exploring the room in the presence of the parent, monitoring the parent’s whereabouts, showing distress during separation, then returning to exploration and play once soothed. Inflexible attention of infants in avoidant classification that is almost constantly directed at the toys and away from the parent appears parallel to the inflexible attention of an adult with insecure-dismissing state of mind disengaging from attachment-related content of the interview. In a similar vein, resistant/ambivalent infants’ hyperfocus on their parents and excessive distress and contradictory reactions to parent during reunion shows similarities with adults in insecure-preoccupied classification who hyperfocus on their attachment-related

2000). AAI categories of “unresolved/disorganized” and “cannot classify” are not included here because they fall outside of the scope of the studies.

experiences. In both insecure classifications, whether in adults or infants, attentional flexibility is limited.

The AAI is considered the “gold standard” measure of adult attachment representation with well-established psychometric qualities (Bakermans-Kranenburg & van IJzendoorn, 1993; Sagi et al., 1994). The adult attachment representations, based on the AAI classifications, were distributed such that a majority was classified as secure-autonomous, followed by insecure-dismissing, and insecure-preoccupied in non-clinical samples (Bakermans-Kranenburg et al., 2025; also, Bakermans-Kranenburg & van IJzendoorn, 2009). This paralleled the distribution of child attachment classification measured with the Strange Situation Paradigm (Madigan et al., 2023, see Bakermans-Kranenburg et al., 2025). In contrast, insecure classifications were more common in clinical samples (van IJzendoorn & Bakermans-Kranenburg, 1996; Bakermans-Kranenburg & van IJzendoorn, 2009, 2025).

Personality/Social Psychology tradition

With the proposition that adult close relationships and romantic love can also be understood as attachment process, the theory - and methods - were extended into investigation of adult attachment *styles* or *orientations*. Encompassing generally stable set of behaviors, feelings, and thoughts regarding close relationships, measured by individuals’ self-reports, attachment orientations are thought to express underlying IWMs (e.g. Simpson et al., 2010; Simpson & Karantzas, 2019). Prototypes of adult attachment styles (as secure, avoidant, and anxious) similar to Ainsworth’s classification system were initially proposed to define individual differences in adult relationship patterns (Hazan & Shaver, 1987), followed by a four-category model based on two dimensions, depicting IWMs of self and others (Bartholomew & Horowitz, 1991). In further refinement of adult attachment measures, a self-report questionnaire combining other attachment questionnaires was constructed (Experiences in Close Relationships/ECR; Brennan et al., 1998) and revised (Experiences in Close Relationships – Revised/ECR-R; Fraley, Waller, & Brennan, 2000) to assess two dimensions of attachment orientations, namely, attachment avoidance and anxiety.

In the context of close relationships, attachment avoidance concerns feelings of discomfort with closeness, avoidance of intimacy, valuing independence and self-reliance, whereas attachment anxiety is characterized by preoccupation with close relationships, worries about abandonment and rejection (e.g., Brennan et al, 1998; J.A. Feeney, 2008). Lower ends of these dimensions signify attachment security. Unlike the interview methods in developmental psychology tradition, self-report questionnaires consider the *content* of individuals’ views about rather than the *form* (of attention) in their reports. While the self-reported measures of attachment converge among themselves (e.g., Bartholomew & Shaver, 1998; Brennan et al., 1998; Strauss et al., 2022), their relation to implicit representational measures (e.g.

attachment interviews) is low (Psouni & Apetroaia, 2014; Roisman et al., 2007), indicating that they assess different components of internal working models of attachment, some that are available to evaluate and reflect on and some not.

Nevertheless, a common interest of both traditions is to understand how beliefs and assumptions about relationships influence ability to use close others as secure base and safe haven as well as functioning in other aspects of life (e.g., Duschinsky et al., 2024). Indeed, attachment security has been influential in relationship satisfaction, stability, and longevity of romantic relationships, as well as effectively seeking, receiving, and providing support whereas both dimensions of attachment insecurity seem to impair these relational processes (Collins & Feeney, 2004; Mikulincer & Shaver, 2007; Pietromonaco & Beck, 2015). Similarly, emotion regulation strategies of individuals on the higher end(s) of insecurity dimensions may become maladaptive, such as cognitive and emotional distancing from stressors in case of high avoidance or becoming hyper-engaged with stressors and emotions they evoke in high attachment anxiety (e.g., Mikulincer & Shaver, 2019).

Implicit scripted knowledge of attachment

In efforts to describe the structure and organization of internal working models of attachment, the concept of “event schemas” or “scripts” (Nelson, 1986; Schank & Abelson, 1988) has been instrumental. As event schemas/scripts are assumed to summarize the information about repeated similar events, attachment representations are thought to have formed by script-like structures that reflect experienced attachment-related events and interactions with caregivers (Bretherton, 1987; 1991). Specifically, the early sensorimotor experiences with caregivers in times of distress lead to the acquisition of attachment related implicit procedural knowledge about distress management, which is conceptualized as attachment scripts or secure base scripts (Mikulincer & Shaver, 2007; Psouni & Apetroaia, 2014; Waters, Rodrigues, & Ridgeway, 1998).

Secure base scripts comprise knowledge regarding the viability of approaching significant others in times of distress, the availability and responsiveness of others, and the experience of comfort as a result of approaching significant others (e.g., Mikulincer, Hirschberger, et al., 2001). Since this knowledge emerges within specific relational contexts, it is initially relation-specific to individual caregivers (Bowlby, 1969). Over time, development, and integration of other new individuals and relationships into the child’s life, this scripted implicit knowledge is assumed to develop into generalized and abstract representations that can be applied to the new relationships (Bowlby, 1988; Di Folco et al., 2017; Psouni & Apetroaia, 2014). The quality of early relationships and felt security within such attachment

interactions lead to a more developed and elaborate knowledge of events and are supposed to be more readily available and easily accessible.

Importantly, this knowledge is assumed to be implicit in nature, which has implications in terms of measurement methods. Implicitness of the scripted knowledge of attachment refers to it being inaccessible to direct observation (Waters et al., 1998) and reportable upon explicit demand (Psouni & Apetroaia, 2014) as it was learned early on through sensorimotor experiences and before language and more complex cognitive processes are fully developed. Contrasting this with explicit (or declarative) evaluations of one's own patterns of behaviors, thoughts, and feelings in close relationships, scripted knowledge of attachment has been more closely related to episodic evidence of secure base – safe haven interactions with parents and quality of early experiences with caregivers, as assessed by attachment interviews (Psouni & Apetroaia, 2014; Steele et al., 2014).

Scripted knowledge of attachment taps into other related constructs and components of generalized attachment representations (IWMs) that correspond to secure attachment organization. Given the body of empirical evidence supporting this, it can be taken/measured as an index of attachment security. For example, scripted knowledge was related to autobiographical narratives and observations of sensitive interactions with caregivers (Psouni & Apetroaia, 2014; Steele et al., 2014), parental support (Vaughn et al., 2016), parental functioning (Krantz et al., 2024), as well as attachment security and coherent thinking about attachment relationships, as reflected in attachment interviews, in mothers (Coppola et al., 2006), adolescents (Dykas et al., 2006), and children (Psouni & Apetroaia, 2014). Scripted knowledge is also associated with perceived social acceptance and general competence in middle childhood (Psouni et al., 2015), and functional adaptive responses to stressors in middle childhood and adolescence (Psouni & Apetroaia, 2014). A recent study also showed links between early deprivation (e.g. institutionalized rearing) and lower scripted knowledge of attachment, while presenting relations between parenting quality and higher scripted knowledge overall (Hare et al., 2025). Finally, associations have been shown with caregiving and care-seeking behavior (T. E. A. Waters et al., 2013), as well as observed quality of interaction and self-reported relationship satisfaction in adult romantic relations (T. E. A. Waters et al., 2018).

Measuring implicit scripted knowledge of attachment

Because of the implicit nature of the scripted knowledge of attachment, it is not directly observed or explicitly declared. Instead, it is inferred through semi-projective measurement tools (Bretherton & Munholland, 2008). These measurements rely on prompted narrating or enacting progression of events, through story completion with the help of doll play (Goldwyn et al., 2000), pictures (George & West, 2001), or word-prompted narrative production (Waters & Waters, 2006; Psouni & Apetroaia, 2014). The core assumption of these measures is that if scripted

knowledge of secure attachment interactions is available, accessible, and coherently represented in the memory (Waters & Waters, 2006), it will be activated by story stems or prompt words – functioning as “primes” – and “spill into” the narratives created as a response to the prompts. A number of such word-prompted narrative-based instruments have been developed in recent years and have demonstrated good psychometric qualities (e.g. Secure Base Script Test/SBST: Psouni & Apetroaia, 2014; Attachment Script Assessment/ASA: Waters, Rodrigues, & Ridgeway, 1998).

The key components of the prototypical secure base scripts are defined in Psouni & Apetroaia, 2013 (p.4): “(1) the child engaging in exploration while the caregiver remaining available and responsive, serving as a resource as the child’s activity necessitates; (2) when encountering a distressing difficulty, the child being aware of her need for help and thus signaling it to caregiver, who in turn detects and interprets the signal correctly so that proximity can be established; (3) appropriate caregiver action and child’s acceptance of this action, and the child’s support, resulting in the difficulty being dealt with; (4) proximity and contact/interaction with the caregiver effectively comforting the child and (5) facilitating a return to exploration or a transition to another activity” (see Figure 1). The extent to which a narrative reflects a clear and elaborate secure base script, as well as the amount of information regarding interactions and emotional exchange, has been termed *scriptedness* which is also the basis of scoring of the instruments.

In both measures (SBST and ASA), produced narratives are scored on a 7-point scale indicating scriptedness. For instance, highest ranked stories contain rich knowledge of secure base script and interpersonal interactions. Attachment figures are portrayed as sensitive and attentive; they pay attention to the psychological state of the main character of the story, and quickly and appropriately offer help in difficult situations which results in resolution of the difficulty and affect regulation. These narratives make complete and coherent stories. Lower ranked stories contain fewer elements of secure base interactions. These stories may contain breaks that lead to incoherence, “odd” contents that are inconsistent with the secure base scripts, sequence of events without emotional content, as well as exclusion of the attachment figure as an active participant from the story (see scoring manual of SBST; Psouni & Apetroaia, 2013, and of ASA; Waters & Rodrigues, 2004).

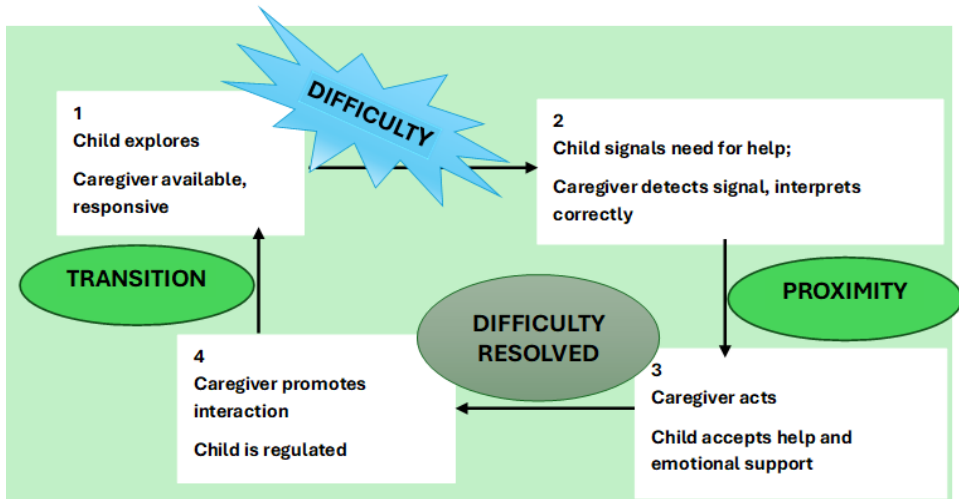


Figure 1. Components of a prototypical script for secure base safe haven interactions. Adopted from Psouni, E. & Apetroaia, A. (2013). Secure Base Script Test (SBST) for Middle Childhood, Scoring and Administration Manual, 2nd revision. Unpublished manuscript, Lund University: Sweden.

These word-prompted narrative-based measures are typically administered in an interview-like context, involving a test leader introducing and instructing the narrative production task, who also acts as a listener, though a relatively passive one. The test leader also audio-records the narratives told by research participants to capture the content and structure of narratives as unedited as possible (Waters & Waters, 2006). The conventional test setting, thus, assumes that the presence of a test leader as a listener is necessary. This may be the case when testing children's narratives, as the test leader may teach a child by facilitating the narrative production process with a practice story, for example (Psouni & Apetroaia, 2013). However, it is unclear how important and necessary the test leader/listener's role is when testing adults. Given the importance of implicit scripted knowledge in attachment theory and research, the field would potentially benefit from widespread testing of this construct. However, implementing the conventional test setting may pose logistic and financial limitations to this end, and thus, there appears to be a clear need for investigating alternative test settings. Study I aimed to address this gap.

Attachment-related patterns in cognitive processes

Regulating attention

In alignment with the theoretical proposition that IWMs function as structured processes that allow or limit monitoring and processing of information (Bowlby 1969, Bretherton, 1987; Main et al., 1985), cognitive biases – such as in attention and memory – in relation to individual differences in attachment (styles/representations) have been widely studied. As described in AAI classifications, IWMs of attachment are closely related to (in)flexibility of attention. While securely attached individuals have the capacity to tolerate discomfort of difficult emotions and frustrating situations while finding ways to cope (flexibility), insecurely attached individuals instead cope by either disengaging from them entirely or becoming extremely preoccupied. Both disengagement and preoccupation lead to not dealing with the problem as a way of regulation/coping (Bowlby, 1980; Hesse, 2016; Dykas & Cassidy, 2011).

As general tendencies in processing social information, for example, individuals whose IWMs are characterized by attachment security tend to be open to processing a variety of information, overall, while they sometimes also show positive bias, potentially influenced by their attachment representations involving positive experiences and feelings (Dykas & Cassidy, 2011). Individuals with insecure attachment orientations, on the other hand, appear to use varying degrees of exclusion of attachment-related information from processing (Dykas & Cassidy, 2011), such as diverting attention away from certain emotional information (Mikulincer & Shaver, 2003). While individuals with attachment anxiety display hypervigilant tendencies (e.g., sustained attention, difficulty disengaging from certain information) and selective attention to negative information, especially in case of limited resources, such as heightened stress, disengagement strategies for avoidant individuals seem to be consistent and relatively unaffected by stress condition, valence and attachment-relevance of information (Peng et al., 2024).

Interestingly, attentional orientation strategies of highly avoidant individuals seem to follow a dual process, such as an initial vigilance to- and later disengagement from certain information. This process implies that high avoidance functions to help detection of information as one to avoid and subsequently employs defensive disengaging strategies to disallow such information from further processing (Chun et al., 2015; Fraley & Brumbaugh, 2007). Neuroimaging studies and electrophysiological methods provide neural evidence for the initial vigilance – later disengagement pattern of emotional information processing (e.g. Kungl et al., 2023; Liu et al., 2017; Zhai et al., 2016; Zheng et al., 2015). These studies together imply that avoidant defenses guiding disengagement may be an effortful process. Further supporting this notion, a number of studies reported that disengagement strategies

of highly avoidant individuals were attenuated when the task introduced cognitive load (e.g. Chun et al., 2015; Edelstein & Gillath, 2008) or emotional load (e.g. memories of insecurity; Gillath et al., 2009).

Guiding expectations

One of the main functions of IWMs of attachment is to form expectations in attachment-related situations about close others' availability, and guide behaviors and strategies (to attain felt security) accordingly (Bowlby, 1969; Zimmermann, 1999). Experimental studies with infants show that securely attached infants (with sensitive mothers; Biro et al., 2015) expect others to comfort a crying baby (Biro et al., 2015; Jin et al., 2018; Johnson et al., 2007) and attend to a child's attachment-related bids (Mohammadzade Naghashan et al., 2021). Similarly, expectation, perception, provision and reception of support from close others in adulthood (e.g. relationship partners) differ based on individuals' IWMs (Pietromonaco & Beck, 2015). These processes have been investigated with wide range of behavioral, observational, and self-reported measures (Collins & Feeney, 2004; McLeod et al., 2020; Waters et al., 2018).

What is still almost entirely missing is the study of attachment-related expectations of support at the neural level. Zayas et al. (2009) investigated neural responses to partner rejection (and acceptance) cues in women with (self-reported) anxious and avoidant attachment orientations in attachment-related and –unrelated contexts. They found, in both conditions and for all participants, that rejection cues resulted in greater semantic processing compared to acceptance cues. This effect was indicated by the N400 component, a neurophysiological marker for prediction error or semantic processing of information (which will be further explained in the next section). Women with anxious attachment had the most magnified N400 effect in general, but the N400 was greater for the attachment-related context than attachment-unrelated context suggesting that anxiously attached women are more sensitive (hypervigilant) to other-related cues and this sensitivity is higher in contexts which may activate the attachment system. For women with avoidant attachment, they found dampened N400 in attachment-related context compared with attachment-unrelated contexts, suggesting disengagement from attachment-related information when attachment system is (de)activated. Despite findings confirming patterns related to attachment insecurity dimensions, direct neural connections to expectations of support availability in attachment related situations are still lacking. Study III aims to address this gap, based on an experimental paradigm and materials that follow script-like structure, while providing an ecologically broad relational context.

Possibility for change? – Attachment security priming

Given the evidence for adaptiveness of strategies that goes hand in hand with attachment security and not-so-desirable “outcomes” of attachment insecurity related strategies, one naturally asks, is there possibility for change? As Howard and Miriam Steele write, “...if an individual was not fortunate enough to have experienced sensitive parenting during childhood, then various compensatory pathways can be charted so that mental health comes to be achieved by way of the human capacity to seek out care, accept it, and in turn provide care in ways that were not previously familiar to the individual” (H. Steele & Steele, 2008, p.4). While the compensatory pathways Howard and Miriam Steele refer to are interactions with a relationship partner, or a therapist, with whom one supposedly can build secure dynamics, ways to induce feelings of security in experimental contexts take a different but theoretically related form.

What is utilized in experimental investigations is a social-cognitive procedure in which attachment representations involving security instilling experiences are activated by “priming” procedures. Priming procedures involve exposing individuals to stimuli designed to induce sense of security, love, support etc., such as security-related words (e.g., love, support, hug), pictures (e.g., a couple holding hands, a mother hugging a child). These stimuli can be presented *subliminally* that lasts for milliseconds embedded into a task in order to prevent participants intentionally reflecting about attachment-related content and yet, activate their attachment representations. Supraliminal priming, on the other explicitly instructs participants to think about and visualize attachment-related situations, lived or imagined, such as being supported and feeling loved by close others.

Attachment security priming has been found to have positive influence on variety of outcomes such as relationship expectations, self-views, and self-compassion (Carnelly & Rowe, 2007; Oehler & Psouni, 2018), creative problem solving (Mikulincer et al, 2011), constructive emotion regulation (Troyer & Greitemeyer, 2018), in both short and long term (Rowe et al., 2020 for a review). However, influence of attachment security priming may differ based on the attachment orientation of an individual. Effects of attachment security priming seem to benefit individuals with high attachment anxiety whereas high attachment avoidance appears to be unaffected by priming (see Gillath & Karantzas, 2019 for a review).

Given that avoidant attachment is related to disengagement from emotional information while also hindering the benefits of attachment security priming, it is not entirely clear what can reduce heavy reliance of avoidant defenses. This problem may be especially relevant in early stages of emotional information processing, for example orientation to emotional information. Even though this question has been asked within the attachment security priming studies, multiplicity of experimental design and other methodological aspects make it difficult to disentangle the issue.

Study II aims to address some of the methodological issues by utilizing a within-subjects design with supraliminal priming manipulation, more subtle emotional stimuli (e.g. contemptuous facial expression), and a more suitable variation of a task to assess attentional orientation.

Methodology

Methods and measurement techniques to infer the content of, and individual differences in, attachment representations were briefly introduced earlier. Many methods were developed to assess the content and structure of the IWMs from multiple perspectives. These methodologies range from observation of behaviors to assessing script-like knowledge of attachment (e.g. event schemas, or scripts), individuals' self-evaluated orientations based on critical dimensions, and to assessing superordinate qualities in the IWMs via attachment-focused clinical interviews. This section, however, focuses solely on methodologies and measurement tools used in the three empirical studies. These concern assessment of implicit scripted knowledge of attachment and self-reported attachment orientations in order to tap into specific components of the IWMs. Additionally, stimuli materials, the priming technique used in order to activate attachment schemas, as well as methods to infer specific cognitive processes (e.g. attentional orientation and prediction making) will be described.

Attachment Measures

Word-prompted narrative-based assessment of implicit scripted knowledge of attachment (Study I & Study III)

The word-prompted narrative-based methods to measure scripted knowledge of attachment builds on principles of priming. The word prompts are primes aimed at activating the implicit script-like knowledge of attachment stored/represented in memory (Molden, 2014). The measure of scriptedness score is the extent this implicit knowledge is retrieved, as reflected in the details of secure base - safe haven interactions in produced narratives.

Both ASA and SBST measures consist of prompt-word lists to activate a pattern of events unfolding (i.e. event schema) in which the close other (i.e. attachment figure) helps the main character deal with distress and facilitate return to a balanced, regulated state (Waters & Rodrigues-Doolabh, 2004; Psouni, & Apetroaia, 2013). The stories depict variety of attachment relationships (e.g. parent-child, romantic partners) where one character can function as a safe haven for the main character to

come back to in times of difficulty. Types of themes used for the storylines in these measures span over variety of situations of (age-appropriate) distress, such as a bike/car accident, a failed math test, not being invited to a party, having troubles at school and so on, all of which can be co-regulated with a supportive other.

As the titles suggest the themes of the stories, twelve word-prompts (printed in three columns) present the setting, actors involved in the story, content and activities, and finally a conclusion or resolution of the storyline. Elements of a prototypical secure base (and safe haven) storyline include stages where a main character who is involved in a constructive activity is interrupted by an event or another character and gets distressed. Then the main character signals for help and an attachment figure responds to this signal sensitively and offers help. The help is received by the main character and leads to resolution of the difficult situation. The attachment figure also helps with the affect regulation, and they return to constructive interactions (as illustrated earlier in Figure 1).

The test instructs study participants to look at the prompt words for a while and tell the story that comes to mind first without thinking too much about it. They are given the flexibility to use the words in different order or omit some of them if they wish to. Importantly, the instructions emphasize that the task is not a creativity test but encourages individuals to elaborate their stories with details. Participants are also reminded that if they need to stop and think for a second, change something or start over, they are free to do so.

Across different measures the scoring manuals use essentially the same scale. High scores (e.g. scored within a range from 5 to 7) indicate that the stories involve varying degrees of elaboration regarding emotional states and interactions with the highest score given to complete and coherent stories with rich content of emotional exchange, sensitive caregivers offering support which leads to positive resolution. A mid-score of 4 is given to stories with rudimentary knowledge of secure base - safe haven but without any elements of emotional exchange. Similarly, a score of 3 is given to event-centered stories with hardly any interactions between the characters or without any sign on psychological states or how they change. Low scores are given to event-centered stories that are too brief to the point of becoming disjointed (score 2) or involving “odd” content (more common in score 1 stories), (see Paper II for examples of stories with different score range).

Test Modalities

A unique aspect of Study I was the manipulation of “context” of testing conditions such that the instructions, as well as the word-prompts, for the narrative production task is presented on a computer task, and the narratives are produced (1) orally and audio-recorded, (2) in text form, typed on a computer, as opposed to (3) told to a listener in the same physical space. In each condition of the narrative-production task, the principles of word-prompt priming are assumed to be the same.

Self-reported measures of attachment orientations

Attachment anxiety and avoidance dimensions were assessed using self-report questionnaires Experiences with Close Relationships (ECR; Brennan et al., 1998, in Study II) and its revised version (ECR-R, Fraley, Waller, & Brennan, 2000, in Study III). The two measures are not significantly different in terms of validity and meaning (Ravitz et al., 2010). Both scales use statements such as “I prefer not to show a partner how I feel deep down” and “I don’t feel comfortable opening up to romantic partners” for attachment avoidance dimension, and “I worry about being abandoned” and “I’m afraid that I will lose my partner’s love” for attachment anxiety dimension. Items are responded to on a 7-point scale, indicating the extent an item describes how the respondent feels in close relationships.

Stimuli Materials

Non-personal prototypical secure-base-script-like narratives

In Study III, the stimuli material consists of a large set of short non-personal narratives designed to provide attachment-related or attachment-unrelated contexts in the form of event sequences. There are several unique properties of the stimuli material that highlights the contribution of the study. First, the narrative material was constructed with particular attention to ecological validity, reflecting a range of everyday contexts, situations, and relationships rather than relying on isolated pictures, words, or sentences. All narratives were carefully calibrated following a three-sentence structure, introducing the characters, describing the situation, and ending with a response from a significant other. Description of situation was manipulated to depict distress/difficulty for attachment condition and an ordinary everyday event for non-attachment condition. Together, the structure provides sufficient context and control for attachment vs. non-attachment conditions.

The narrative endings were manipulated to present a close other who approaches the main character in either supportive or non-supportive manner. Critically, the narrative endings were presented in the following frame marking the “event” for the neural activity. Type of endings were counterbalanced across narrative contexts, and length of narratives and endings were kept comparable across all stimuli. Overall, the structure of these narrative materials allows for assessment of attachment-related expectations regarding availability of support in times of need by activating implicit scripted knowledge of attachment with the attachment narratives. In contrast, narratives depicting non-attachment situations are not supposed to activate attachment-related schemas, thus, providing a control context.

Emotional and Neutral Faces

In the experimental task in Study II, pictures of facial expression, taken from Radboud Faces Database (Langner et al., 2010) were used. Expressions were either neutral or contemptuous, and counterbalanced for gender of the model. For emotional cue stimuli, expression of contempt was chosen because it is more likely to convey rejection and social exclusion which may pose a threat to undermine an individual's sense of worthiness (Fischer & Roseman, 2007).

Priming attachment security

Study II involves a common priming technique in attachment research used to experimentally provide attachment and non-attachment contexts. Specifically, we utilized supraliminal priming of participants' own memories of attachment security and then assessed post-priming attentional orientation as an indication of cognitive bias. These post-priming measures were compared with pre-priming attentional orientation on an emotional cueing task (introduced in the next section). This approach was based on the assumption that recalling attachment-related memories activates a sense of security and reduces reliance on chronic avoidant defenses as emotion regulation. In contrast, a neutral (i.e., non-attachment) priming was implemented to provide a control condition.

For the priming manipulation, participants were instructed to think about a social interaction they had experienced and write it down. To encourage as open and detailed descriptions of situations as possible, participants were informed that their writings would not be read or collected by the experimenter. Participants who received attachment security priming were asked to "Think of people to whom you turn when you feel distressed or worried. List five qualities for each of these people. Visualize a specific situation in which one of them provided comfort and help when you were feeling distressed or worried. Write a description of the situation, and your feelings during its course." Participants who received neutral prime were asked to "Think of acquaintances that you know but don't have a close relationship with. List five qualities describing each of these people. Visualize a specific, ordinary situation (e.g. a work meeting) you shared with one of them. The situation should be relatively neutral, neither emotionally positive nor negative. Write a description of the situation and your feelings during its course." These instructions were adapted from Mikulincer et al. (2011).

At the time of inception of Study II, attentional orientations in relation to avoidance-related defenses were not investigated with a pre-post-priming experimental design with supraliminal priming. Because a supraliminal personal priming technique was assumed to be more effective in activating own memories, and a similar study that did not find priming effects with subliminal priming, such as milliseconds-long

exposure to a security instilling picture (e.g., Picasso's mother-child picture; Andriopoulos & Kafetsios, 2015), a personalized supraliminal priming was chosen. The limitations and implications for this choice are discussed in the last section.

Methods to infer cognitive processing patterns related to attachment

Assessing attentional orientation – A Dot-Probe Task variation

The dot-probe task is a commonly used method to assess attentional orientation. Attentional orientation can be defined as “alignment of attention with a source of a sensory input or an internal semantic structure stored in memory” (Posner, 1980, p.4). In the context of this work (i.e. Study II), it refers to where the attention is drawn in a visual field. The task involves simultaneous presentation of stimulus-pairs (such as words, faces, pictures) on opposite sides of the screen, either vertically, horizontally, or diagonally. Following the stimulus-pairs, a visual probe (e.g., a dot) appears on one of the two sides of the screen (MacLeod et al., 1986). Participants are to press a button on the keyboard to indicate the location of the probe as quickly and accurately as they can. The core assumption of the task is that individuals will detect the probe faster if it appears at the same place as the stimuli their attention was oriented toward. Thus, the reaction time (RT) to the probe detection indicates whether attention is shifted toward (shorter RT) or away from (longer RT) a preceding stimulus.

The dot-probe task is a common method to assess attentional orientation (or biases) in attachment research (Peng et al., 2024), as well as in depression and anxiety (Winer & Salem, 2016, for a review, although raising some concerns and criticisms too: e.g., Kappenman et al., 2014). Because the dot-probe task presents two stimuli simultaneously, it may not allow for disentangling exact attentional processes for either stimulus, for example, longer RT in detecting the probe following an emotional stimulus may be due to fast engagement with or difficulty disengaging from that stimulus (see Bar-Haim et al., 2007 for discussion). To circumvent this limitation of the dot-probe task, the emotional cueing variation was chosen to assess attentional orientation in Study II where the task presents one stimulus at a time.

The emotional cueing task, also known as the exogenous cueing paradigm (Posner, 1980), that was used in Study II is a variation of the dot-probe task, adapted from Chun and colleagues (2015). Similar to the original dot-probe task, the emotional cueing paradigm involves emotional and neutral cues. However, a critical difference from the dot-probe paradigm is that the cues are presented one at a time at a specific location (e.g., on the right or the left side) on a screen. This variation, thus, allows

for clarity in measuring attentional biases to each cue individually. Emotional cues used in Study II consisted of pictures of contemptuous facial expressions, and neutral faces were included as a control condition. Following the emotional cue presentation, a dot probe (target) appears either at the same location as the cue (congruent trial) or at a different location (incongruent trial). RT are measured for targets following emotional vs. neutral cues. Faster responses to targets following emotional cues indicate an attentional bias toward emotional stimuli. For analysis, an attentional orientation index is calculated by subtracting averaged RT on congruent trials from averaged RT on incongruent trials for each type of stimulus.

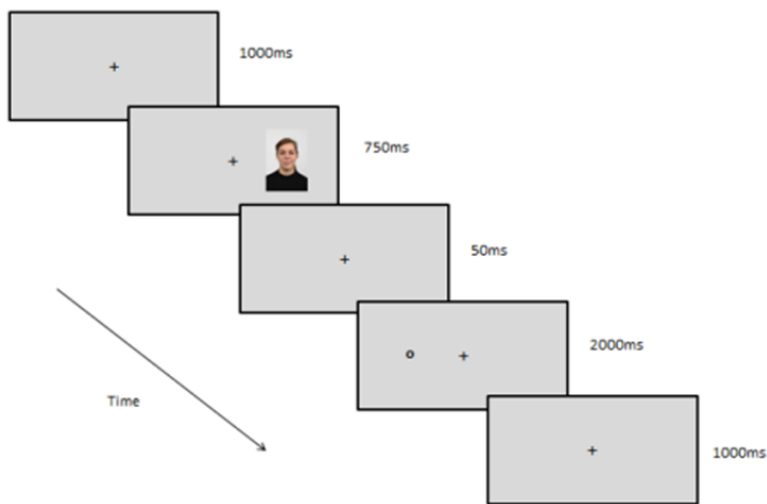


Figure 2. An illustration of a trial in the emotional cueing task (an example of incongruent trial), borrowed from Han & Psouni (2025).

Assessing neural activity - Electroencephalogram (EEG) and event related potentials (ERPs)

Electroencephalography is a non-invasive electrophysiological method used to measure electrical activity in the brain. Small electrodes are placed on the scalp to detect electrical signals generated by the activity of a large number of neurons. EEG records this activity continuously and to the level of milliseconds, thus, provides an advantage of high temporal resolution. Event-related potentials (ERPs) refer to the electrical potentials in the EEG that are time locked to specific sensory, cognitive,

or motor events and thus considered as neural manifestations of specific psychological processes (Fabiani et al., 2007). Given that the ERPs are small (e.g. a few microvolts) potentials that are embedded in the EEG signal, their detection is possible through time-locking to the onset of the event and averaging over many trials of the particular event, or experimental condition. ERP waveforms are characterized by positive and negative peaks referred to as ERP components, typically described regarding their special distribution on the scalp, polarity, and latency (e.g. Fabiani et al., 2007).

Specific ERP components that are investigated in Study III are the N400 and late positive potential (LPP). N400 is a negative-going ERP component peaking around 400ms after stimulus onset with a broad scalp distribution but largest over the centro-parietal sites (Kutas & Federmeier, 2011). First reported in a seminal study by Kutas and Hillyard (1980), effects in the N400 component have been related to semantic anomalies in linguistic studies (e.g. improbable/unexpected endings of sentences) such that a sentence ending in “He spread the warm bread with socks” elicits larger negative amplitudes than ending in “...with butter”. N400 effects are observed in many other contexts such as in violation of world knowledge (Hagoort et al., 2004), semantically incongruent information within a sentence and in the wider discourse of a narrative (van Berkum et al., 1999; Nieuwland & van Berkum, 2006). Across studies a clear pattern emerges: an information that is incongruent or unexpected within the context it is presented evokes larger N400 amplitudes than congruent/expected information that is easier to process semantically.

LPP is a positive-going ERP component that can be observed around 300ms post stimulus onset and can be sustained during the presentation of emotional stimuli (Hajcak et al., 2010). The LPP amplitudes have been larger for positively or negatively valenced information compared with neutral, and even within positive stimuli, it was larger for emotionally salient content, thus, it is suggested to index emotional arousal levels (Hajcak et al., 2010). In a similar line, LPP amplitudes have been smaller when research participants are instructed to regulate their emotional responses to arousing stimuli than when there was no instruction (Meynadasy et al., 2022).

The EEG/ERP method was chosen for Study III due to its temporal resolution, allowing for detection of differences in early stages of information processing at a neural level. Specifically, in the context of semantic incongruity, the N400 effect has been consistently and reliably shown to mark this process. Given that internal working models of attachment encompass semantic knowledge about the relational world and have been related to theoretically relevant outcomes in terms of behavior, perception, and self-reported tendencies in support processes, providing neural evidence for their functions helps completing the picture. An additional benefit of a neurophysiological method in investigation of attachment related information processing might also be circumventing potential defensive mechanisms that may involve in the later stages of evaluation of certain information.

Summary of the Studies

The overall aim of this dissertation is to contribute to the literature on further understanding the implicit nature and functions of internal working models of attachment (or attachment representations). Given the implications of implicit scripted knowledge of attachment in attachment field, a cost-efficient method allowing widespread assessment is still lacking. Study I specifically addresses this issue and presents possibilities to assess attachment scripts on a digital space without the presence of a test leader/listener. Furthermore, the attachment literature shows that individual differences in working models of attachment are reflected in their functioning such as regulating attention and guiding expectations. Study II asks if attention regulating function of internal working models, especially with regards to attachment avoidance, can be influenced by attachment security priming to reduce reliance on avoidant defenses. It shows complexities of disentangling avoidant defenses in relation to attention orientation and priming. Study II and Study III investigate cognitive/behavioral and neurophysiological correlates of such functions in rigorous experimental paradigms. While both studies confirm existing literature on attachment-related patterns in information processing, they bring in specific contributions. Study III addresses neural correlates of attachment-schema-related prediction making as events unfold, using an ecologically valid experimental stimulus set. By linking attachment schemas to temporally sensitive electrophysiological responses, the study strengthens the bridge between attachment theory and cognitive–affective neuroscience, advancing understanding of how IWMs shape perception, prediction, and emotional engagement at both behavioral and neural levels.

Study I – Can we measure scripted attachment knowledge equally reliably in different modalities?

Background and Aims

This study concerns novel ways of measuring implicit attachment knowledge. This implicit knowledge regarding attachment interactions is assumed to develop through early experiences with caregivers and has a script-like cognitive structure

(attachment scripts) which comprise of the secure base – safe haven cycle. Attachment scripts are measured with word-prompted narrative measures in children (Psouni & Apetroaia, 2014), adolescents (Dykas et al., 2006) and adults (Waters & Waters, 2006). Word prompts are assumed to function as primes that activate the implicit knowledge of secure base – safe haven interactions and produced narratives (short stories) are assumed to reflect this knowledge.

Conventionally, word-prompted narrative-based measures are conducted in an interview-like setting where a test leader instructs participants and audio-records the narratives for later transcription and scoring for secure base – safe haven content. The study asks the questions: given the ground assumptions of measuring attachment scripts in narrative forms (i.e., word primes activating the scripts which are then reflected in the narratives) is the presence of a listener necessary to enable the process, namely, can people read the instructions and record their narratives themselves? The other question regards the possibility of typing narratives instead of telling a listener. These questions are important because if the scripted attachment knowledge can be reliably captured with more flexible alternative methods without relying on the interview setting, reaching out to wider populations may become possible. Therefore, the study investigated comparability of novel modalities of word-prompted narrative production to the conventional interview-like setting. We additionally tested some background information and personality dispositions for their potential influence on the outcomes in the three modalities. To address these questions, we have set up two novel test settings and compared the (scores of) secure base content (i.e. scriptedness), as well as the length of produced narratives, to that of the narratives produced within the conventional, interview modality.

Method and Procedure

One hundred and fifty-six participants ($M_{\text{age}} = 27.7$ years, $SD = 10.3$) were recruited through posters set up at the university campus and advertisements on social media platforms. The study was administered via an online survey tool where participants carried out three modalities of word-prompted narrative measure (i.e., typing narratives in a text box in the survey = text modality, audio-recording narratives via a recorder embedded in the survey = audio-recording modality, telling narratives to the test leader = interview modality), with two stories are narrated within each modality, making up to six storylines in total to be scored for scriptedness, namely the richness of attachment-related content they involved. Importantly, materials ensured ecological validity by depicting variety of relational contexts in which scripted knowledge of attachment security may be activated, including parent-child, romantic and friendship relationships. Participants then filled out questionnaires, reporting on their personality dispositions in five dimensions (the Mini IPIP; Donnellan et al., 2006), their general coping tendencies (the Brief-COPE; Carver, 1997), and finally provided background information about their age, gender, level

of education, country of origin, fluency in English, and familiarity with texting as a means of daily communication.

Results and Discussion

When word-prompted attachment narratives were produced in the absence of a listener (audio-recording modality), they yielded comparable scriptedness scores to when they were produced in the presence of a listener (interview modality). Similarly, scriptedness of written (text modality) narratives was comparable to those of produced in the interview modality, but only when the length of the narratives was controlled for. In an absolute sense, typed narratives were shorter than both audio-recorded and those produced in an interview setting, which is not surprising supposing that speech is likely faster than typing.

Interestingly, the imagination/creativity personality disposition seemed to be partially involved in the storytelling task, increasing the length of narratives when told in the presence of a listener as opposed to audio-recording in the absence of a listener. In other words, individuals who reported having a vivid imagination and interest in abstract ideas narrated longer stories in the presence of a listener compared with when they audio-recorded their narratives themselves. This was not the case for their counterparts who reported being less imaginative. Importantly, imagination/creativity disposition did not influence the scriptedness content of narratives, implying that longer stories likely involved detailed description of events not necessarily depicting secure base – safe haven content. Thus, this finding does not question the robustness or validity of the measure.

Another test of reliability of novel modalities checked their prediction power of a theoretically related construct, that is, the use of emotional support as a coping strategy when they are distressed (self-reported). Using emotional support was chosen as a criterion validity because of its centrality in implicit scripted knowledge of attachment. Here, only the scriptedness from the interview modality marginally predicted emotional support coping, while the novel modalities did not succeed in predicting this construct – which calls for caution when planning to implement them in research or clinical settings.

Besides the main questions, we also tested if all six narratives converged independent of type of relationship they depict or type of modality they were produced in. Exploratory factor analysis showed a single factor underlying all six narratives which we assume to be the scripted knowledge of attachment (as reflected in scriptedness in the narratives). The type of relation depicted in narratives or the modality did not seem to be highly influential in variation in narratives, indicating generalized and relation-independent nature of the implicit scripted knowledge of attachment.

Conclusion and Contributions

The study introduced novel test settings for implementing a word-prompted narrative-based measure and compared their effectiveness to assess scripted knowledge of attachment. Findings indicate a relative modality invariance such that scripted attachment knowledge may be tapped into and assessed without the presence of a listener, but not without limitations. Although creativity/imagination trait of individuals appeared to be involved in narrative production, it did not result in differences in scriptedness scores. Taken together, the study presents initial evidence for the usability of novel modalities in assessment of scripted attachment knowledge.

Study II – Can attachment security priming influence habitual attachment (avoidance)-related defenses/patterns in attention?

Background and Aims

The main purpose of this study was to investigate the possibility of influencing attachment (avoidance) related attention patterns via attachment security priming. Literature on attachment-related cognitive biases shows that individuals who score high on attachment insecurity dimensions (avoidance and anxiety) may show certain patterns of information processing in accordance with their attachment representations (Peng et al., 2024). Specifically, high level of attachment avoidance has been related to disengaging from emotional or threatening information (Fraleley et al., 2000; Dewitte, Koster et al., 2007), while high level of attachment anxiety was associated with showing vigilance (e.g. quickly drawing attention to) and difficulty disengaging from such information (Dewitte, De Houwer et al., 2007).

Given that attachment security has been related to flexibility and openness to a wider range of information and a relatively unbiased processing of information (Dykas & Cassidy, 2011), experimentally induced attachment security has been investigated within this literature. It has been shown to have positive influence on cognition and emotion (e.g., Gillath & Karantzas, 2019), which implies that the relatively stable patterns of cognition and emotion may be influenced at different levels. Since attention can be considered as an earlier stage of information processing that may influence what kind of information will be further encoded and retained (e.g., Fraley et al., 2000) we asked the question whether attachment-related attentional biases can be influenced by attachment security priming. This question is important because it has implications for the possibility of inducing flexibility or reducing inflexibility of information processing. Greater flexibility in attentional orientation (and

relatedly, general information processing), may then allow for integrating and processing multiple aspects of information in a relatively unbiased manner, and may reduce sustaining habitual avoidant defensive strategies.

Based on previous evidence, we expected higher attachment avoidance to be associated with attentional disengagement from emotional stimuli (facial expression of contempt) at baseline (before priming). Consistent with the evidence that high avoidance entails limited processing of emotional information, priming manipulation was expected to be more effective in participant with lower avoidance. Additionally, given the attachment security priming has been related to positive (affective) outcomes, we expected reduces negative affect and/or increased positive affect pre- to post-priming.

Method and Procedure

To address the limitations of previous studies investigating influences of attachment security priming on attentional orientations, the study employed a between-within mixed experimental design with supraliminal experimental priming. A hundred and four participants ($M_{age} = 26.15$ years, $SD = 3.71$) were recruited through posters set up at the university campus and advertisements on social media platforms. Upon arriving at the lab, participants were randomly assigned to attachment security priming or neutral priming condition, and carried out the procedure in this order: responding questionnaire items related to state anxiety (State-Trait Anxiety Inventory/STAI; Spielberger & Gorsuch, 1983), positive and negative affect (Positive Affect and Negative Affect Scale/PANAS; Watson et al., 1988), completing the first block of the emotional cueing task adapted from Chun and colleagues (2015), engaging in the priming exercise, responding to the positive and negative affect items again, completing the second block of the emotional cueing task, then finally responded to self-reported attachment questionnaire (Experiences in Close Relationships/ECR; Brennan et al., 1998), and trait anxiety items (STAI; Spielberger & Gorsuch, 1983). Importantly, the study employed an attachment security priming that could be made personal, guiding participants to recall and transcribe a memory of a difficult situation that was resolved with the support of a close other.

Results and Discussion

Our main findings showed an overall increase in attentional vigilance towards pictures of faces regardless of their expression, from pre-to-post-priming block. This increase in vigilance was also independent of the type of priming, meaning that attachment security priming did not have the expected effect on attention. However, as expected, attachment avoidance was related to attentional disengagement whereas attachment anxiety was associated with attentional vigilance. Interestingly,

positive affect declined from pre-to-post-priming, independent of the type of priming induced, especially for the low avoidance (compared with high avoidance) participants. Negative affect also declined from pre-to-post-priming, regardless of the priming type. The unexpected effect of priming on positive affect for low-avoidance participants may be an indication of affective ambiguity caused by recalled distress (along with potential support and recovery), whereas lack of this effect on high-avoidance individuals may indicate disengagement from the priming task itself.

Conclusion and Contributions

This study was designed to address some of the gaps in related literature, thus, included pre-post priming control in addition to group comparison, implemented supraliminal (as opposed to subliminal) priming procedure, and focusing on the avoidant defenses in attentional orientation process, while controlling for attachment anxiety. Findings confirmed the expected pattern in high avoidance – it was related to looking away from the social stimuli and focusing on the task at hand, albeit indiscriminately of emotional content or the type of priming. These findings raise important questions regarding what types of experimental manipulation (priming) in terms of both content (e.g. empathy, e.g. Boag & Carnelley, 2016) and form (subliminal, supraliminal, or other ways) might be effective in reducing the avoidant defenses, if attachment security priming is ineffective or insufficient.

Study III – Neural correlates of attachment schema congruent predictions

Background and Aims

Scripted knowledge of attachment (attachment schemas) is thought to involve knowledge about patterns of events unfolding, and of one's and others' behavior, in times of distress, and thus, guide expectations about availability of support when needed. The literature has shown behavioral, self-reported, and observational evidence for such attachment-schema-related expectations in the context of social support, yet neurophysiological evidence for these links is lacking. Thus, Study III investigated neural evidence for attachment schema congruent expectations of support by using electroencephalography (EEG) method. The main question asked was whether the content of attachment schemas guide expectations about availability of support at an implicit level of functioning captured by electrophysiological brain activity.

To address neural activity regarding expectations, a critical electrophysiological component is the N400, a negative-going event-related potential (ERP) deflection that peaks around 400ms after stimulus onset. This component has been consistently shown to be larger (more negative amplitudes) for stimuli that are incongruent or unexpected within the context they appear in, as opposed to congruent or expected stimuli (less negative amplitudes). Thus, it is an appropriate index to investigate violation of expectations. Given that individuals with secure attachment schemas hold implicit knowledge regarding available and effective support in times of distress, their neural activity was expected to reflect this, indicated by amplified N400 effects when they are presented with information depicting a lack of support, as opposed to its presence, in distress situations.

Method and Procedure

Forty-one women ($M_{\text{age}} = 25.3$ years, $SD = 6.89$) were recruited. Upon arriving at the lab, and while being prepared for the EEG recording, they created two word-prompted narratives (borrowed from the Attachment Script Assessment/ASA: Waters & Waters, 2006; and the Secure Base Script Test/SBST: Psouni & Apetroaia, 2014) as assessment of their attachment scripts. Then they underwent the computerized tasks while their EEG was being recorded. In a within-subject experimental design, they read individually presented narratives (attachment vs. non-attachment situations), depicting parent-child vs. adult close relationships, paired with endings (presenting supportive vs. non-supportive approach) counterbalanced across participants. For each narrative, they reported how easily they could visualize the situations by pressing a number key on the keyboard. At the end of the task, they also filled out an attachment questionnaire (Experiences in Close Relationships – Revised/ECR-R; Fraley, Waller, & Brennan, 2000) and reported background information (age and level of education).

Given that IWMs comprise both explicit and implicit components that jointly shape expectations of support, the study assessed attachment orientations using complementary declarative self-report measure and a narrative-based assessment of scripted assessment knowledge to index both components. In alignment with the theoretical conceptualization of attachment avoidance and anxiety in the ERC-R, and scriptedness from the ASA as dimensional constructs (Fraley, Waller, & Brennan, 2000; T. E. A. Waters et al., 2015), we first tested if our data from both measures load into a single latent construct. Despite a significant Bartlett's test of sphericity ($\chi^2 = 27.9$, $p < .001$), the overall inter-item correlations were weak, and sampling adequacy was below acceptable levels ($KMO = .56$). Thus, the data did not support this strategy, and, even when proceeding despite these limitations, factor analysis yielded a two-factor solution, rather than a coherent unidimensional construct.

In light of these findings indicating that the measures do not reflect a single underlying continuum but rather distinct, partially independent components of attachment, a clustering approach was deemed appropriate as a data-driven method to capture naturally occurring profiles across implicit and explicit attachment indicators, providing a more valid representation of the structure present in the data. Thus, two attachment groups (secure vs insecure) were created based on participants' scriptedness scores on the word-prompted narratives and scores on the self-reported attachment anxiety and avoidance (ECR-R) dimensions by using k-means clustering method.

ERP effects were first analyzed for the whole sample, and significant effects were further tested for the secure attachment and insecure attachment groups, respectively, to assess moderating effects of attachment (in)security, using cluster-based permutation analysis. To address the research question, analyses were run for the N400 effects contrasting non-supportive vs supportive endings within narrative contexts (attachment vs non-attachment) to test attachment-schema related expectations of support when schemas are activated (by attachment narratives) vs not (non-attachment narratives). Additional exploratory analyses were run for a late positive going component (LPP) indicating emotional engagement with the narrative endings. Ease of visualization of narratives was also reported for the whole sample and moderated by attachment group.

Results and Discussion

Results showed an N400 effect for the attachment ($p = .05$), but not for non-attachment condition ($p = .06$), created by larger (more negative) amplitudes for non-supportive endings than supportive endings in attachment narratives for the whole sample. This indicates that a non-supportive conclusion of a distress situation created a “surprise” effect as opposed to resolution with support. As expected, and in line with attachment theory, this effect was significant for the participants in the secure attachment group but not for the ones in the insecure attachment group.

An exploratory analysis revealed a LPP effect that has been associated with emotional reactivity to a motivationally salient stimuli regardless of their emotional valence (Hajcak et al., 2010). This LPP-like effect emerged in attachment condition ($p < .001$) – with non-supportive endings generating more positive amplitudes compared with supportive ones. This effect was driven by the secure attachment group, as the effect stayed significant for the secure group but not for the insecure group at the group-level analysis. This may be an indication of emotional reactivity to the lack of support in a difficult situation, which is likely understood as an undesirable outcome among participants in the secure attachment group. There was also an overall effect in the non-attachment condition ($p = .05$) in the reverse direction, with supportive endings generating more positive amplitudes compared with non-supportive ones, but no effect was found by the group-level analysis. The

overall effect may be interpreted as emotional engagement with the supportive conclusion of narratives where the depicted situations do not call for specific action from a close other.

Results also showed that the attachment narratives with supportive resolution are most easily visualized, overall. Importantly, among participants in the secure group, narratives with supportive endings were more easily visualized compared to narratives with non-supportive endings, regardless of narrative context. No such effect was found for the insecure group. Cautiously taken together with the trend appearing for the LPP-like effect in the non-attachment condition, this result potentially suggests that a positive bias of secure attachment schemas may be “spilling into” attachment unrelated contexts.

Conclusion and Contributions

Overall, the study findings confirm a fundamental assumption within attachment theory that attachment schemas influence expectations of availability of support in times of need. Additionally, the findings contribute to the discussion of the functions of insecure attachment schemas (although not as a central focus) as non-discriminatory processing of relational/emotional information, likely indicating defensive processes. The study broadens the evidence base for these theoretical assumptions by presenting attachment-schema-congruent neural patterns of such expectations. Interestingly, among individuals with secure attachment orientations combined with secure attachment schemas, there were also indications of a potential spillover effect for those expectations to appear in attachment unrelated contexts. Importantly, these results are based on script-like narrative stimuli that involve various relational and situational contexts, thereby increasing the ecological validity of the findings. Altogether, the study methodological apparatus and findings constitute a meaningful theoretical and methodological advance towards integrating attachment theory with neuroscientific approaches to social cognition.

General Discussion

This dissertation aimed to address the nature and functions of implicit scripted attachment knowledge, through assessment of it in a narrative-based method in novel ways and investigation of cognitive and neural patterns related to its functions of regulating attention and guiding expectations. Furthermore, it examined the possibility for influencing avoidance-related defenses via experimental priming manipulation. While confirming some of the core theoretical propositions, the findings of this work have raised critical questions relevant to the attachment field. In this section, I summarize main findings of the three empirical studies under common themes and questions they inform, present their contribution and discuss unresolved questions. Finally, I reflect on strengths and limitations of this work with suggestions for future research.

Assessment and the nature of scripted knowledge of attachment

A core assumption of assessing implicit scripted knowledge of attachment is that this knowledge needs to be primed (by word-prompts) to be activated and reflected in subsequently produced narratives (Han et al., 2026/Study I; Molden, 2014). The conventional practice of assessment assumes the necessity of a test leader/listener to enable this process of priming and storytelling. Study I challenged the assumptions of the conventional assessment practice and presented initial evidence for usability of novel test settings allowing location-independent widespread testing. Main findings showed relative modality-invariance as the scriptedness scores of narratives produced in conventional, interview setting, via self-recording, and typing converged on a single factor. However, typed narratives (in text modality) were shorter in length and contained fewer details of secure base – safe haven interactions (i.e. lower in scriptedness) than other two modalities. Even though the difference in scriptedness disappeared when narrative length was controlled, implementation of only text modality in studies may become problematic as the length of typed narratives may limit the possibility of secure base – safe haven content to be sufficiently captured.

Waters and Waters (2006) emphasized the importance of audio-recording of spoken narratives in order to capture them as being spontaneously produced instead of writing them. While it was not possible to infer how much the participants edited their thoughts while writing, the brevity of narratives may imply insufficient capacity of text modality to reliably capture scripted knowledge of attachment. However, audio-recorded narratives were comparable to those produced in the conventional, interview setting. Even though creative tendencies influenced the length of narratives, this was not reflected in the scriptedness scores for these narratives (a similar pattern was observed in children's narratives as well, Psouni & Apetroaia, 2014). Thus, a personality disposition of high creativity and vivid imagination does not seem to pose threat for implementing the alternative, audio-recording modality for assessing scripted attachment knowledge.

Besides measurement-related findings, Study I findings present that individuals who possess scripted knowledge of attachment also report using emotional support when in need, to cope with stressors. Given scripted knowledge of attachment is rooted in early experiences of distress and support, this finding confirms that it is carried over into current patterns of social support processes and emotional regulation, in line with other research (e.g., Cassidy, 1994; Psouni & Apetroaia, 2014). This link is also supported by both self-reported and neural evidence from Study III, that individuals with secure attachment schemas (measured as combined scriptedness and self-reported avoidance and anxiety scores) do, indeed, recognize the script-like event sequence of a difficult situation followed by support as a familiar pattern, and easily visualize them.

In sum, the findings from Study I and Study III show that content and functions of secure attachment schemas encompassing implicit knowledge of secure base – safe haven interactions versus insecure attachment schemas, manifest at not only behavioral but also neurophysiological level. As an implicit component of the IWMs, this knowledge can be inferred through narrative production, is demonstrated in affecting visualization/imagery of narratives, but, most importantly, is confirmed by differential brain activity while processing script-like attachment events. This shows that the implicit knowledge learned through early experiences with one's caregivers, about what happens when one is in distress (Bretherton, 1987; Psouni & Apetroaia, 2014; Waters & Waters, 2006), continues to influence functioning on different levels (e.g. neural, behavioral) even without one's active awareness or effortful control.

Cognitive processes and (their) neural correlates: the functions of attachment schemas in relation to information processing

Biases and defenses in information processing such as inflexible attention have been identified as indicators of attachment insecurity (e.g. a classification marker in the AAI, see Hesse, 2016). Relatedly, this informs the connection between the IWMs of attachment and related (defensive) cognitive processes that may be operating outside of one's agency and awareness (e.g. idealization, preoccupying anger). To deepen our understanding of functions of the IWMs in information processing, Study II and Study III investigated attention orientation to emotional (vs. neutral) information and neurophysiological markers of attachment-related predictions of support, respectively. Findings revealed patterns of information processing as a function of attachment security (vs. insecurity) and based on the characteristics of information to be processed.

Specifically, findings from Study II and Study III together present evidence for biased information processing and non-differentiation of social or attachment information which are related to attachment insecurity. Findings from Study II confirmed existing literature by showing theory congruent attentional biases in a general sense that individuals with high attachment anxiety tend to be vigilant towards facial expressions while the ones with high avoidance tend to look away from them. Interestingly, in both types of attachment insecurity, these biases were non-discriminatorily applied to both contemptuous and neutral faces: experimental stimuli of contemptuous and neutral facial expressions were not differentially attended to. This may be because the emotional or social salience of the stimuli material (i.e. contemptuous vs neutral expression) was not strong or relevant enough to elicit preferential reactions. In other words, it may be the attachment-relevance (or the lack thereof) of the facial expressions that could lead to preferentially orienting to certain stimulus. Attachment-relevance of stimuli in this particular case could be the facial expressions of a close person who can be considered as an attachment figure (e.g., a safe haven to turn to when in need, see. Gillath et al., 2016, Chapter 2, p. 31), such as a romantic partner, which appears to hold visual attention longer than faces of strangers (Sanscartier et al., 2020).

By contrast, in Study III, a more ecologically valid and emotionally salient stimuli material with attachment relevance (depicting secure base – safe haven interactions) revealed patterns of information processing based on attachment security vs. insecurity. That is, while securely attached individuals showed discrimination – which can be read as schema congruent preference – between support and non-support in attachment context, insecurely attached individuals did not show such differential processing in either attachment or non-attachment contexts. The pattern of differences between individuals in the secure and those in the insecure group was

evident in both mental visualization of the narrative stimuli and brain responses to them.

An important factor when investigating information processing appears to be the *kind* of information to be processed. The literature on attachment-related attention involves a range of methods (the dot-probe task/variations, e.g., Andriopoulos & Kafetsios, 2015; Chun et al., 2015; flanker task; Gillath et al., 2009) and materials (emotional vs. neutral / attachment vs. non-attachment words, pictures, faces; see Peng et al., 2024 for the extent of variety in methods and materials). An investigation of visual attention on attachment-relevant and -irrelevant emotional faces found no effect of attachment insecurity on attending to emotional (happy, angry vs. neutral) faces of romantic partners (attachment-related information) vs. strangers (attachment-unrelated information) (Sanscartier et al., 2020). Findings from Study II and Study III are aligned with this associations between insecure attachment and non-differential processing of emotional attachment-irrelevant stimuli (facial expressions in Study II) as well as attachment stimuli (attachment narratives in Study III). In contrast, attachment security was related to differential processing when attachment schemas are activated (by narratives with attachment context; Study III).

The literature in attachment-related information processing pays special attention to types of attachment insecurity (i.e. avoidance and anxiety) and contrasts these types against attachment security as a “control” condition. Considering that attachment security does not merely denote a lack of insecure patterns and tendencies, indexing it by combining the lower ends of attachment insecurity dimensions with scripted knowledge of attachment, Study III provides support for open, non-biased, yet differential processing of attachment relevant information. Additionally, Study II shows that, when this openness is implicated in lack of avoidant defenses, it is linked to emotional responses such as reduced positive affect after being reminded of an experience of difficulty, despite it being followed by support. There are two ways of thinking about this finding. If these individuals who are characterized by low avoidance are in fact low in anxiety too, they will eventually recover from the feelings that remembering a difficulty evokes. And perhaps they do, but this was not captured by the capacity and timeframe of the experimental procedure in Study II. If, on the other hand, low avoidance is combined with high anxiety, participants may become preoccupied with the thoughts and feelings the remembered difficulty evokes and do not have the capacity/resources to recover within the duration of the experiment. The study was not able to tease apart these possibilities due to its time-limited procedure and a lack of a follow-up measurement on affect.

Possibility For Change? – Workings of avoidant defenses and effectiveness of attachment security priming

Given that IWMs of attachment may involve defensive mechanisms that influence how the environment is monitored and (emotional) information is appraised (Bowlby, 1980; Zimmermann, 1999), this dissertation investigated a possibility to reduce reliance on attachment avoidance related defenses through experimental manipulation. For this, avoidant defenses were operationalized within the constraints of the experimental framework, that is, attention orientation. Main findings regarding this, from Study II, were that high avoidance predicts attentional disengagement (albeit from all types of stimuli, as discussed above). Thus, findings imply that individuals high in attachment avoidance might have disengaged even from the priming task itself. In addition, it is also possible (and perhaps somewhat entangled with) that they may not have autobiographical memories involving experiences of effective support seeking and resolution of distress. Interestingly, though, another study (Mellor & Psouni, 2021) with a similar design implemented a supraliminal but non-personal/autobiographical and implicit activation of attachment schemas (via word-prompted narrative production task) and found no influence of priming on avoidant defenses in visual attention studied with an eye-tracking method (also see Sanscartier et al., 2020 for similar findings). These findings raise the question about what type of priming may permeate avoidant defensive regulatory strategies, or what an effective way of reducing reliance on habitually insecure/avoidant strategies may be.

Perhaps it is worth paying attention to the dual nature of avoidant defenses in attention regulations processing. As mentioned earlier (see section “Attachment-related patterns in cognitive processes”), experimental studies found that these are effortful processes that may break down under stress (Chun et al., 2015; Edelstein & Gillath, 2008; Gillath et al., 2009). For experimental paradigms this is reflected in reduced task performance that was otherwise associated with high avoidance tendencies. In out-of-the-lab contexts however, the breakdown of avoidant defenses may take a different form, such as rock-bottom situations or life crises that may lead to sudden religious conversions (Granqvist & Kirkpatrick, 2004) – which all seem to be indicating that a breaking point is the determinant of permeating avoidant defenses. Then a critical question to consider is, what comes after the defenses break? What can help build up more secure strategies, and how sustainable can they be?

Findings from an experimental paradigm show that repeated priming with various types of security-instilling content (peaceful moments and positive experiences with family, supportive friends, love of a romantic partner, belonging to a team, etc.) reduced self-reported attachment avoidance upon a week-long priming period

(Oehler & Psouni, 2019). Aspects of close relationships other than support seeking may be more influential for highly avoidant individuals given that deactivating attachment system in order not to seek proximity/support is one of the defining characteristics of attachment avoidance (Bowlby, 1980; Dozier, 1990). Speculatively, enhancing highly avoidant individuals' sense of security in different aspects of close relationships (e.g. friendship, belongingness) may promote a positive view of others as trustworthy and of interdependence without losing autonomy (e.g., Arriaga et al, 2018). Likely, these would need to happen out-of-the-lab, and repeatedly, to have a lasting effect.

In this matter, there seems to be *some* evidence of change in attachment-related constructs after psychotherapy interventions in adults (Taylor et al., 2015 for a review) measured with the AAI classifications and self-reported attachment orientation dimensions. Notably, the review also revealed considerable variation and inconsistencies in methodology, sample, and findings across studies. In the context of representational change, this implies that after certain periods of receiving psychotherapy, some individuals were able to more coherently talk about their attachment-related experiences (e.g. Levy et al., 2006; Reiner et al., 2016). The findings from Study III indicate that, with the methodological apparatus and the experimental paradigm used, it is possible to investigate whether implicit components of the IWMs also bear secure characteristics. Thus, potential alterations at the level of implicit knowledge and relational expectations may possibly be investigated at a neural level, marked by components, such as the N400.

Strengths, Limitations, and Future Directions

The dissertation handled some of the current questions in attachment field with rigorous experimental design with ecologically valid stimuli material. Empirical work has presented that scripted knowledge of attachment can be measured in novel modalities, it is indeed linked to expectations regarding availability of support and introduced a paradigm that captures predictive functioning of this knowledge via neural activity. Additionally, it joins and contributes to the conversation on the resistance of avoidance-related defenses and effectiveness of type of interventions.

Besides their contributions, some limitations of the studies should be acknowledged. Study I used the coping strategy of seeking emotional support as a theoretically related construct to attachment, to test criterion validity of the novel modalities. Even though a trend appeared between the conventional modality and using emotional support, this was not the case for the two novel modalities tested in Study I. The main issue concerning Study I was the comparability of the novel and conventional modalities, and it presented useful initial findings, such as relative modality-invariance, to construct future studies upon. Perhaps a more implicit (as

opposed to self-reported coping strategies) construct can be used to test predictive power of the novel modalities in the future.

Even though attachment anxiety was included in Study II, the focus was mainly on attachment avoidance. This was partly because the ambivalence of schemas characterized by attachment anxiety (e.g., reflected in greater variability in scripted attachment knowledge, McLean et al., 2014) may require a different approach than when investigating avoidance-related defenses. Study II also addressed avoidant defenses without directly measuring *defensiveness* (e.g., through an implicit measure), which was assumed based on the self-reported measure of attachment dimensions. Given the inadequacy of self-report measures in inferring implicit processes (e.g., see van IJzendoorn & Bakermans-Kranenburg, 2024) such as attachment-related defenses, future studies should also administer implicit measures to complement the aspects that self-reports cannot address. Perhaps implementation of recently introduced scoring system of word-prompted narratives (Groh & Haydon, 2024) that can capture deactivation would be a suitable alternative as an implicit assessment.

Another issue worth addressing in the future is the level of information processing (e.g. attentional orientation) that can in fact be influenced by priming. A recent meta-analysis (Gillath et al., 2022) shows that attachment security priming has a larger effect on affective outcomes compared with behavioral or cognitive outcomes and explains it by the core function of attachment system being emotion regulation (an affective process). Alternatively, a review by Peng et al. (2019) reports that attachment avoidance does not influence early attention stage where orientation happens as opposed to later executive stage where interference is resolved and attention disengages from task irrelevant information (such as in emotional Stroop task, or flanker task). Eye-tracking studies of visual attention confirm the null effects of attachment avoidance on attentional orientation (e.g., Mellor & Psouni, 2021; Sanscartier et al., 2020). Disentangling the level of information processing (e.g., attention) at which attachment-related patterns manifest, and priming manipulations influence, can inform what kind of intervention methods could lead to effective change.

Exploratory analyses in Study III revealed an LPP-like effect, which was challenging to interpret for a few reasons. LPP has been related to a few processes such as motivational engagement with emotional stimuli and emotional regulation, so valence and emotional value of stimuli material are central. It is, however, difficult (if not impossible) to separate attachment context from its emotional content, given that emotional interchange during secure base – safe haven interactions is an essential component of attachment schemas (Psouni & Apetroaia, 2013; 2014). Future studies should design appropriate controls to disentangle this question.

The current paradigm of Study III used only two types of ending (supportive and non-supportive) within each narrative context. This paradigm would benefit from adding a “neutral” ending as a more reliable control condition to contrast valenced endings with. Importantly, analyzing neural activity in response to different relations depicted in narratives in the future can contribute to the understanding of processes of generalization. Both Study I and Study III used experimental paradigms with stimuli that included a range of different close relationships. This methodological choice was deemed necessary to enhance the ecological validity of the stimuli material. Study I showed convergence of attachment narratives in a single underlying construct, independently of depicted relationships (and test modality), and preliminary analysis in Study III hinted at a meaningful pattern related to relational focus. Thus, these study paradigms may allow further understanding of relational specificity/generalizability of attachment knowledge through neural activity.

Conclusions and Contributions

The findings of this dissertation contribute to the attachment field in several meaningful ways. They present initial evidence for the feasibility of flexible, location-independent assessment of scripted attachment knowledge in modalities compatible with everyday means of communication. This broadens the reach of data collection by making it possible to reach populations across physical borders to various cultural groups, clinical or high-risk samples. Furthermore, the findings regarding avoidance-related defensive strategies acknowledge the complexity of such defenses, at which level they manifest, and possible influence of experimental manipulations. While confirming some of the existing patterns in attentional processes, findings also encourage careful consideration for potentially unexpected affective outcomes of priming-based interventions. Finally, Study III introduced an ecologically valid neurophysiological paradigm for studying attachment-schema-congruent prediction making. The findings of it provide clear neurophysiological evidence supporting the theoretical assumptions regarding content and function of attachment schemas. This is a meaningful step towards integrating fundamental assumptions of attachment theory with neurophysiological approaches to the study of (social) cognition. A particular strength of this work lies in its methodological breadth, using behavioral, cognitive, and neural levels of analysis in efforts to deepen our understanding of the nature and functions of implicit attachment knowledge, and the limits of the malleability of its related defenses.

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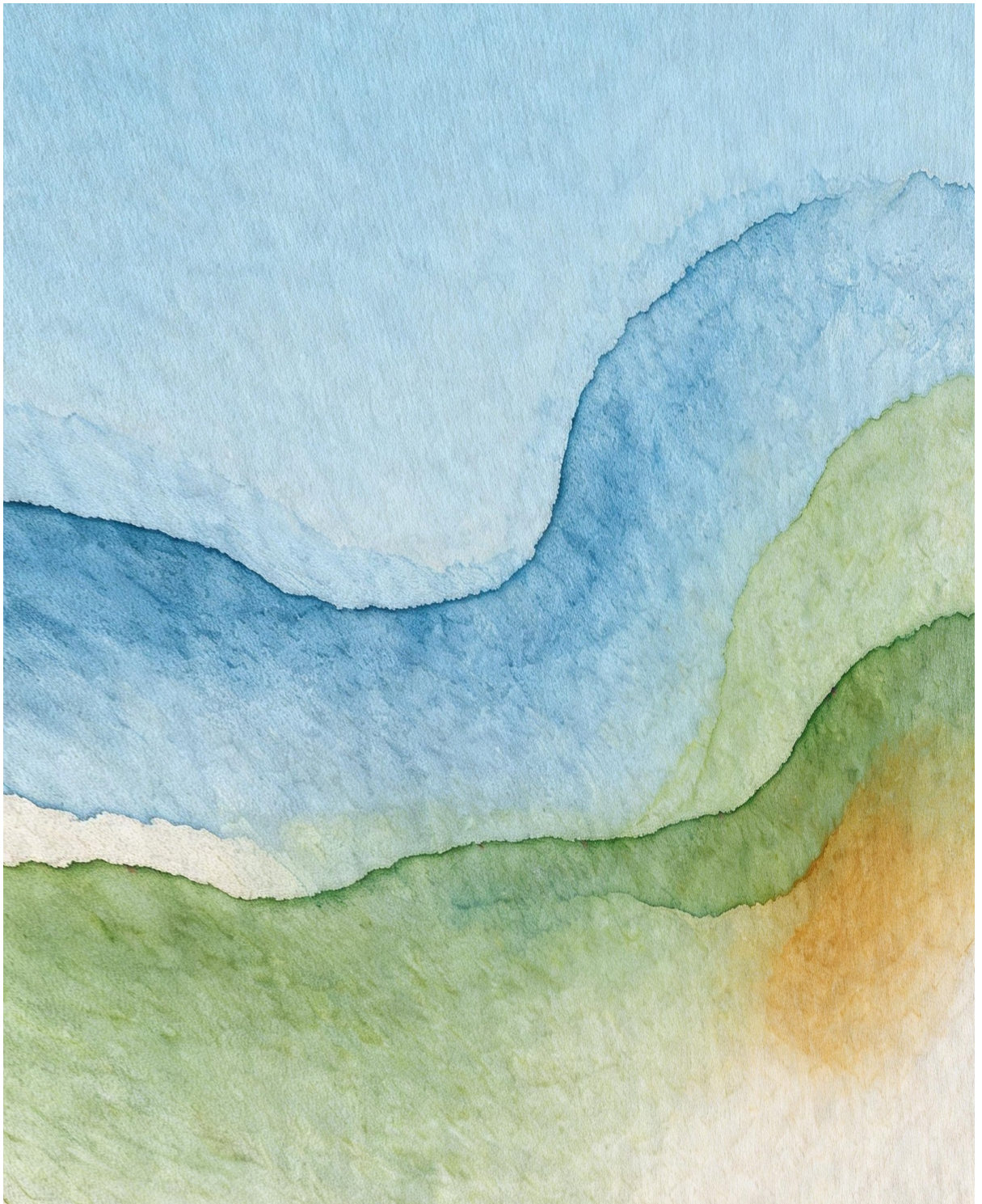
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ISBN 978-91-8104-998-5



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