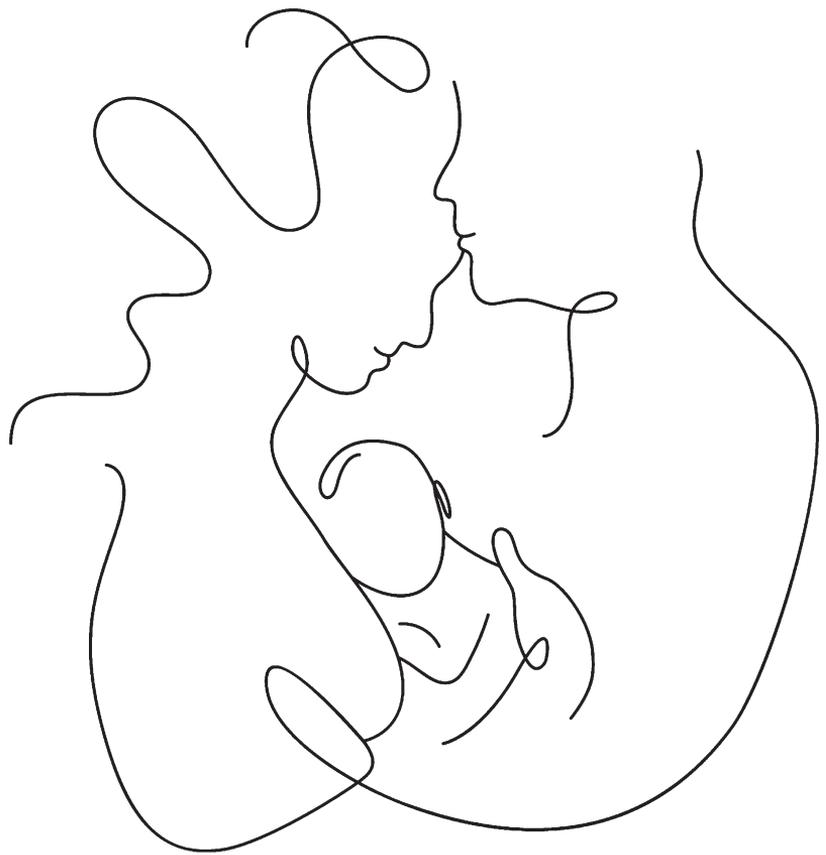




**TURUN
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**ALEXITHYMIC TRAITS
AND EARLY PARENTING
– PARENTAL REFLECTIVE
FUNCTIONING, POSTPARTUM
BONDING AND CAREGIVING
BEHAVIOUR**

FinnBrain Birth Cohort Study

Hanna Ahrnberg



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FinnBrain Birth Cohort Study

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To my daughters Aino and Aada

UNIVERSITY OF TURKU

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ABSTRACT

Alexithymic traits with characteristics of difficulties in identifying and describing feelings and externally oriented thinking may potentially affect emotion-linked domains of parenting such as parental reflective functioning, postpartum bonding and caregiving behaviour. Studies on parental alexithymic traits are still scarce. Especially knowledge concerning parental alexithymic traits and their influence on parenting during the first year of a child's life, as well as studies including fathers are lacking.

This dissertation is part of the FinnBrain Birth Cohort Study. The aim of this thesis was to explore the associations between parental alexithymic traits and emotion-linked parenting abilities, i.e., parental reflective functioning and postpartum bonding by self-report questionnaires as well as maternal alexithymic traits and caregiving behaviour by observational method.

The main findings showed that higher levels of parental alexithymic traits were associated with weaker parental reflective functioning and more problems in postpartum bonding in both mothers and fathers. Furthermore, maternal alexithymic traits were shown to associate with less sensitivity and more hostility in caregiving behaviour. The three dimensions of alexithymic traits were differentially associated with the studied dimensions of parenting. Further, the associations varied by parental sex. These findings support for the idea of dimensionality of alexithymic traits.

The results imply that alexithymic traits may influence parenting but future studies are needed to establish the causality of the associations, as well as the underlying mechanisms. Alexithymic traits, as a relatively common personality construct, could be considered as potential risk factors for sub-optimal parenting among the general population. Screening for alexithymic traits could be considered a possible route for detecting families that would benefit from more support in their emotional skills e.g., in maternity clinics and primary health care.

KEYWORDS: Alexithymic traits, Parenting, Parental reflective functioning, Postpartum bonding, Caregiving behaviour

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TIIVISTELMÄ

Aleksityymiset piirteet, joihin liittyy vaikeus tunnistaa ja kuvata tunteita sekä ulkokohtainen ajattelutapa, voivat olla yhteydessä tunteisiin liittyviin vanhemmuuden osa-alueisiin, kuten vanhemman reflektiokykyyn, varhaiseen kiintymisen kokemukseen ja hoivakäyttäytymiseen. Vanhemman aleksityymisiä piirteitä koskevaa tutkimusta on kuitenkin varsin vähän, ja erityisesti tietoa vanhemman aleksityymisten piirteiden merkityksestä vauvuuden aikana ei ole juuri lainkaan. Lisäksi tähänastinen aleksityymiaan liittyvä vanhemmuustutkimus on keskittynyt pitkälti äiteihin, minkä vuoksi isien aleksityymisten piirteiden yhteyksistä heidän vanhemmuuteensa ei tiedetä juuri mitään.

Tämä tutkimus on osa FinnBrain-syntymäkohorttitutkimusta. Tämän väitöskirjatyön tavoitteena oli tutkia vanhempien aleksityymisten piirteiden ja vanhempien reflektiokykyyn sekä varhaisen kiintymisen kokemuksen välisiä yhteyksiä kyselylomakkeilla. Lisäksi tavoitteena oli tutkia äitien aleksityymisten piirteiden yhteyttä hoivakäyttäytymiseen havainnointitutkimuksen menetelmin.

Tutkimuksen keskeinen tulos oli, että sekä äitien että isien aleksityymiset piirteet olivat yhteydessä heikompaan vanhemman reflektiokykyyn sekä ongelmallisempaan varhaisen kiintymisen kokemukseen. Lisäksi äitien aleksityymiset piirteet olivat yhteydessä heikompaan sensitiivisyyteen ja voimakkaampaan vihamieliseen käyttäytymiseen osana hoivakäyttäytymistä. Eri aleksityymian osa-alueet olivat yhteydessä eri vanhemmuuden osa-alueisiin ja äitien ja isien välillä havaittiin eroja siinä, mikä aleksityymian osa-alue selitti kutakin yhteyttä vahvimmin. Tämä tukee aiempaa tutkimustietoa aleksityymian moniulotteisuudesta.

Tutkimustulokset viittaavat siihen, että vanhemman aleksityymiset piirteet saattavat olla yhteydessä vanhemmuuden laatuun, mutta yhteyden kausaliteettia tai sitä selittäviä mekanismeja ei vielä tunneta. Näin ollen, aleksityymian ja vanhemmuuden välisiä yhteyksiä tulee tutkia lisää. Jatkossa on hyvä arvioida, olisiko vanhempien aleksityymisten piirteiden seulonta mahdollisesti hyödyllistä osana ns. riskiperheiden tunnistamista esimerkiksi neuvolajärjestelmän kontekstissa.

AVAINSANAT: Aleksityymiset piirteet, vanhemmuus, vanhemman reflektiokyky, varhainen kiintymisen kokemus, hoivakäyttäytyminen

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Abbreviations

ADHD	Attention-Deficit/Hyperactivity Disorder
APRQ	Alexithymia Provoked Response Questionnaire
AQC	Alexithymia Questionnaire for Children
ASD	Autism Spectrum Disorder
BAP	Broader Autism Phenotype
BVAQ	Bermond-Vorst Alexithymia Questionnaire
CNS	Central Nervous System
DIF	Difficulty Identifying Feelings
DDF	Difficulty Describing Feelings
EAS	Emotional Availability Scale
EOT	Externally Oriented Thinking
EPDS	Edinburgh Postnatal Depression Scale
FEEL	Facially Expressed Emotion Labeling
fMRI	functional Magnetic Resonance Imaging
GLM	General Linear Model
HPA	Hypothalamic-Pituitary-Adrenal
PBQ	Postpartum Bonding Questionnaire
PRFQ	Parental Reflective Functioning Questionnaire
PRFQ-Fi	Parental Reflective Functioning – Finnish version
SAM	Sympathetic Adrenal Medullary
SCL-90	Symptom Checklist 90
TAS-20	The 20-item Toronto Alexithymia Scale
TSIA	The Toronto Structured Interview of Alexithymia
VIF	The Variance Inflation Factor

List of Original Publications

This dissertation is based on the following original publications, which are referred to in the text by their Roman numerals:

- I Ahrnberg, H., Pajulo, M., Scheinin, N.M., Karlsson, L., Karlsson, H. and Karukivi, M. Associations between parental alexithymic traits and self-reported postnatal reflective functioning in a birth cohort population. *Psychiatry Research*, 2020; 286, 1–8.
- II Ahrnberg, H., Pajulo, M., Scheinin, N.M., Kajanoja, J., Karlsson, L., Karlsson, H. and Karukivi, M. Alexithymic traits and parental postpartum bonding. Findings from the FinnBrain Birth Cohort Study. *Scandinavian Journal of Psychology*, 2022; Vol. 63(2), 100–108.
- III Ahrnberg H., Korja R., Scheinin NM., Nolvi S., Kataja E-L., Kajanoja J., Hakanen H., Karlsson L., Karlsson H. & Karukivi M. Maternal Alexithymic Traits Are Related to Lower Maternal Sensitivity and Higher Hostility in Maternal Caregiving Behavior—The FinnBrain Birth Cohort Study. *Frontiers in Psychology*, 2021; Vol 12: 1–12.

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1 Introduction

Rather convincing knowledge prevails on parenting's association with the positive and negative outcomes of the child and parent-infant interaction (e.g., Sirois and Bernier, 2018; Smith et al., 2007; Yoo et al., 2006). Much less is known about the reasons why parents respond to their child's emotional needs the way they do. A parent's emotional capacity is an important factor in influencing the quality of parenting and the interaction between the parent and child, as well as both the parent's and child's well-being (e.g., Hughes and Leekam, 2004; Luyten et al., 2017). The first year of a child's life is especially important: many socioemotional developmental milestones as well as the formation of attachment style and the development of emotion regulation occur during this time (Bretherton, 1992; Morris et al., 2017; Zubler et al., 2022).

Alexithymia is a personality construct characterised by difficulties in identifying and describing one's own feelings as well as a concrete, externally oriented cognitive style (Sifneos, 1973). High levels of alexithymic traits as a whole construct, but also as specific alexithymia dimensions, could potentially negatively influence emotion-linked parenting abilities. Alexithymic traits are reportedly associated with various factors that potentially complicate interpersonal relations, which a parent-infant relationship also profoundly is. The factors that may act as underlying mechanisms for the possible associations between alexithymic traits and parenting are e.g., altered emotion regulation (e.g., Luminet et al., 2006; Swart et al., 2009, Preece et al., 2017), emotion-related memory functions (e.g., Luminet et al., 2006; Terock et al., 2019), and deficits in expressing facial mimicry (e.g., Franz et al., 2021) as well as in interpreting facial expressions (e.g., Grynberg et al., 2012; Jongen et al., 2014). Furthermore, alexithymic traits are linked with altered emotional language (e.g., Hobson et al., 2019; Welding and Samur, 2018) and altered behaviour in interactions (e.g., Luminet et al., 2021b). What may be the most interesting is not so much alexithymic traits as a whole construct, but rather that the different dimensions of alexithymic traits are shown to associate uniquely with the different phenomena of emotions and cognitions (Luminet et al., 2021b).

Despite the relatively long history of alexithymia research, there is still a gap of knowledge concerning the associations between parental alexithymic traits and

parenting abilities. To date, only few studies on the topic have been conducted, mostly among mother-toddler dyads or mothers with school-aged children (Porreca et al., 2020; Tarantino et al., 2018; Yürümez et al., 2014). Knowledge of parental alexithymic traits and parenting abilities during the first year of life is practically nonexistent. Another gap is in research on fathers' alexithymic traits and parenting because most of the studies have been conducted among mothers, which to date, is still the tendency in parenting research in general.

The etiology of alexithymia is probably diverse but remains still unclear to some extent. However, the development of alexithymic traits is reportedly associated with many neurological (e.g., altered functioning or structures of the limbic system) and environmental factors (e.g., childhood adverse events and low socioeconomic status) as well as common psychopathology (e.g., depressive symptoms) (Karukivi and Saarijärvi, 2014). All of these factors are reported to associate with problems in emotion-linked parenting abilities, such as parental reflective functioning (Krink et al., 2018; Luyten and Fonagy, 2015), postpartum bonding (Bieleninik et al., 2021; Muzik et al., 2013) and caregiving behaviour (Leung et al., 2020, Tronick and Reck, 2009). Lastly, alexithymic traits are potentially associated with intergenerational transmission of problematic parenting, because literature suggest that alexithymic traits are associated with inadequate parenting (Evren et al., 2009) and emotional neglect (Aust et al., 2013). It is generally acknowledged that the experience of suboptimal parenting is a significant risk factor for such parenting abilities later on in one's own parenting style (Lehnig et al., 2019). Indeed, the literature suggests that a negative parenting style could be passed on from one generation to another e.g., through weaker sensitivity in caregiving behaviour (Mielke et al., 2016).

Alexithymic traits are relatively common in the general population (Franz et al., 2008; Mattila, 2009). The parent-infant relationship is potentially modifiable (Biringen et al., 2014), and positive recollections of one's own upbringing and positive parenting are also reportedly transmitted through generations (Hall et al., 2015; Hofferth et al., 2012). Thus, focusing attention on parenting abilities in potential risk groups, such as mothers and fathers with high levels of alexithymic traits, seems justified. Therefore, if parental alexithymic traits are indeed associated with problems in emotion-linked parenting abilities in a way that could be ameliorated by interventions, it is important to study this relation and further discuss possible future clinical implications.

2 Review of the Literature

2.1 Alexithymia

2.1.1 Emotions and cognitions

One of the still unanswered but essential questions is related to the definition of emotion itself. This is because a clear consensus has not yet been reached on what emotion *de facto* is, despite wide multidisciplinary interest in studying the topic (Siegel, 2012). Out of many attempts, two main approaches particularly have been described in the literature to define emotion. One is keen to adopt a categorical approach, classifying several distinct emotions, such as happiness, sadness, anger and fear (Eysenck, 2016). Another approach relies on a dimensional description that argues for two uncorrelated dimensions that are described in research using a couple of different terms, e.g., dimensions of misery-pleasure and arousal-sleep (Barret and Russell, 1998) or dimensions of positive affect and negative affect (Watson and Tellegen, 1985). As knowledge has increased over time, these approaches do not seem thorough enough to describe emotion as a phenomenon.

Hence, a more modern concept within emotion research has brought a more dynamic approach into the description of emotions. According to Siegel's (2012) interpersonal and integrative aspect, emotion could be described as an integrative process, *a flow*, involving a pathway from a stimulus evoking particular reactions in thought, feeling and behaviour (Figure 1). Thus, emotion should be seen as different than a *feeling*, i.e., the awareness of an emotional state; *mood* i.e., the overall tone of the emotional state of mind; or *affect*, i.e., the external expression of an internal emotional state. With the idea that emotion is something that *moves* us within the flow, it seems logical that emotion as a term is derived from the Latin word *moveo*, that means 'to agitate' or 'to move' (Siegel, 2012). Indeed, this origin underlines emotion as a dynamic phenomenon.

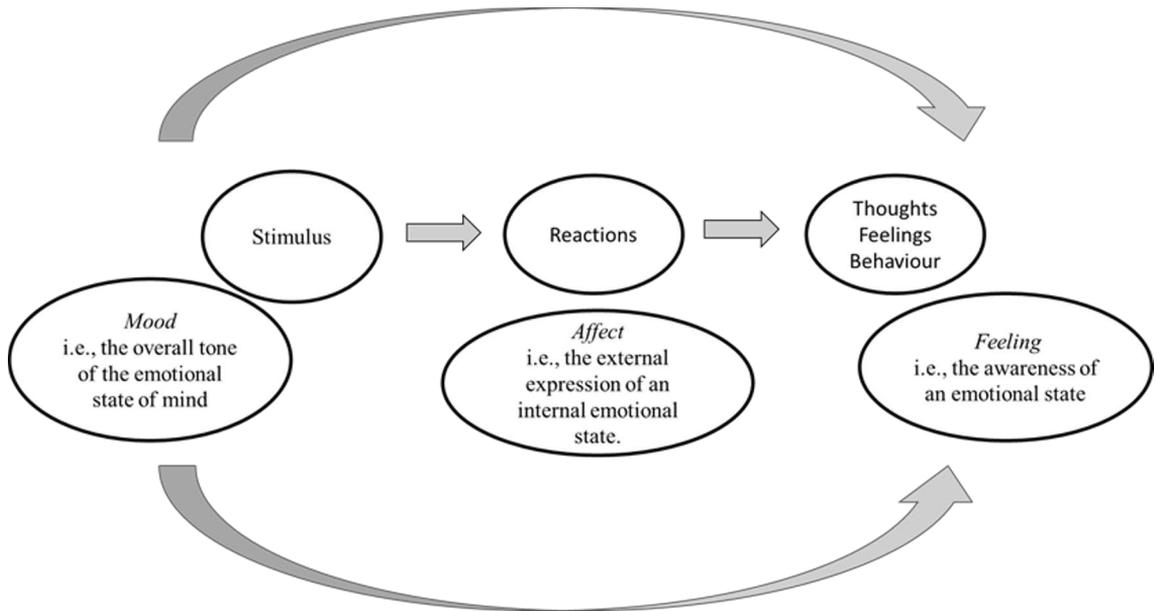


Figure 1. Flow of emotion as an integrative process

The approach of exploring emotions as a dynamic process has linked emotions, cognitions and personality more firmly together. Instead of categorical or simplified descriptions of emotions, the objective has been directed towards a more integrative understanding of the relations among these three entities. However, systematic research on the interrelations of emotions and cognitions is relatively new to the field, arising in the mid 1990s (Luminet et al., 2021a). The focus on personality traits especially has increased knowledge on within-person variations in the way one interprets and reacts to stimuli, leading to the flow of an emotional process. Furthermore, the clinical contribution of research at the interface of emotions, cognitions and personality traits has aimed at studying possibilities to influence this process by cognitive and behavioural tasks, for example, within individuals with psychopathology (Joormann, 2019; Robinson et al., 2019).

Why are emotions needed and what is the significance of emotions in a world of logic? Numerous studies have shown that both in patient populations and within the general population, changes in emotional capacity are linked with general well-being. Experiencing positive emotions is related to better general health and better social capacity whereas negative emotions are associated with increased risks for both psychiatric and somatic illness (Lyubomirsky et al., 2005; Suinn, 2001). Emotions underlie our everyday actions, reactions and interactions with others. As the most primitive function, emotions have the task to direct survival. Within the great amount of information that we receive all the time, emotions direct our

attention to the information most relevant to our needs. Thus, emotions are firmly connected with cognitions; there is not one without the other. Indeed, studies with patients suffering from cerebral damage, e.g., due to trauma, have shown that diminished emotions also complicate the ability to make decisions even in the simplest matters (Bechara et al., 2000). Therefore, it is an indisputable fact that emotions are essential for each one of us in our everyday lives.

2.1.2 Definition and history of alexithymia

If it is not too bold to say, almost everyone can identify with sometimes not knowing what they are feeling. The phenomenon seems common and normative, but if it is the case most of the time, it may naturally cause confusion and distress to oneself and others. To describe the phenomenon of this emotional blindness, Peter Sifneos (1973) coined the term ‘alexithymia’ nearly 50 years ago. It is derived from the Greek language – *a*=lack, *lexis*=word and *thymos*=emotion – and therefore it is usually defined as having ‘no words for feelings’. Despite the straight translation referring to lack of words for emotions, the phenomenon seemed more complex from the very beginning.

The need to conceptualise alexithymia arose when the psychiatrist and psychoanalyst Peter Sifneos became aware of numerous observations of patients that had somatic complaints but remarkable difficulty in describing their feelings and inner sensations. These patients lacked imagination as well as introspection, and furthermore, they had a concrete, externally oriented cognitive style. A psychoanalytic treatment approach did not work well on them, due to their complicated connection to their own emotional world (Taylor, 1984). Naturally, the observations were not new themselves; similar findings had been reported in 1920s by Groddeck (1923) and even described as unsolved psychological conflicts in the 1950s by Alexander (1943). Even the concrete way of thinking of these patients was of interest already in the 1950s in the research of Marty and de M’Uzan (Luminet et al., 2021a). However, Sifneos was the first to gather these observations systematically with the aim of exploring them more closely. Later on, these patients were described as ‘psychosomatic’ to underline their typical representation of a complex set of symptoms with both prominent somatic and psychological features that seemed to be associated with each other (Luminet et al., 2021a).

Alexithymia research quickly gained interest among psychiatrists and psychologists, and soon it was a central theme in two international conferences, in London (1972) and in Heidelberg (1976). As a result of these meetings, the concept of alexithymia was widely discussed. To describe the core features of it, the term ‘emotion’ was agreed to be more accurate in describing the somatic aspects of alexithymia whereas the term ‘feeling’ was preferred to describe the cognitive aspect

(López-Muñoz and Pérez-Fernández, 2020). The first actual studies on psychosomatics and alexithymic traits showed associations between alexithymic traits and substance abuse, compulsive behaviour and bizarre eating behaviour (Taylor, 1984). More recent studies have also focused on many somatic complaints, and alexithymic traits have been associated with various somatic problems, such as cardiovascular diseases e.g., essential hypertension (Grabe et al., 2010), endocrinological diseases e.g., diabetes mellitus (Chatzi et al., 2009) and autoimmune disorders such as psoriasis (Picardi et al., 2005), to mention some. In addition, alexithymic traits have been linked with unfavourable health behaviours such as alcohol and tobacco use (Kajanoja et al., 2018). Support for the hypothesis that emotions indeed have a physical dimension has been provided by Nummenmaa et al., (2014) who have constructed maps of bodily sensations associated with experienced emotions.

In the nearly 50 years of research on alexithymia, the scope of studies has expanded from concerning mainly psychosomatics into a broad range of interests across, for example, psychiatric symptomology and disorders, neuropsychiatric disorders and interpersonal relations. Alexithymia has been studied widely within patient populations as well as in general population samples, and throughout the lifespan from childhood to elderly age. Despite the relatively long history of alexithymia research, much seems to be still unexplored. The clinical implications and treatment options of alexithymia especially remain largely unknown (Samur et al., 2013).

2.1.3 Dimensionality and subtypes of alexithymic traits

Findings from alexithymia studies with both patient and general population studies, together with clinical observations, have made it evident that individuals with alexithymic traits are indeed not all cut from the same cloth. Bermond et al. (2007) were the first researchers to discuss whether alexithymia could be divided into different subtypes. This hypothesis was constructed on the findings that alexithymia included two main components: cognitive peculiarities with problems in identifying, describing and analysing emotions, and an affective component with, e.g., problems in emotionalising and fantasizing. The researchers classified alexithymic individuals into two types: Type I, with features of both cognitive and affective peculiarities and Type II, with only the cognitive domain. This approach gained interest from other researchers later on, and the division has been used in various studies. However, very few cluster analyses have been performed to explore the existence of actual subtypes, and the evidence is thus not robust.

Bagby et al. (2009) performed the first cluster analysis with the Bermond-Vorst Alexithymia Questionnaire (BVAQ) but did not gain support for the hypothesis of

alexithymia subtypes. In contrast, Chen et al. (2011) examined the possible subtypes by using the 20-item Toronto Alexithymia Scale (TAS-20, Bagby et al., 1994a; Bagby et al., 1994b) with a cluster analytical approach. They found three alexithymia subtypes: an introvert-high group with high levels of Difficulty Identifying Feelings (DIF) and Difficulty Describing Feelings (DDF) traits, an extrovert-high group with high levels of Externally Oriented Thinking (EOT) and a general-high alexithymic group with high levels of DIF, DDF and EOT. More recently, a cluster analysis performed by Kajanoja et al. (2017) explored possible subtypes by using TAS-20. Their results suggested that two alexithymia subtypes could exist: type A with high levels of Difficulty Identifying Feelings and type B with high levels of Externally Oriented Thinking.

Interestingly, in the study by Kajanoja et al. (2017), type A individuals also had prominent depressive and anxiety symptoms, whereas type B did not suffer from significant psychiatric symptoms. These findings were in line with previous studies implying that difficulties in identifying feelings and describing feelings would be associated with common psychopathology like depression and anxiety, whereas externally oriented thinking would not (Conrad et al., 2009; Grabe et al., 2004a). On the other hand, externally oriented thinking has been associated with negative traits especially in social interaction, such as deficits in empathy (Grynberg et al., 2010) and social detachment (Vanheule et al., 2011). In addition, externally oriented thinking has been linked with less attention to negative emotional stimuli accompanied by decreased physiological responses (Davydov et al., 2013). Together these findings suggest a possible downregulation of negative affect in individuals with high levels of externally oriented thinking and a pronounced negative affect in those with high levels of difficulty in identifying and describing feelings.

As a conclusion, it could be stated that some evidence has been provided that alexithymia subtypes would meaningfully exist. However, to date the methods of exploration have varied, and more studies are needed to establish the findings more firmly. More importantly, future investigations are needed to study the clinical significance of these possible subtypes. Since TAS-20 has reached its position as the gold standard for measuring alexithymic traits, most of the discussion regarding alexithymia dimensions has included the differentiation of three dimensions: DIF, DDF and EOT (Bagby et al., 1994a; Bagby et al., 1994b). According to a recent integrative review on cognitive-emotional processing in alexithymia, it seems that EOT is more likely to be associated with deficits in this processing, whereas DIF and DDF are more often associated with over-responding. Thus, different response patterns can be detected depending on the dimension of alexithymic traits. Hence, in many cases, it is justified to explore alexithymic traits dimensionally rather than only as an overall level of alexithymic traits. (Luminet et al., 2021b).

2.1.4 Etiology

Alexithymia research has reached quite a lot of interest from different areas due to alexithymia's relations with many somatic and psychological symptoms and disorders. However, there is still no clear picture of the etiology of alexithymia. Many studies have examined the potential etiological pathways for how and why alexithymic traits become evident in certain individuals. To date, the development of alexithymia has been associated with environmental, neurobiological and genetic pathways (Karukivi and Saarijärvi, 2014). In the literature, the social and environmental factors related to alexithymia have been studied the most extensively, but there are a few studies suggesting alexithymia could be to some extent a genetically determined personality feature (Jørgensen et al., 2007). Furthermore, the relatively well-established associations between alexithymic traits and neuropsychiatric disorders have led to growing interest in finding the neurobiological factors potentially associated with the development of alexithymic traits.

2.1.4.1 Genetic background

The possible genetic background of alexithymic traits has been a topic of discussion from early on, but not many studies have been conducted to explore the heritability of alexithymia or specific genes linked to it. In addition, most of the studies suffer from small sample sizes and very limited age ranges of the participants. The first study to examine the heritability of alexithymic traits was conducted in the late 1970s (Heiberg and Heiberg, 1977; Heiberg and Heiberg, 1978). This study included only 33 twin pairs and an alexithymia measurement that is not considered a valid instrument according to current standards. However, the researchers' conclusion was that alexithymic traits would be to some extent under genetic influence. The next attempt to examine alexithymic traits in a twin study was by Valera and Benenbaum (2001) a couple of decades later. Similarly, their sample size was modest, consisting of only 77 twin pairs, but the measure they used to detect alexithymic traits was the 20-item Toronto Alexithymia Scale, which is still considered a valid instrument for the purpose. The results suggested that there would be differences between the TAS-20 dimensions and the underlying influence of genetic factors: they reported that EOT would be more strongly associated with genetic factors than DIF and DDF (Valera and Benenbaum, 2001).

The first larger twin study with a more convincing sample size of 8785 twins was performed by Jørgensen et al. (2007). Again, TAS-20 was used, but in contrast to the findings of Valera and Benenbaum (2001), genetic influence was detected as significant across all of the three dimensions of alexithymia (DIF, DDF and EOT). In addition, alexithymic traits were explored categorically, and genetic background

was reported to associate with a high level of alexithymic traits (TAS-20 total score >60 points). The heritability rate was evaluated to be as high as 30%–33%. Shared environmental factors were evaluated to account for 15%–20% and nonshared environmental factors for 47%–55% of the variance in TAS-20 total scores. In addition to the sample size and inevitable strength of the study was the quite large age range (20–71 years) of the participants (Jørgensen et al., 2007). The most recent study to complement the previous findings was conducted among 729 Italian twins by Picardi et al., (2011) with very similar findings to those reported by Jørgensen et al. (2007).

Even though heritability studies are conducted within study samples of twin pairs, which is understandably considered the gold standard for measuring heritability, they are still subject to criticism. The issue is whether they are able to detect well enough the differences of environmental factors' influence between monozygotic and dizygotic twins. There is evidence that environmental factors would be more similar for monozygotic twins compared to dizygotic twins (Horwitz et al., 2003), which should also be taken into account within heritability studies.

There are only a handful of studies with the objective of exploring specific genes that would be linked with alexithymic traits. A consensus has not been reached on any specific gene variant, and the few obtained results remain unreplicated (Karukivi and Saarijärvi, 2014). To date, the interest has been projected towards, e.g., the serotonin transporter-linked promoter region (Kano et al., 2012), brain-derived neurotrophic factor (Walter et al., 2011), catechol-O-methyltransferase genes (Ham et al., 2005) and oxytocin receptor gene polymorphism (Koh et al., 2015). For example, a recent study by Terock et al. (2021) investigated the association between alexithymic traits and serotonin receptors 5-HT1A and 5-HT2A but did not find a significant association. In contrast, Li et al. (2020) found evidence for an association between 5-HT2A and a higher alexithymia score. All in all, the genetic background of the development of alexithymic traits is still mostly an unanswered question and, hopefully, in the scope of future studies to come.

2.1.4.2 Neurobiology

Before the 1990s and the development of modern functional neuroimaging, studies on the neural correlates of emotions were mostly restricted to patient populations, especially those with brain damage. Nowadays, imaging studies, e.g., positron-emission tomography (PET) studies or functional magnetic resonance imaging (fMRI), have provided evidence for the notion that changes in emotional processing can be detected as changes in brain functioning.

In the 1980s, the concept of the triune brain, i.e., the failure of communication between the visceral brain and the neocortex, was linked to etiological research of

alexithymia. It was hypothesised that the connective deficit would prevent the processing of emotional information, thus leading to activation of the autonomic nervous system. (Lesser, 1981.) Another early theory of the neurobiological explanation of alexithymia relied on the assumption of inadequate interhemispheric transfer of information. It was based on the observations of so-called split-brain patients who suffered from cleavage of the corpus callosum after, e.g., severe head trauma. These patients were reported to possess alexithymic traits, with poor emotional vocabulary, flat facial expressions for emotions and a dull fantasy life. (TenHouten et al., 1986.) However, this theory was later disputed due to reports of transcallosal inhibition being both facilitated (Grabe et al., 2004b) and reduced (Romei et al., 2008) in alexithymia. Thus, deficits in interhemispheric transmission hardly provide a straightforward explanation for the development of alexithymic traits.

As time passed, theoretical attempts to explain the neurobiological background of alexithymia moved towards certain central nervous system (CNS) areas associated specifically with emotions and their processing. Some of the CNS regions linked with emotions and their processing are presented in Figure 2. As emotion processing has been observed to be anatomically located dominantly in the right hemisphere (Gazzaniga, 1989), it has been suggested that alexithymic traits could be associated with left-hemisphere dominance (e.g., Parker et al., 1992). However, alexithymic traits have since been linked with an increase in the activity of the right hemisphere (Li et al., 2006). In addition, there are reports of gender differences in hemispheric dominance in the expression of alexithymic traits (Lumley et al., 2000). A recent study by Vicario et al. (2021) presented results supporting the hypothesis of alexithymic traits being linked with right-hemisphere deficit. They used a Line bisection task after completion of the TAS-20 questionnaire and found that higher alexithymic traits were indeed associated with a more significant rightward shift in the task. Therefore, they suggest that alexithymic traits would be associated with right-hemisphere deficit and visuospatial abnormality. (Vicario et al., 2021.)

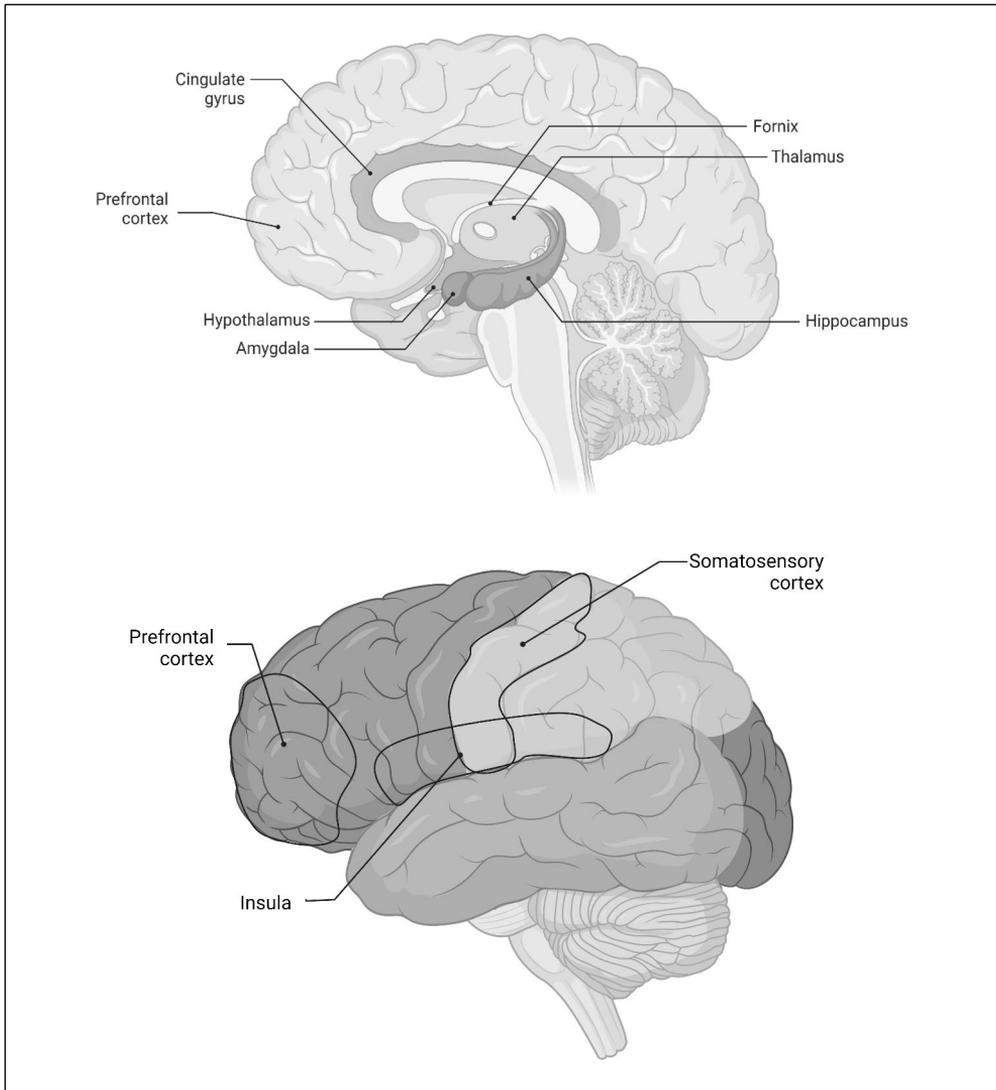


Figure 2. Some key central nervous system regions typically associated with emotions and their processing. The limbic system, including e.g., hippocampus and amygdala, is a collection of structures involved in various behavioural and emotional responses. (created with Biorender.com)

Concerning the hemispheric hypotheses, it should be acknowledged that these models fail to see the brain as a plastic organ functioning as a complex network when aiming in determining specific, clear-cut delineation of functions and CNS areas, especially regarding emotion processing. Emotions do not arise specifically from any certain area or part of the brain but are rather formed by interconnected functioning of various CNS areas that are responsible for different tasks in forming

emotion: cognitive processing, emotion regulation and the awareness of emotional state (Kober et al., 2008). The earliest imaging studies with healthy study populations have revealed that emotions are firmly linked with allostatic regulation of bodily functions (hypothalamus) and the CNS regions specialised in processing the received interoceptive and somatic information (sensory cortex, insula, anterior cingulate gyrus).

Emotion perception, processing and regulative functions within the cognitive framework became an interest in alexithymia research in the mid-1990s (Luminet et al., 2021a). Since then, various central parts of the limbic system have been associated with alexithymic traits through modern imaging techniques, but the results are not consistent from study to study. Some of the studies suffer from a relatively low number of participants, which is naturally the case when using expensive technology, such as functional neuroimaging.

A recent meta-analytic review by Xu et al. (2018) gathered the results of structural brain-imaging studies conducted with altogether 2586 individuals with different levels of alexithymic traits. They found that the volumes of left insula, left amygdala, orbitofrontal cortex, and striatum were consistently smaller in alexithymic individuals in comparison to non-alexithymic subjects. (Xu et al., 2018.) In addition, a recent study by Terock et al., 2020) confirmed the earlier findings that alexithymic traits were associated with altered cortical thickness in a general population sample. Studies with functional magnetic resonance imaging have revealed links between alexithymia and various regions associated with emotion processing. Increased activity of the anterior and middle cingulate cortex and decreased activity of the amygdala, fusiform gyrus, right insula, dorsomedial prefrontal cortex and premotor areas have been detected in alexithymic individuals by van der Velde et al. (2015a). They suggested that alexithymic traits could indeed be associated more specifically to perception of emotional stimuli rather than emotion regulation. Furthermore, there are reports of fMRI studies showing the association between lower activity of the amygdala and especially the alexithymia dimensions of DIF and DDF (Kugel et al., 2008; Reker et al., 2010). An interesting finding regarding the possible link between alexithymic traits and somatic complaints has been reported by Karlsson et al. (2008). They performed PET scans with distribution of [15O]H₂O on otherwise healthy alexithymic individuals and controls and were able to detect excess activation of motor and somatosensory cortices and insula in alexithymic individuals (Karlsson et al., 2008).

CNS regions and networks in and between different areas that are associated with emotion perception, processing and regulation are, as presented, numerous. Thus, it is no surprise that many of these regions have been found to associate also with alexithymic traits. Presumably there are no alexithymic traits without a link to CNS functions, but it should be acknowledged that a certain neurobiological phenotype

alone has not been proven as the only or sufficient grounds for the development of alexithymic traits. In addition, the neural correlates of different dimensions of alexithymic traits still remain underexplored.

2.1.4.3 Environmental factors

Among the most studied factors associated with the development of alexithymic traits are environmental factors, such as sociodemographic determinants. Not only the family surroundings present in childhood but even perinatal social situations, such as socioeconomic status, are associated with alexithymic traits in adulthood (Joukamaa et al., 2003). Because the development of alexithymic traits is dependent on many things and not just one, it has been said that the actual presentation of alexithymic traits is a cumulative process starting in childhood and reinforcing itself along with social determinants (Kauhanen et al., 1993). To date, low educational level and low socioeconomic status in general have been linked with alexithymic traits (Franz et al., 2008; Kajanoja et al., 2017; Salminen et al., 1999). Furthermore, a large Finnish prospective study examining the social situation of mothers in the 1960s and alexithymic traits 31 years later in their offspring revealed that living in rural areas and being an unwanted child, or in a family with many other children were associated with alexithymic traits in adulthood (Joukamaa et al., 2003). However, it is clear that much has changed in Finnish society in the past decades and more current knowledge would give us a better understanding of the association between environmental factors and alexithymia nowadays.

2.1.4.4 Childhood adverse events, family environment and experienced parenting

The emotional surroundings in which a child receives primary care and comfort are important for child development. The care and comfort received lay the foundation for children's emotional development and are known to have long-term effects on their adolescence and adulthood (Biringen, 2008; Saunders et al., 2015). The influence of childhood experiences, parenting they experienced, and family environment has been the scope of numerous alexithymia studies. However, most of these studies have been retrospective and relied on self-reports. Interestingly, researchers have recounted that otherwise healthy but alexithymic individuals actually tend to better remember negative experiences and focus on the negative aspects of the past, thus being more prone to recall bias (Barchetta et al., 2021).

The initial interest of association between childhood experiences and alexithymic traits arose from the observation of alexithymic individuals reporting that their caregivers had been emotionally absent and had shown no interest in their

emotional world as children (MacDougall, 1982). To date, evidence suggests that adverse childhood experiences and the parenting experienced do indeed associate with alexithymic traits later in life. However, it is not clear to what extent alexithymic traits can be explained specifically by these factors instead of, for example, genetic predisposition. Kench and Irwin (2000) reported that family environment and especially expressiveness within the family communication would associate with alexithymic traits. In more detail, they described that different aspects of the family environment would be associated with different dimensions of alexithymia. In their study they reported that disengagement, for instance, was associated with difficulties in identifying feelings and externally oriented thinking but not with difficulty describing feelings (Kench and Irwin, 2000).

Because parenting includes many aspects, different factors have been reported to associate with alexithymia. Studies exploring experienced parenting style have especially focused on overprotective parental behaviour. Thorberg et al. (2011) reported an overprotective parenting style combined with a lack of affection and adequate care to be linked with the offspring's alexithymic traits later in life. Similarly, Karukivi et al. (2011) reported an overprotective parenting style to associate with alexithymic traits in adolescent offspring. A maternal overprotective parenting style especially has been linked to DIF and DDF. Based on the results, the hypothesis suggests that overprotection by the parent diminishes the offspring's psychological autonomy and furthermore, their possibilities to express feelings freely (Karukivi et al., 2011; Thorberg et al., 2011). Cuzzocrea et al. (2015) reported in their study that parental alexithymic traits associated with dysfunctional parenting styles, more closely, authoritarian and permissive parenting. They assert that alexithymic traits would predispose the parents to having problems in understanding their children's inner states and therefore to being unable to respond to their needs accurately. Furthermore, they would have to rely on compensating mechanisms to solve difficult family situations, which would tend to be presented as, e.g., an authoritarian parenting style (Cuzzocrea et al., 2015).

Childhood maltreatment is usually described in the literature to include different types: physical, emotional and sexual abuse, and also neglect (Infurna et al., 2016). Recently Terock et al. (2021) reported that childhood trauma, experienced as neglect or abuse, was significantly associated with alexithymic traits. Previously, Joukamaa et al. (2008) reported that childhood physical and emotional abuse, as well as neglect, were associated with alexithymic traits. However, adjusting for concurrent psychiatric symptoms diminished the association for all but physical abuse. Early emotional neglect has been reported to strongly associate with the development of alexithymic traits. Neglect predisposing to the formation of insecure attachment style could potentially influence the development of emotional competence in general, including identifying and describing emotional states. (Aust et al., 2013.) The

evidence for the importance of emotional neglect especially in the development of alexithymic traits has also been supported by Brown et al. (2016) and Kajanoja et al. (2021). Furthermore, insecure attachment style and alexithymic traits are indeed reported to associate with each other (Carpenter and Chung, 2011; Thorberg et al., 2011). A recent study by Honkalampi et al. (2020) revealed that neglect and emotional as well as physical abuse in childhood especially predicted difficulties in describing feelings in adulthood. Similar results were reported by Terock et al. (2021).

Parenting is greatly influenced by the health, and especially the mental health, of the caregiver. Lumley et al. (1996) reported that general psychopathology as well as alexithymic traits of the mother were associated with alexithymic traits in the offspring. More closely, they studied associations between alexithymic traits and family dysfunction. The main findings were that difficulties in identifying feelings were associated with dysfunction in the family's affective involvement, whereas a tendency for externally oriented thinking was associated with deficits in behavioural control. Scarce imagination was associated with inadequate problem solving within the family context (Lumley et al., 1996).

As presented, the emotional environment in which a child is growing is constructed from a complex set of features that alone or together with other features are in multiple studies linked with proneness on developing alexithymic traits later in life.

2.1.5 Epidemiology

In population-based studies, the overall prevalence of categorically defined alexithymia is reported to be around 10% with a slight male overrepresentation. These population-based studies were conducted with the 20-item Toronto Alexithymia Scale and its cut-off point for high alexithymia was a TAS-20 score over 60 points. (Mattila, 2009; Franz et al., 2008.) In these population-based studies, alexithymic traits seem to follow normal distribution, and thus it could be expected that alexithymic traits defined as moderate to high TAS-20 scores would be even more prevalent. In general, it could be concluded that alexithymic traits are quite common features. However, these studies are conducted within Western populations and may not be generalizable to different cultures. It has been suggested that alexithymic traits may be more prevalent among Asian populations (Zhu et al., 2007).

The stability of alexithymic traits has been under discussion for decades, and the concepts of primary and secondary alexithymia were presented in the early stages of alexithymia research (Freyberger, 1977; Lesser, 1981). Primary alexithymia was defined as a stable, developmental trait that would act as an individual risk factor for

diseases. Secondary alexithymia was defined as a result of a physical trauma, e.g., a brain injury complicating emotional processing abilities. This division has been explored in different study designs, from war veterans (Zeitlin et al., 1989) and holocaust survivors (Yehuda et al., 1997) to stroke (Spalletta et al., 2001) and cancer patients (De Vries et al., 2012). Altogether, evidence suggests that organic disease could indeed be the underlying factor for the development of secondary alexithymia. However, it should be acknowledged that these studies have multiple potential confounding factors, all of which are difficult to control for.

Current knowledge suggests that alexithymia as a personality trait is a relatively stable feature (Hiirola et al., 2017; Karukivi and Saarijärvi, 2014). Population-based studies have shown that some differences can be detected throughout the lifespan. According to Joukamaa et al. (2007), the overall prevalence of alexithymic traits among adolescents is similar to that of adults but with less significant gender differences. Alexithymia has also shown to be more prevalent in the early adolescence (Säkkinen et al., 2007), and thus it has been hypothesised whether alexithymia is actually an infantile personality feature that would persist more firmly in individuals with other psychiatric morbidity or with stressful life events. In elderly age, higher prevalence of alexithymic traits has been detected in comparison to the prevalence among adults or adolescents in a large Finnish population-based study by Mattila (2006). However, these results were not congruent with the population-based study by Franz et al. (2008) nor the 11-year follow-up study by Hiirola et al. (2017). In addition, it is not known whether this is really a question of age or generation.

Some debate has concerned alexithymic traits to be state-dependent. A couple of studies have indicated that the decrease of alexithymic traits can be linked to the simultaneous decrease of depressive symptoms (Honkalampi et al., 2001; Spek et al., 2008), but the causality of this association has not been established. Le et al. (2007) explored the stability of alexithymic traits during pregnancy and in the postpartum period. They concluded that alexithymic traits were indeed quite stable, despite the fact that becoming a parent is an emotionally turbulent period of time including various potential stressors among all the positive experiences. Because of the varying expression from individual to individual e.g., Karukivi et al. (2014) state that alexithymia is, similarly to other personality traits, clearly a dimensional, not a categorical concept. However, although alexithymia has been studied quite extensively in adults, there are only a handful of studies concerning alexithymia among children (Donfrancesco et al., 2013). In addition, we are still lacking repetitive results of the stability of alexithymic traits during pre- and postpartum periods and during early parenthood.

2.1.6 Measuring alexithymic traits

As alexithymic traits are not part of clinical diagnostic criteria and thus, do not account for a diagnosable disease or disorder, the most commonly used method to evaluate and capture alexithymic traits as part of an individual's psychological features relies on clinical interviews. In this context, the understanding of one's emotional competence and possible challenges within emotional interaction might be crucial in e.g., psychotherapeutic process and there is rather a need for understanding than naming or scoring these features. However, in research, the need for more reliable measures is understandably relevant. Since conceptualising alexithymia, there has been an effort to develop an appropriate measure to concretely evaluate an individual's alexithymic traits. Sifneos (1973) introduced the Beth-Israel Hospital Psychosomatic Questionnaire that is a 17-item questionnaire filled by a professional during an interview with a patient. However, the inter-rater reliability of this measure was only modest and other measures have been developed from very early on (Sifneos, 1973).

Measuring alexithymic traits and the search for an appropriate measure has been under debate from the very beginning. The main question has been, whether a self-report can be a valid measure of emotional competence among individuals with deficits in their emotional abilities or would e.g., an interview be a more appropriate method (Lane, 1997). The problem regarding self-reports is that individuals high in alexithymic traits may not experience this feature as problematic and thus self-report measures may not be able to identify the centre dilemma of alexithymia. Indeed, the first self-report questionnaires, The Schalling-Sifneos Personality Scale (SSPS, Apfel and Sifneos, 1979) and MMPI alexithymia scale (Kleiger and Klinsman, 1980) suffered from poor internal reliabilities, as well as response and gender biases, and were not regarded as valid instruments for measuring alexithymia in the long run (Bagby et al. 1988).

Despite the critique towards self-report measures of alexithymia, Taylor et al. (1985) developed the 20-item Toronto Alexithymia scale (TAS-20) which has then further developed and remained the gold-standard in measuring alexithymia in both adult and adolescent populations. Initially it consisted of 26 items with four different dimensions: Difficulty Identifying Feelings, Difficulty Describing Feelings, Externally Oriented Thinking Style and reduced daydreaming. After almost a decade, in 1994, the 20-item scale with three dimensions (DIF, DDF and EOT) was introduced and it has been the most widely used measure for alexithymic traits ever since (Bagby et al., 1994a; Bagby et al., 1994b). It has been proven as a reliable and valid measure of alexithymic traits (Bagby et al., 2020). Some critique has been presented towards TAS-20: the EOT dimension suffers from poor internal consistency in some studies (Kooiman et al., 2002; Müller et al., 2003) and after omitting the dimension of daydreaming, the measure lacks a part capturing

imaginative processes of individuals high in alexithymic traits. This can be considered problematic as lack of imagination is a significant component of alexithymic features.

Even though TAS-20 has been used in various studies with adolescent populations, not without critique. Parker et al. (2010) examined the use of TAS-20 among adolescents in different age groups: younger adolescents (13-14 years), middle adolescents (15-16), older adolescents (17-18) and furthermore, among young adults (19-21 years) as a control group. They found significant group differences in the factor structure and psychometric properties and the quality of the measure being weaker for younger adolescents. Therefore, they discussed that TAS-20 should be used with caution among adolescents and only with further adaptation and careful evaluation of the psychometric properties. (Parker et al., 2010.) Measuring alexithymia in children has not been an objective in many studies yet which is why there is still lack of sufficient knowledge of validated methods within this age group. However, for example Donfrancesco et al. (2013) used a modified TAS-20 as an Alexithymia Questionnaire for Children (AQC) constructed by Rieffe et al. (2006) with a reportedly adequate internal consistency and very good test-retest stability.

Another measure, The Bermond-Vorst Alexithymia Questionnaire (BVAQ) was developed in the late 1990s by Vorst and Bermond (2001). This questionnaire included emotionalising and fantasizing as affective components and identifying, describing and analysing feelings as cognitive components. Preece et al. (2017) compared the TAS-20 and BVAQ in a confirmatory analysis and suggested, according to previous criticism, that emotionalising and fantasizing would not present as salient dimensions of alexithymic traits. Therefore, TAS-20 has been suggested as the measure of choice for alexithymia construct. However, BVAQ has been shown to have good psychometric quality (Vorst and Bermond, 2001; de Vroege et al., 2018). Furthermore, Preece et al. (2018) developed the Perth Alexithymia Questionnaire according to their attention-appraisal model, described more in detail in section 2.2.5.2.1. The central thought relied on the hypothesis that DIF and DDF would be representation of deficits in appraisal and EOT would be linked to inadequate attention to emotional response (Preece et al., 2017).

Lastly, a few structured interviews have been developed to assess alexithymic traits, e.g., the Alexithymia Provoked Response Questionnaire (APRQ, Krystal et al., 1986), the Observer Alexithymia Scale (Haviland et al., 2000) and the Toronto Structured Interview of Alexithymia (TSIA, Bagby et al., 2006). However, structured interviews are not that widely reported within research, even though it has been discussed that using both self-report questionnaires and interview methods simultaneously could potentially be recommended (Bagby et al., 2006).

2.1.7 Alexithymic traits and mental health

Several studies have assessed the associations between alexithymic traits and mental health. The literature covers evidence for alexithymic traits to associate, e.g., with substance use disorders (Cruise and Becerra, 2018), eating disorders, (Westwood et al., 2017), personality disorders, such as borderline personality disorder (Deborde et al., 2012), and even psychotic disorders (van der Velde et al., 2015b). In many of the studies it is discussed whether alexithymic traits indeed act as a vulnerability factor for developing a certain disorder, but mostly these notions have remained as hypotheses because causality is hard to demonstrate.

As regards this thesis and its focus on alexithymic traits and parenting, especially relevant are those mental health associations that concern common pathologies during the postpartum period, e.g., symptoms of depression and anxiety. In addition, it is important to acknowledge those disorders that have connections with specific cognitive features of emotion processing that are essential within the interaction of an infant and the primary caregiver, e.g., neuropsychiatric disorders. Therefore, in the following section the focus of mental health disorders and symptomology associated with alexithymic traits is on symptoms of depression and anxiety, neuropsychiatric disorders and experienced stress.

2.1.7.1 Depression, suicidality and anxiety

Alexithymia and depression have been proven to associate with each other in multiple study designs. The prevalence of alexithymic traits was almost 8-fold among depressive individuals compared to non-depressive individuals in a large Finnish population-based study by Honkalampi et al. (2000). Since then, the association between alexithymic traits and depressive symptoms has been detected again in the large population-based sample of the FinnBrain Birth Cohort Study (Kajanoja et al., 2017). A meta-analysis including both patient and general population studies by Li et al. (2015) revealed that alexithymia scores were associated with depression severity. The dimensions of Difficulty Identifying Feelings and Difficulty Describing Feelings particularly were linked to depression.

Some discussion has been presented on the similarity between the characteristics of alexithymia and those of depression and thus the overlapping of these phenomena. However, studies have indicated that alexithymia and depression are indeed distinct, yet to some extent similar and related constructs (Hemming et al., 2019). A more ambiguous question is the causality of the relationship between alexithymia and depression. The vulnerability hypothesis provides the idea that alexithymia as a relatively stable trait would act as a risk factor for developing depressive symptoms, whereas the reactivity hypothesis describes depression as a cause of alexithymia. These hypotheses are accompanied by another possible explanation: that alexithymia

and depression as distinct constructs simply coexist. (Hemming et al., 2019.) As a conclusion, longitudinal studies are still needed to explore the causality of this relationship more thoroughly.

Suicidality and alexithymic traits have been associated both in studies with population-based samples and with patient samples of various psychiatric disorders, such as depression (Hintikka et al., 2004) and substance use disorders (Gratz et al., 2010). The severity of depression has been reported to mediate the relationship between alexithymia and suicidality in various studies (e.g., Hintikka et al., 2004), but there are also studies indicating that the link between alexithymia and suicidality remains significant after controlling for depression (Kim et al., 2016). As suicidality can be provoked by many other psychosocial factors related to personality traits and psychiatric symptomology, no straightforward explanation has been established regarding the links between alexithymia, depression and suicidality.

Furthermore, from among other common disorders with so-called internalising symptoms, different anxiety disorders have been reported to associate with alexithymic traits. De Berardis et al. (2008) reported higher alexithymic traits to associate with more severe symptoms of panic disorder, and Marchesi et al. (2004) reported higher levels of alexithymic traits in both the acute phase of panic disorder as well as after achieving remission. Higher alexithymia scores have also been reported in patients with obsessive-compulsive disorder in comparison to controls (Robinson and Freeston, 2014). In addition, in adolescent populations alexithymic traits have been linked to anxiety in various studies (Karukivi et al., 2010; Paniccia et al., 2018). Karukivi et al. (2015) studied anxiety symptoms and alexithymic traits among expecting mothers and fathers of a birth cohort population. Correlational associations between alexithymic traits and anxiety symptoms were reported for both mothers and fathers. More closely, difficulties identifying and describing feelings in fathers were linked with an increase in anxiety symptoms in the postpartum period suggesting that alexithymic traits should be taken into consideration when assessing psychiatric well-being of fathers-to-be.

2.1.7.2 Neuropsychiatric disorders and other developmental correlates

The emotional deficits described in alexithymia have been linked with emotional difficulties commonly present in different neuropsychiatric disorders, such as autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD). In the literature, alexithymia is reported to be more prevalent among individuals with both ASD (Milosavljevic et al., 2016; Bird et al., 2013) and ADHD (Donfrancesco et al., 2013). Indeed, neurobiological and imaging studies have shown that various shared brain regions and their abnormalities, especially involving the limbic system and frontal cortex, are typical in ASD (e.g., Baum et al., 2015), ADHD (e.g., Batty

et al., 2015; Kasparek et al., 2015) and alexithymia (Goerlich-Dobre et al., 2015; Aust et al., 2014). To some extent, this explains at least the biological dimension of the shared features of emotional difficulties in alexithymia and neuropsychiatric disorders. Additionally, at least one study showed alexithymia to be more prevalent among parents of ASD individuals (Szatmari et al., 2008). Furthermore, Piven et al. (1997) suggested that subclinical features similar to the core symptoms of ASD are more prevalent among close relatives of ASD individuals than in the general population. In the literature, this phenomenon is sometimes referred to as broader autism phenotype (BAP), and commonly seen features are, for example, speech development deficits and difficulties in social interaction that are also linked with alexithymic traits.

Previously it was thought that emotional deficits such as alexithymic traits would present as a core feature of ASD, but current knowledge relies on the interpretation that the overlap is rather a question of co-occurrence of alexithymia and ASD. In the literature the prevalence of alexithymic traits among ASD individuals is between 30% and 60% (Kinnaird et al., 2019). Alexithymic emotional deficits are known to correlate with reduced ability to control, regulate and adapt behaviour, especially in goal-oriented actions (Picardi et al, 2005). Such temperament features that are generally known to influence, e.g., a child's attachment style are also associated to high negative affects commonly seen both in ASD (Adamek et al., 2011) and ADHD (Vissert et al., 2016).

Longitudinal studies have also brought up the association between alexithymic traits and deficits in speech development. Speech development deficits in early childhood are reported to associate with alexithymia in adolescence (Karukivi et al., 2012) and later in adulthood (Kokkonen et al., 2003). Kokkonen et al. (2003) reported that the ability to speak at the age of one year was negatively associated with alexithymic traits, especially externally oriented thinking, in adulthood. The significance of speech development deficits is clear in various social situations. The literature provides extensive evidence of complicated regulation and communication skills beyond just speech in those children who suffer from lagging speech development (Brinton et al., 1999). Problems in speech development are thought to be linked with challenges in other modes of communication, such as facial expressions. Regarding alexithymic traits, a hypothesis has been presented that diverse problems in emotional expression, including speech, would predispose someone to the development of alexithymic traits later in life (Way et al., 2007). However, studies confirming the hypothesis are still lacking.

2.1.7.3 Psychological distress and chronic stress

At the interface of psychology and somatics lies stress, a phenomenon that has also been an interest in alexithymia research due to its psychosomatic nature. Studies have focused on the functioning of the hypothalamic-pituitary-adrenal (HPA) -axis and the sympathetic adrenal medullary (SAM) -axis. The alexithymia-stress hypothesis is based on the idea that diminished emotional awareness predisposes alexithymic individuals to fail in responding to stressful situations adequately. Thus, alexithymic traits would further on lead to chronic stress levels. (Martin and Pihl, 1985). Indeed, individuals with alexithymic traits have been reported to present with increased cortisol responses in socially stressful situations (Hua et al., 2014) as well as lower cortisol awakening responses accompanied by higher perceived stress in socioemotional situations (Härtwig et al., 2013). Terock et al. (2019) studied alexithymic traits and chronic stress and found that especially difficulties identifying feelings were linked with chronic perceived stress. Similarly, alexithymic traits and especially difficulties in identifying feelings, have been associated with the levels of the stress hormone cortisol in pregnant women (Kajanoja et al., 2020). Hence, it could be stated that there is some evidence that alexithymic traits are associated with stress as physiological changes but also as perceived stress.

2.1.8 Treating alexithymia – is there a need and is there a way?

To date, no treatment interventions specifically targeted for alexithymic traits exist. Considering the relatively high prevalence of alexithymic traits in the general population, a discussion is merited on whether these traits should be better recognised or even considered as a specific focus of treatment. On the other hand, exactly because of their high prevalence, one should be careful not to medicalise alexithymic traits when they are not relevant. Still, some researchers have explored the ability of individuals with high alexithymic traits to receive treatment and to benefit from it. For example, psychotherapy often presumes that individuals have a connection to their emotions; therefore, individuals with alexithymic traits may not be considered optimal candidates for receiving this kind of intervention. Reflecting on the origin of alexithymia research, Sifneos himself observed that individuals with alexithymic traits did not seem to respond to a psychoanalytical therapeutic approach well, possibly due to their lack of introspection (Taylor, 1984).

However, there is some evidence that high alexithymic individuals could benefit from psychotherapeutic interventions, e.g., cognitive behavioural psychotherapy (Spek et al., 2008) and group therapy interventions (Beresnevaite, 2000; Ogrodniczuk et al., 2011). Ogrodniczuk et al. (2011) reported that individuals with high levels of alexithymic traits who attended group therapy were able to increase

their emotional capacity, i.e., with better recognition of emotions, and to become more skilled in communicating their emotional states to others. Beresnevaite (2000) studied post-myocardial infarction patients and reported that alexithymic traits were not only reduced significantly during a group therapy intervention, but a lower level of alexithymic traits was also maintained during the two-year follow-up period. In addition, those patients whose alexithymia scores decreased and remained lower during follow-up also experienced fewer cardiovascular symptoms during the follow-up time than those whose alexithymia scores did not change.

Bakan et al. (2020) studied the influence of a nine-week psychoeducation program on the level of alexithymic traits in adolescents. The program was focused on enhancing recognition of emotions and describing their own and other's feelings, thus aiming to increase participants' emotional awareness. A statistically significant decrease in alexithymic traits was found immediately after the program concluded. Despite the promising results, data on the permanence of these changes were unfortunately not reported. Further, with no follow-up, it is impossible to evaluate whether the participants benefitted from the reduction of their alexithymic traits in the first place. Because psychoeducation is typically an easy-access intervention, at least when compared to psychotherapy, more studies regarding psychoeducation programs targeted for alexithymic traits are indeed needed.

Lastly, there are some studies investigating the potential administration of neuropeptide oxytocin to alexithymic individuals. Oxytocin is a key hormone in parenting, and studies have indicated that higher oxytocin levels facilitate parent-child synchrony, sensitivity in parenting and the formation of emotional bonds between a parent and an infant (Feldman and Bakermans-Kranenburg, 2017). Intranasally administered oxytocin potentially reduces the HPA-axis in emotional situations, and therefore, it has been discussed whether alexithymic individuals could use oxytocin to enhance their sociability and strength of bonding (Luminet et al., 2011). Low oxytocin levels have been reported to associate with alexithymia, and especially with DIF, in patients with anorexia nervosa (Schmelkin et al., 2017). On the other hand, Koh et al. (2015) did not find significant association between oxytocin receptor genes and alexithymic traits among patients with OCD.

To date, the evidence of the benefits of administration of intranasal oxytocin for individuals with alexithymic traits is scarce and somewhat controversial. More studies are conducted within the context of autism spectrum disorder, in which oxytocin administration has been shown to improve the ability to understand others' emotions (Aoki et al., 2014; Guastella et al., 2010). In addition, a study conducted by Marsh et al. (2010) among a general population showed the interpretation of positive emotions to increase after oxytocin administration whereas enhanced interpretation of negative emotions was not found. Accordingly, a recent review by Leppänen et al. (2017) concluded that a single dose of intranasal oxytocin

significantly improved the recognition of basic emotions, particularly fear, among healthy individuals. In addition, a significant increase in the expression of positive emotions was found among the healthy individuals whereas significant enhancement on theory of mind or the expression of negative emotions was not found. (Leppänen et al., 2017.) Specifically in the context of alexithymia, Luminet et al. (2011) tested recognition of complex emotions in the Reading the Mind in the EYES test (RMET) by administering oxytocin or placebo to alexithymic individuals and healthy controls. They reported that individuals with high levels of alexithymic traits performed better in RMET than controls but individuals with lower levels of alexithymic traits performed as well as healthy controls. (Luminet et al., 2011.)

All in all, because having alexithymic traits may very well complicate everyday life situations and interaction, it might indeed be a relevant target for interventions, at least for some individuals or in certain situations. Enhancing emotional interactive abilities could be especially important in close relationships, such as the relation between a parent and a child. It should be acknowledged that even though some studies imply that individuals with high alexithymic traits are as open to receive psychotherapy as individuals with a low level of alexithymic traits, the benefit may be more modest (Ogrodniczuk et al., 2011). Samur et al. (2013) assert that the relatively high prevalence of alexithymic traits and the fact that alexithymic traits are associated with less benefit from psychotherapeutic interventions are reasons that effective, evidence-based treatments specifically focused on these traits are needed.

2.2 Parental alexithymic traits and early parenting

The first year of life is a unique and significant period of time for both the infant and the parent. Typically, their relationship is intensive and interactive: both are learning a whole new world together. During infancy, the child is also very much dependent on the parent for fulfilling both the child's concrete needs and social and emotional needs. Simultaneously, the parent grows into parenthood, which is not a straightforward task either. Optimally, the parent-infant relationship works as a synchrony of bi-directional, coordinated, timely, and smooth exchange of responses. However, this is not always the case. Parental emotional abilities are essential in forming this dyadic relationship, and they are reported to associate with central developmental processes with long-lasting effects on a child's later life, e.g., attachment style, emotion regulation and theory of mind. Further, there are various emotion-related underlying parental factors that influence the development of these essential regulative and interactive processes.

The associations between the type of parenting experienced and the development of alexithymic traits later in life are quite well established. However, we are lacking prospective studies exploring how parental alexithymic traits are potentially

associated with parenting itself, and more precisely, the emotional context of parenting. In this thesis, the focus is on the dimensions of alexithymic traits and three different aspects of parenting: *parental reflective functioning* as the dimension describing the mental processes in separating the self (parent) from the other (infant); *postpartum bonding* as the dimension describing the process of developing a bond, including psychological emotional connectedness; and lastly, *maternal caregiving behaviour* as the dimension reflecting actual presentation of the ability to mentalise and to be emotionally connected with the infant within the parent-infant interaction. The key concepts of the present study are presented in Figure 3.

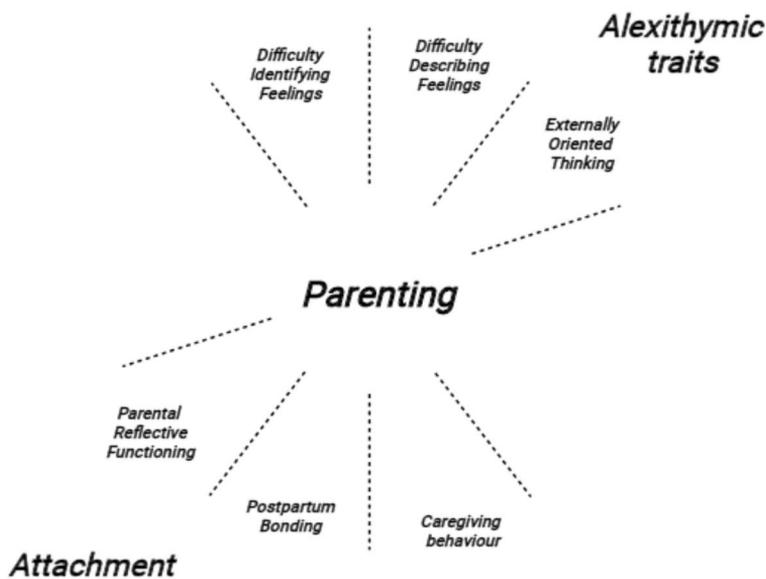


Figure 3. The key concepts of Studies I-III (created with Biorender.com)

2.2.1 The significance of parental emotional abilities during the first year of life

2.2.1.1 Socioemotional and communicative milestones

To understand the significance of the first year of life as regards the dyadic emotional relationship between the parent and child, we begin with describing the main developmental socioemotional milestones and concepts. It is well established in research and clinical observations that the first year of life includes numerous socioemotional milestones, e.g., from simply looking at the caregiver in the very

early months to later reacting when the caregiver leaves and developing ways to keep their attention (Zubler et al., 2022). In addition, language and communication skills are developing fast within the first year of life, which is crucial to getting understood and learning to understand others. These skills range from the early months' reflective sounds to making different sounds with underlying specific meanings and gestures like lifting hands, to express the wish to be picked up by the caregiver. (Zubler et al., 2022.) All these milestones lay the foundation for the future development of a child's socioemotional and communicative skills and are built within the interactions with a primary caregiver.

From the very beginning, the child is seeking interaction with the parent. Even newborn infants have a social side and even an ability for self-concept – the minimal sense of self. In practice, this becomes evident when the infant seeks nutrition and closeness from another person. The need and ability for newborns' social interaction is evident in many ways: babies tend to look at human faces longer than other objects (Simion and Di Giorgio, 2015), they prefer human sounds over other sounds (Vouloumanos et al., 2010) and they even imitate phonetic sounds of speech (Markodimitraki and Kalpidou, 2021). Already by the age of six weeks, they commonly perform a social smile (Wörmann et al., 2012). With a growing body of supporting research, social skills of interaction are constantly found even in younger infants.

Caregiving acts as a basis for child socioemotional development when infants align their own feelings with those of the caregiver, thus leading to shared, mutual experiences. Becoming sensitive to emotional expressions is already occurring during the first year of life, and infants begin to discriminate between positive and negative emotional cues (Missana et al., 2015). Furthermore, the social abilities and means of communication seen already in newborns, and further within the first year of life (*Figure 4*), are associated with the later development of theory of mind, the capacity to understand one's own and others' mental states (Fonagy and Target, 1997; Meins et al., 2002; Zubler et al., 2022). Theory-of-mind skills transform and are developed by children's close relationships, such as the parent-infant relationship (Hughes and Leekam, 2004). In short, even newborns are social and present with emotional needs.

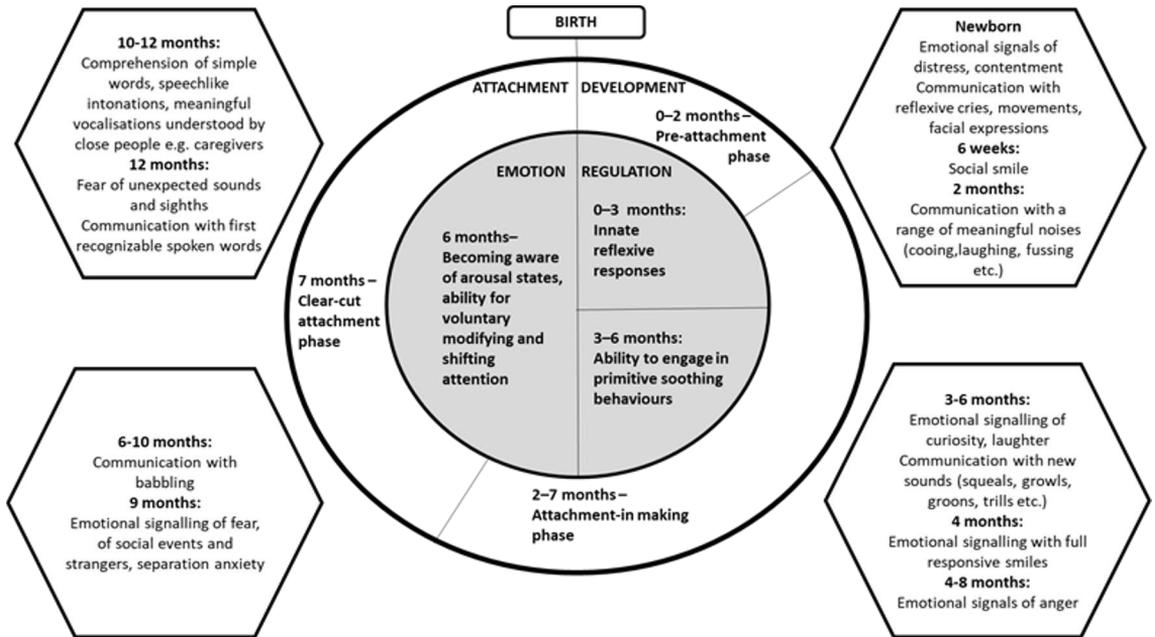


Figure 4. Developmental phases of attachment style and emotion regulation, and the means for emotional communication during the first year of life

2.2.1.2 Development of attachment style

More broadly and beyond individual stages of developmental milestones should be discussed one of the most important developmental processes during infancy: the formation of attachment style. Attachment theory, by the joint work of John Bowlby and Mary Ainsworth, arose in the 1950s (Bretherton, 1992). Since then, the theory has been the focus of a lot of researchers all over the world, and it is still a topic of interest. In the beginning research was keen on describing and explaining what attachment actually is. In recent years efforts have turned to exploring potential factors that influence the development of a certain attachment style. According to the current understanding, attachment style refers to the way the individual relates to others in intimate relationships, and the basis is formed within the interaction of an infant and the primary caregiver. (Bretherton, 1992.) Attachment style can be avoidant, secure, ambivalent or disorganised – all describing the way a child reacts to separation from the primary caregiver.

Attachment style develops in steps through the first months of infancy (*Figure 4*), and already by seven months of age, a clear attachment style can be detected. The developmental span goes again from reflective responses to social interaction to recognizing the caregiver and lastly to more intentional ways of seeking care and

comfort as well as the reaction when the needs are, or are not, fulfilled. Further on, the child begins to form reciprocal relationships according to the attachment style. Therefore, the socioemotional foundations formed within the first significant relationships with others have long-lasting effects in later in life. In addition, the development of secure attachment style has been associated with earlier maturing of theory of mind (Fonagy and Target, 1997; Meins et al., 2002).

2.2.1.3 Development of emotion regulation

Similarly to reaching individual developmental milestones and attachment style, the early phases of development in emotion regulation impact the way the child modifies emotional states later in life (Calkins et al., 1999; Ekas et al., 2013). Emotion regulation refers to modulating the occurrence, duration and intensity of both positive and negative internal states, feelings (Morris et al., 2017). Adults, more precisely the primary caregivers, have essential roles in the development of a child's emotion regulation. The parental role in the development of a child's emotion regulation is suggested to occur by three mechanisms: the child observing the parent's emotion regulation; emotion-related parenting behaviour; and the emotional climate in the family. Thus, a parent's own emotional abilities are crucial in the process of developing a child's emotional abilities. (Morris et al., 2017.) The caregiver's task is to first regulate the child's emotional states, then assist in regulating emotions and further help the child to develop independent skills of emotion regulation (Calkins and Hill, 2007). Again, the developmental phases during the first year of life proceed from relying on innate, reflexive behaviours to being able to engage in primitive soothing behaviours at three months of age, and by six months of age becoming aware of arousal states and being able to voluntarily shift attention (*Figure 4*).

2.2.2 Parental reflective functioning

Mentalization, or the operationalised term 'reflective functioning', describes an individual's ability to pay attention to mental states in oneself and in others. These mental states are, e.g., one's experiences, feelings, wishes and intentions. Like alexithymia, reflective functioning as a theoretical concept has its roots within the psychoanalytic field. It was first described over 30 years ago in relation to attachment theory especially regarding intergenerational transmission of attachment security (Camoirano, 2017; Fonagy et al., 1991a; Fonagy et al., 1991b). Luyten and Fonagy (2015) describe that the capacity for reflective functioning is to a certain extent 'prewired', meaning it is something that everyone has the prerequisites for. However, reaching optimal capability to use this ability is a high developmental

achievement. The literature suggests that the foundation for reflective functioning ability is built within development of attachment style. Later on, experiences and environment modify the direction to which development of reflective skills proceeds. (Fonagy and Target, 1997; Fonagy et al., 2012; Luyten and Fonagy, 2015.)

The question of what an optimal or sufficient capacity for reflective functioning could be is not a straightforward one. The concrete presentation of mentalising depends on the interpersonal situations one faces during life. However, in general, a capacity for sufficient reflective functioning is described as being able to consider diverse perspectives between people as well as alternative experiences behind overt behaviour in self and in others. The capability for reflective functioning thus facilitates more accurate interpretations of behaviour and becomes evident as more successful communication within interactions. Furthermore, reflective functioning is linked with more optimal emotion regulation and a greater capacity to negotiate in conflictual situations (Fonagy et al., 2012). Impaired reflective functioning, however, is linked with the development of various mental health problems, such as borderline personality disorder (Diamond et al., 2014) and depression (Fischer-Kern et al., 2013).

Reflective functioning is also important within parent-infant interaction, and thus, *parental reflective functioning* (PRF) has been derived as a separate concept. It includes the parent's effort to see a child as an individual from the very beginning of the child's life. In addition, parental reflective functioning includes curiosity towards the child's own thoughts and feelings. (Luyten et al., 2017.) Especially during the child's first year of life, when the child, the infant, is not yet able to express emotions and needs verbally, the parent's ability to try to understand the child's own thinking and feelings becomes crucial. Therefore, parental reflective functioning consists not only of efforts to understand but also of interest in the child's mind. (Luyten et al., 2017.) In practice, when an infant is crying, there are numerous possible explanations, from hunger to needing to be held. Interest in the child's mind is needed as the initial step for further reflective functioning and for getting closer to the ability to respond to the child's actual need. At least the parent can demonstrate the ability to respond to the child's discomfort by showing affection and safety and giving care.

The literature suggests that parent's reflective functioning ability is beneficial for both parent's and child's well-being. Parental reflective functioning is especially important for a child's socioemotional development and the intergenerational transmission of attachment. From the parental aspect, better reflective functioning is associated with the quality of parenting, more secure parental attachment pattern (Luyten et al., 2017), and caregiving quality (Camoirano, 2017; Ensink et al., 2016; Suchman et al., 2017) – especially sensitive, caring behaviour in interactions with the child (Berthelot et al., 2015; Ensink et al., 2017; Katznelson, 2014). Higher

parental reflective functioning is also reported to increase a parent's ability to be emotionally available during parent-child interaction (Luyten et al., 2017).

Parent's reflective functioning greatly supports better child socioemotional development. From the early postpartum period, parental reflective functioning influences the development of attachment, and a child whose parent has sufficient reflective functioning abilities has been reported to more likely develop a secure attachment style (Berthelot et al., 2015; Camoirano, 2017; Fonagy et al., 2016; Luyten et al., 2017). In addition, through parents' reflective abilities, children are more likely to develop better reflective functioning capacities of their own (Camoirano, 2017) as well as better emotional regulation capacities (Camoirano, 2017; Heron-Delaney et al., 2016; Schultheis et al., 2019).

The neural origin and CNS regions most likely to be linked with reflective functioning are very much like those associated with alexithymic traits. Reflective functioning has been shown to associate with neural circuits that are especially involved in modulating and processing social information, e.g., the amygdala, basal ganglia, ventromedial prefrontal cortex, lateral temporal cortex, and dorsal anterior cingulate cortex. Deficits in these areas may associate with parental reflective functioning capacity. (Luyten and Fonagy, 2015.)

First-time mothers reportedly have better reflective functioning capacity compared to multiparous mothers (Pajulo et al., 2018). It could be that first-time mothers have higher parental preoccupation than more experienced mothers, as reported by Kim et al. (2013). Possibly the higher preoccupation is further reflected to parental reflective functioning capacity. A higher educational level is also linked with better parental reflective functioning (Rosenblum et al., 2008), and receiving social aid is linked with weaker reflective abilities (Pajulo et al., 2018). Postpartum depression is a relatively common psychopathology. Thus, it has understandably also been of interest in studies regarding reflective functioning. However, the evidence of whether reflective capacity is decreased when having postpartum depressive symptoms is still controversial. For example, a study by Krink et al. (2018) presented that postpartum depression would associate especially with the pre-mentalising states, whereas in the study by Cordes et al. (2017), there was no association found between parental reflective functioning and postpartum depressive symptoms.

One other associated factor is gender, as mothers tend to have better reflective capacity than fathers (Benbassat and Priel, 2015). To date, most of the studies concerning parental reflective functioning include mothers (Cooke et al., 2017), and fathers have been explored to a lesser extent. However, based on some reports, mothers tend to score higher in parental reflective functioning than fathers postnatally (Luyten, 2017; Pajulo et al., 2018) but also within the prenatal period (Pajulo et al., 2015). Interest in fathers' reflective functioning should not be forgotten because it is reported to influence the child's socioemotional development as well (Sharp and Fonagy, 2008).

2.2.3 Postpartum bonding

Similarly to reflective functioning, postpartum bonding has its roots in attachment theory. Saunders et al. (2015) write that the formation of an emotional bond between a caregiver and an infant is one of the most important tasks of the postpartum period. Postpartum bonding refers to the parent's emotional connectedness towards the infant. In practice, postpartum bonding arises from the emotions experienced by the parent, further extending to the way the parent provides care and comfort for the infant. (LeBas et al., 2020.) A well-formed postpartum bond comprises a healthy range of positive emotions, warmth and affection, expressed and present in everyday interaction with the infant (Saunders et al., 2015; Taylor et al., 2005). The formation of an emotional bond between a parent and infant starts during pregnancy, further developing through infancy and later childhood. The postpartum period, encompassing the first months after the child's birth is especially important in developing the emotional bond. (Siddiqui and Hagglöf, 2000.)

An optimal postpartum bond is beneficial for both the parent and the child. It facilitates adjustment to the parental role (Müller, 1996), which is essential in developing the skills to respond to the child's needs as timely and accurately as possible, referring to sensitivity in interaction. Sometimes the parent is not able to form an affectionate bond with the child and thus may present with bonding problems or even impaired bonding (Brockington, 2006). Impaired bonding is associated with child developmental delay (Faisal-Cury et al., 2021) and deficits in child socioemotional development (Le Bas et al., 2021). According to the population-based studies described in the literature, 7%–13% of mothers experience postpartum bonding problems of some kind (Reck et al., 2006; Edhborg et al., 2011). In clinical samples the prevalence of impaired bonding is reported to range between 6% and 41% (Nakano et al., 2019). The corresponding numbers for fathers are not clear, because there are much less studies on postpartum bonding among fathers (Bieleninik et al., 2021; de Cock et al., 2016). Faisal-Cury et al. (2020) studied bonding impairment in the beginning of the second year of life and found that bonding impairment in the postpartum period, specifically at 6–8 months of age, strongly predicts later bonding impairment. Hence, it seems evident that early postpartum bonding plays a significant role in further development of emotional bond experienced by the parent. (Faisal-Cury et al., 2020.)

Neural correlates associated with postpartum bonding are not extensively studied, but it is hypothesised that the relatively well-reported neural reorganization during the postpartum period would also have an impact on postpartum bonding. Therefore, Rutherford et al. (2020) studied brain functional connectivity and its potential predictive value for postpartum bonding at 2 and 8 months postpartum. As a result, they reported that some evidence was found regarding changes in network connectivity being associated with anxiety toward the infant in the bonding

relationship. However, no straightforward evidence for actual bonding impairment and the underlying neural correlates was found. They discuss that changing connectivity among maternal brain networks could provide insight into the anxiety-related context of the mother–infant bond, in addition to the more typical anatomical approach in neuroimaging studies. (Rutherford et al., 2020.)

Impaired postpartum bonding is more often detected in mothers with depressive symptoms (Ayers et al., 2007; Nakano et al., 2019; Nolvi et al., 2016; Muzik et al., 2013) and posttraumatic stress disorder (Muzik et al., 2013). Accordingly, fathers' depressive symptoms have been linked with problems in paternal postpartum bonding at least in one study by Bieleninik et al. (2021). In addition, reports of associations between impaired bonding and parental anxiety and stress have been presented (Bieleninik et al., 2020; de Cock et al., 2016). Interestingly, inadequate partner support has also been linked with impaired bonding (de Cock et al., 2016), and furthermore, Bieleninik et al. (2020) have reported that mothers' postpartum bonding was significantly associated with paternal postpartum bonding with infant. Also, primiparity (Nakano et al., 2019) and unwanted pregnancy (Goto et al., 2006) have been linked with increased odds of developing bonding problems. Intergenerational transmission of bonding is also a question of concern, because childhood adverse events, such as neglect, have been suggested to predict bonding difficulties in mothers with an insecure adult attachment style (Julian et al., 2022). Studies exploring the association between parental alexithymic traits and postpartum bonding are still lacking.

2.2.4 Caregiving behaviour

Caregiving behaviour, i.e., how the parent concretely interacts with the child, is a significant part of the parent-infant relationship, and thus, it has been investigated in studies for decades (e.g., Bowlby, 1988; Biringen, 2008; Emde, 1980). The quality of maternal caregiving behaviour especially has been the focus of numerous studies, whereas paternal caregiving behaviour has risen as a new interest only in recent years.

In determining the quality of parent-infant interaction, the term emotional availability is often used among researchers. The term includes both parental and child perspectives of the dyadic interaction, with the parental aspect referring to caregiving behaviour. Typically, parental caregiving behaviour is thought to include dimensions such as sensitivity, structuring, non-intrusiveness and non-hostility. Thus, caregiving behaviour relies on the parent's ability for responsiveness, maintaining contact, enabling a child's independent learning and playing, as well as being able to control their own negative emotions in conflictual situations. (Biringen,

2008.) Many of these skills are enabled by parents being aware of, and able to regulate, their own emotions.

Many beneficial outcomes are described in the literature considering better emotional availability. The influence of emotional availability on child socioemotional development from childhood to early adulthood is a relatively well-studied entity. For example, Moreno et al. (2008) reported that children experiencing better emotional availability in parent-infant interaction have better abilities to express empathy towards adults. Furthermore, better prosocial skills at three to four years of age (Howes and Hong, 2008), as well as better overall social skills (Raby et al., 2015) have been linked with better emotional availability in the interaction with the primary caregiver. In addition, better emotional availability has been associated with better academic achievement later in adolescence and adulthood (Raby et al., 2015). On the other hand, disrupted maternal caregiving behaviour has been reported to mediate the association between mother's disrupted prenatal representations and later socioemotional problems of the child as a toddler (Guyon-Harris et al., 2020).

Parents' early life stress and adverse events are suggested to associate with less sensitivity in later parental caregiving abilities, and hence the association also represents intergenerational transmission of parenting (Cooke et al., 2019; McDonald et al., 2019). The stress-related hypothesis has given roots to neuroimaging studies aiming to detect those brain regions that are key areas regarding caregiving behaviour (Moses-Kolko et al., 2021). Special interest has been directed to extra-hypothalamic stress circuitry, including the ventromedial prefrontal cortex, hippocampus and amygdala (Rutherford et al., 2011). A few studies have described the cortical grey matter volume changes, decrease and following increase from the early postpartum period up till six months after delivery. These studies demonstrate the plasticity of the maternal brain in response to interaction with the child. (Moses-Kolko et al., 2021.) However, much is still undiscovered about the neural correlates regarding parental, especially paternal, caregiving behaviour.

Low socioeconomic status and low educational level especially are known risk factors for problems in emotional availability. Leung et al. (2020) reported that mothers with low educational levels were less likely to be sensitive in their caring behaviour as well as less likely to foster child socioemotional growth and provide cognitive stimulation to the child. However, those parents with a low educational level but more specific knowledge of their child's cognitive and language development performed better in their caring behaviour than those with less knowledge. Therefore, not educational level alone but rather knowledge of child socioemotional development may affect the caring behaviour, and thus, psychoeducation could provide a route for interventions. (Leung et al., 2020.)

Caregiving abilities are known to be negatively influenced by common postpartum psychopathology, e.g., depression and anxiety symptoms. In their study,

Tronick and Reck (2009) showed that mothers with depressive symptoms were more intrusive and more withdrawing in their caring behaviour, and Hakanen et al. (2019) reported such mothers being less structuring within their interaction with the child. One underlying mechanism could be the weaker emotion regulation abilities that are reported in depressive parents (Riva Crugnola et al., 2016). In addition to depressive symptoms, anxiety symptoms are also known to negatively influence the quality of parent-infant interaction. Ierardi et al. (2019) reported anxiety to associate with weaker sensitivity and responsivity among mothers with anxiety symptoms. A recent study by Holmberg et al. (2020) presented that mothers' prenatal elevated anxiety symptoms associated with greater unpredictability in later caring behaviour. This association became especially evident among mothers with low self-regulation capacity in addition to the anxiety symptoms. (Holmberg et al., 2020.)

Similar to studies between alexithymia and parental reflective functioning and postpartum bonding, studies regarding parental alexithymic traits and caregiving behaviour are also greatly lacking. As most of the caregiving studies have been conducted among mothers, it is evident that studies including fathers are also indeed needed to describe the phenomenon more thoroughly.

2.2.5 Alexithymic traits and parenting

2.2.5.1 Previous studies on parental alexithymia

Despite the fact that emotional interaction, the 'how' parents are in contact with their children, is known to be crucial for both children's and parents' well-being, there are few studies that specifically concern the association between parental alexithymic traits and parenting. Even fewer are studies that concern parental alexithymic traits and early parenting during the child's first year of life, and moreover, studies concerning fathers' alexithymic traits and parenting. However, it is known that a child's ability to regulate emotions, attention and arousal develops in the context of their primary caregiving, mother or father, from the very beginning of infancy (Bornstein et al., 2012.). Therefore, it could be hypothesised that parental alexithymic traits may negatively influence the bidirectional signalling and understanding of emotions in a parent-infant dyad.

Some evidence has been found that maternal alexithymic traits would be associated with an impaired mother-infant relationship in toddlerhood (Yürümez et al., 2014). In their study, Yürümez et al. (2014) found that a mother's higher alexithymic traits correlated negatively with caregiver-child interaction when depressive and anxiety symptoms were controlled for. The association was found for the TAS-20 total score as well as for all three dimensions of alexithymic traits (DIF, DDF and EOT). Another recent study by Porreca et al. (2020) explored the

relationship between maternal alexithymic traits and observed parenting behaviour among mothers with substance use disorder and their toddlers. They found that alexithymic traits were related to lower sensitivity and structuring scores. However, when taking depressive symptoms into account, the association between maternal alexithymic traits and parenting behaviour remained only for structuring. In this study, alexithymic traits were explored as a dichotomous feature, and the different dimensions were not explored separately.

Tarantino et al. (2018) studied maternal alexithymic traits and children's attachment style and psychological profile (anxiety and depressive symptoms and somatic concerns) in school-aged children suffering from headaches and migraines. Firstly, they found that higher maternal alexithymic traits were associated with children's avoidant and ambivalent attachment styles with no specific differences between the dimensions of alexithymic traits (DIF, DDF and EOT). Furthermore, maternal alexithymic traits were associated with children's more prominent separation anxiety, school anxiety, and feeling of guilt. Interestingly, EOT specifically was associated with school anxiety and feelings of guilt, whereas other alexithymia dimensions were not. Children's migraine and headache features were not associated with their mothers' alexithymic traits, and the findings regarding attachment style and anxiety were not affected by children's migraine severity. (Tarantino et al., 2018.) Cuzzocrea et al. (2015) examined the relationship between parental alexithymic traits and parenting style among mothers and fathers of adolescents. All three alexithymia dimensions were associated with more authoritative, permissive and controlling parenting style in both mothers and fathers. However, these findings were based on questionnaires only.

As is evident, most of the studies concern only mothers and no more than hints about the possible associations between father's alexithymic traits and parenting can be found in the literature. The reported studies include children from toddlerhood to adolescence, but studies concerning the first year of a child's life, i.e., infancy, are basically nonexistent. To date, there is a significant gap in the literature concerning both mothers' and fathers' alexithymic traits and parenting, especially during the first year of life.

2.2.5.2 Possible mechanisms linking alexithymia with parenting

As presented, alexithymia and dimensions of parenting that are linked with emotions share numerous similar associated factors, from changes in certain CNS regions to environmental factors, such as early life experiences and the parenting they received. The causality between these factors and alexithymic traits, as well as parenting, has been difficult to establish due to the typical retrospective design of the studies. In addition, as presented in the literature, changes in CNS may affect how one interacts

with the environment, but environment also has the potential to alter CNS structure, as happens when experiencing repeatedly adverse events in early childhood. Therefore, establishing causality and giving profound and detailed explanations for the complex associations between alexithymic traits and parenting and their environmental and neurobiological explanators is a tricky and still-unaccomplished task. It is crucial to understand the multidirectional interaction and potential dynamics between the underlying factors and the presentation of a given problem (*Figure 5*).

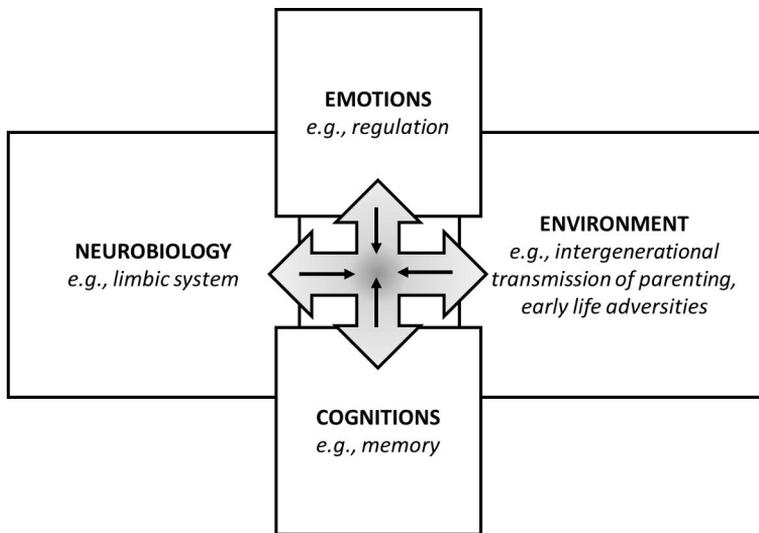


Figure 5. Multidirectional interaction and potential dynamics between neurobiology, environment and the interface of emotions and cognitions underlying alexithymic traits and emotion-linked parenting abilities.

It is very likely that also the association between alexithymic traits and emotion-linked parenting is a somewhat cumulative and intergenerational process. To increase the knowledge of both alexithymic traits and parenting, as well as the possible association between them, only one careful step at a time should be taken, while keeping in mind the complexity and dimensionality underneath. To begin with, we may set the hypothesis that due to so many overlapping etiological and associated factors, it is likely that alexithymic traits and emotion-linked parenting dimensions are to some extent associated. In the next section, some thoughts on the potential underlying mechanisms and studies supporting the hypotheses are briefly presented.

2.2.5.2.1 Altered attention and appraisal

Altered emotion regulation among alexithymic individuals has been reported in various studies (Luminet, Vermeulen, Demaret, Taylor and Bagby, 2006; Swart, Kortekaas and Aleman, 2009; Vermeulen, Luminet and Corneille, 2006). Preece et al. (2017) have presented the idea that alexithymia manifests within the valuation system that comprises a *situation-attention-appraisal-response* sequence which is firmly linked to emotion regulation. The four-stage sequence of attention and appraisal starts with an emotion-inducing stimulus, proceeds to focusing attention on the stimulus and then to appraising the stimulus in terms of the interpreted significance, and lastly results in an emotional response. Preece et al. (2017) hypothesise that EOT would be associated with the attention stage, so that focusing attention on the emotional response would be inadequate. Alexithymic traits, especially EOT, have indeed been associated with deficits in automatic and further controlled attention (Luminet et al., 2021).

Furthermore, Preece et al. (2017) discuss that appraisal, referring to one's subjective evaluation of the significance of a situation or event, would be especially associated with DIF and DDF. High levels of DIF and DDF would then be linked with inadequate appraising of emotional response and its meaning. (Preece et al., 2017.) Alexithymic traits are indeed reported to associate with more suppression and less appraisal in emotion regulation. These are events that involve conscious processing and therefore awareness of emotions (Swart et al., 2009) that alexithymic individuals are to some extent lacking (da Silva, Vasco and Watson, 2017). Luminet et al. (2021b) reported that almost all studies in their review showed that alexithymic traits were associated with a deficit of emotional response to unpleasant stimuli. The dimensions DDF and EOT seemed to contribute to the association the strongest. A parent experiences relatively many somewhat unpleasant stimuli, such as a baby's fussiness and crying. It could be that a deficit in emotional responding to these kinds of stimuli is one route to complicated interaction with the baby.

2.2.5.2.2 Altered memory functions

Memory encodes our individual experiences and thus influences our future expectations and thoughts on new experiences to come. Emotions play a significant role in memory functions by directing and prioritizing to which experiences we pay especial attention and thus remember the best. According to a recent review by Luminet et al. (2021b), the vast majority of the reviewed studies indicated alexithymic traits to associate with weaker memory functions, particularly for emotional stimuli but even for 'neutral' stimuli. All three dimensions of alexithymic traits were associated with memory functions, but EOT contributed to the association in the majority of findings. (Luminet et al., 2021b.)

For example, alexithymic traits have been linked with weaker memory for emotional words and verbalising emotions (Luminet et al., 2006). Beyond just emotional verbal abilities, Terock et al. (2019) studied the relations between alexithymic traits, chronic stress and overall memory performance. They found that alexithymic traits were independently significantly associated with poorer memory performance in both immediate and delayed word recall. The association was present for the TAS-20 total score, but looking deeper into dimensional differences, it was found that EOT mainly carried the effect while DIF contributed only partly. On the other hand, DDF did not account for this association. (Terock et al., 2019.) Even though these studies address processing verbal information, it could be hypothesised that similar problems may extend to nonverbal communication as well.

As presented, emotions are significant in memory functions, and their role is to direct and prioritise the experiences attention is directed to. In addition, memory functions are especially important in learning processes. The child's first year of life consists of intense everyday learning by both parent and infant: the parent is learning to interact with the infant and how to provide the needed care accurately and timely enough, and the infant is, in the broadest description, learning the world. Therefore, it could be hypothesised that altered memory functions, especially when linked to emotional processing, could also be a potential mechanism between parental alexithymic traits and the quality of parenting.

2.2.5.2.3 Deficits in interpretation of facial expressions

Facial expressions are important in social relations and the signalling of emotions. To date, quite many studies have reported that alexithymic individuals have increased difficulty interpreting facial expressions (Grynberg et al., 2012). Jongen et al. (2014) studied facial emotion recognition among healthy individuals divided into groups of relatively high and low alexithymic traits. By using fMRI, they were given the *Facially Expressed Emotions Labeling (FEEL)* test, and it was found that the group of high alexithymic trait individuals showed weaker emotion recognition scores compared to the control group. In addition, they showed less activity in various CNS regions, such as the anterior cingulate cortex, amygdala and insula. Jakobson and Pearson (2020) have also reported that individuals with more difficulty identifying their feelings experienced also more difficulty in distinguishing different statement types (e.g., literal or sarcastic) from the nonverbal cues given (Jakobson and Pearson, 2020).

In infancy, the majority of interaction between a caregiver and an infant relies on nonverbal communication. An infant's social world comprises face-to-face interaction with the primary caregiver. In a preverbal state, the infant perceives the facial expressions of a caregiver as signals that they are safe, loved and cared for. On

the other hand, an infant's own facial expressions are ways of signalling that the baby is feeling insecure and in need of care and comfort. Furthermore, an important dimension of nonverbal interaction between the caregiver and an infant is *mirroring*: an intuitive, parenting response is mirroring an infant's facial and vocal expressions. Studies have shown that parental mirroring facilitates an infant's social communication by, e.g., strengthening the infant's facial gesturing later on and predicting later neural processing of facial expressions (Rayson et al., 2017). It could be that parents with alexithymic traits may have difficulty interpreting, and thus mirroring, an infant's facial expressions, leading to more complicated nonverbal communication during the first year of a child's life.

2.2.5.2.4 Reduced facial mimicry

Few studies have been conducted to explore facial mimicry among individuals with alexithymic traits. Recently, Franz et al. (2021) studied whether individuals with alexithymic traits would express themselves with facial mimicry differently compared to individuals without significant alexithymic traits. Facial mimicry was registered by electromyographic activity when shown video sequences of faces displaying basic affects, such as fear, anger or joy. Significantly reduced facial mimicry was indeed detected in the alexithymic group in comparison to the non-alexithymic control group. (Franz et al., 2021.) These results were in accordance with previous results of Scarpazza et al. (2018); however, the latter used static pictures of affective expressive faces as stimuli.

Facial mimicry represents a fundamental signalling mechanism of emotional attunement (Foroni and Semin, 2011) and thus reflects one's own emotional awareness (Coles et al., 2019). As presented, facial mimicry is important in caregivers' mirroring of infants' facial expression – an intuitive communicative way for infants to enhance their social skills (Rayson et al., 2017). Therefore, facial mimicry is especially important within interpersonal relationships lacking verbal communication (Foroni and Semin, 2011), such as parent-infant interaction. Franz et al. (2021) discuss that deficits of facial mimicry in caregivers of young children could have extensive consequences since modulated facial reactions of the caregiver are significant in the development of the child's affect system as described by Fonagy et al. (2018). Decreased facial mimicry is known to associate with elevated stress as higher cortisol levels (Kouzakova et al., 2010). The stressfulness of the parent-infant interactive situation with a parent's diminished facial mimicry is also well documented within the widely known still-face paradigm (Weinberg and Tronick, 1996). Possibly, diminished facial mimicry in parents with alexithymic traits could be one mechanism for complicated parent-infant interaction.

2.2.5.2.5 Altered emotional language

Social interaction is in most cases at least partly constructed by language. The role of language is understood to be significant in emotion processing, and it is known to firmly link with cognitions. The association between alexithymic traits and language disturbances is well known and has been reported in recent reviews addressing the relation (Hobson et al., 2019; Luminet et al., 2021b; Welding & Samur, 2018). Many of the studies are conducted by asking the subject to write or tell in words about their emotional experiences. Reduced emotional expression (Parker et al., 2000), low frequency of emotional words (Jelinek et al., 2010), and less complexity in emotional vocabulary (Vanheule et al., 2011) have been associated with alexithymic traits regarding their relation to language. According to Luminet et al. (2021b), some evidence supports alexithymic traits being associated with responding with more negative language, especially when scoring high in DIF and DDF. In their review, DIF was shown to most commonly associate with language deficits (Luminet et al., 2021b). In parent-infant interaction, the caregiver's language and use of emotional words is important despite the fact that infant is not yet able to answer in words. This is because emotional words, and in general the language caregivers use with their infant, typically include intuitively integrated affect expressed by intonations and mimicry expressing positive emotions (Papousek, 2012). Thus, difficulties in parent-infant interaction when the parent has significant alexithymic traits might be reflected by altered emotional language and associated emotional expression.

2.2.5.2.6 Altered behaviour in interactions

In studying caring behaviour, it has been discussed that maternal alexithymic traits indeed may be shown as less sensitive interactions with the child. Therefore, these mothers are not able to respond and react appropriately and timely to the child's needs, meaning they do not succeed in parental reflective functioning. It is also hypothesised that parental alexithymic traits could influence a child's affective regulation. When a parent has difficulty in interpreting and expressing their own emotions, it might appear to the child as incongruous emotional signalling and caring behaviour. This may lead to further confusion in interaction. Alexithymic individuals are indeed reported to present with problems in general executive functions, too (Correro et al., 2019), which could become evident as incongruence in everyday actions with the child. Furthermore, the caregiver's emotional unavailability is known to potentially affect the child's ability to learn emotion regulation. Hence, the bidirectional emotional interaction with deficits of some kind may later lead to an accumulation of difficulties in parent-infant interaction. (Tarantino et al., 2018.) Luminet et al. (2021b) reported in multiple studies that alexithymic traits are associated with being more prone to aggression and especially impulsiveness.

Underlying dysfunctional strategies have been shown to be suppression, avoidance and emotion dysregulation. Among the alexithymia dimensions, DIF and DDF were shown to be linked with over-responding to stimuli and thus presented with altered behaviour in interactions (Luminet et al., 2021).

2.3 Conclusions based on the reviewed literature

Despite the relatively long history of both alexithymia and parenting research, only a small number of studies have explored parental alexithymic traits and their association with parenting. To date, the majority of the studies concerning parenting and alexithymic traits are retrospective and focus on the parenting that was experienced as a risk factor for developing alexithymic traits later in life. (Thorberg et al., 2011.) The very few studies that have explored parental alexithymia have concentrated on toddlers and school-aged children and their parents (Porreca et al., 2020; Tarantino et al., 2018; Yürümez et al., 2014). Therefore, studies on parental alexithymic traits and parenting during the first year of a child's life still remain unexplored. In addition, as parenting research that also includes fathers is a relatively new approach, knowledge on paternal alexithymic traits and parenting is basically nonexistent.

However, parental alexithymic traits with emotional deficits may very well be potentially associated with emotion-linked dimensions of parenting and thus could act as a risk factor for problems in the parent-infant relationship. Alexithymic traits are increasingly seen as a deficit at the interface of emotions and cognitions (Luminet et al., 2021a). The literature includes links between alexithymic traits and altered emotion regulation, verbal and facial emotional signalling, and altered cognitions such as memory functioning, as well as peculiarities in emotional behaviour (Luminet et al., 2021b). All of these are also important within parent-infant interaction. Therefore, the underlying mechanisms hypothetically explaining the possible association between alexithymic traits and emotion-linked parenting could be associated to those related to altered emotion regulation and cognitive processes. Development of alexithymic traits and problems in parenting dimensions of parental reflective functioning, postpartum bonding and caregiving behaviour also share environmental background factors, such as socioeconomic situation and early life adversities, as well as associations with symptoms of anxiety and depression relatively common in the postpartum period.

Special importance should be noted when evaluating a parent's emotional abilities during the first year of a child's life, because various significant developmental and socioemotional milestones occur in the very first months postnatally (Zubler et al., 2022). These are, e.g., development of attachment style, the child's own emotion regulation and the means of communication from nonverbal

to verbal communicative skills. The parent's own emotional abilities are significant in directing the socioemotional development of the child, and thus, alexithymic traits should be considered as a potential risk factor for suboptimal parenting, and studies exploring the possible association are needed.

3 Aims

The aim of this thesis was to extend the knowledge on alexithymic traits and their possible association with early parenting. Since there is only a small number of studies regarding parental alexithymia, this thesis aims to fill the gap in both research on alexithymia and in the field of parenting. Moreover, this thesis aims to increase the knowledge on fathers' parenting abilities. The specific aims were:

1. To investigate whether parental alexithymic traits were associated with the parent's ability for reflective functioning with the infant (Study I).
2. To investigate the possible association between parental alexithymic traits and the parent's ability to develop an early connectedness with the infant, i.e., early postpartum bonding (Study II).
3. To examine observed mother's caregiving behaviour in light of alexithymic traits and the possible associations between alexithymia dimensions and dimensions of caregiving behaviour (Study III).

4 Materials and Methods

4.1 Study design and participants - FinnBrain Birth Cohort Study

The present study is based on the FinnBrain Birth Cohort Study (www.finnbrain.fi), a prospective cohort established to explore the effects of prenatal and early life exposures on child brain development, health and wellbeing (Karlsson et al., 2018). The main objective of FinnBrain is to investigate the effect of genetic and environmental factors on early programming of the brain, emotional and stress experiences, and adaptation. It is a cross-disciplinary study including, e.g., psychiatry, psychology, molecular genetics, brain imaging and sociology as the core disciplines and consisting of numerous study methods including, e.g., questionnaires, imaging, biological samples, and observational studies.

The study was first implemented in 2010. The birth cohort study population (overall $n=3808$ families) was recruited in the Turku region, Western Finland and from the Åland islands between December 2011 and March 2015. Expecting parents were initially recruited from maternity clinics during their first ultrasound visit at gestational week 12, the visit provided through public health care, free of charge to all expecting mothers. The participants were then followed through the pregnancy as well as after the birth. Self-assessment questionnaires were filled in at three time points during pregnancy, at gestational weeks 14, 24, and 34. After birth, the families were followed up with questionnaires, and some families were further recruited for sub-studies with e.g., pediatric visits, imaging studies, and observational studies.

4.2 Subjects in Studies I-III

In this study the focus was primarily in exploring parental alexithymic traits from the adults' perspective among those mothers and fathers who participated in the FinnBrain Birth Cohort Study. The flowchart of data collection is presented in *Figure 6*. In Studies I and II we included all those mothers and fathers who had filled in the relevant questionnaires regarding alexithymic traits and the chosen main outcome variable (parental reflective functioning or postpartum bonding). In Study III we included those mothers who had filled in the relevant questionnaires and

participated in an observational study of mother-infant interaction at the FinnBrain Child Development and Parental Functioning Study visit. Thus, Study I included 1882 mothers and 994 fathers and Study II included 1766 mothers and 905 fathers. Study III focused on mother-infant dyads and included 158 mothers.

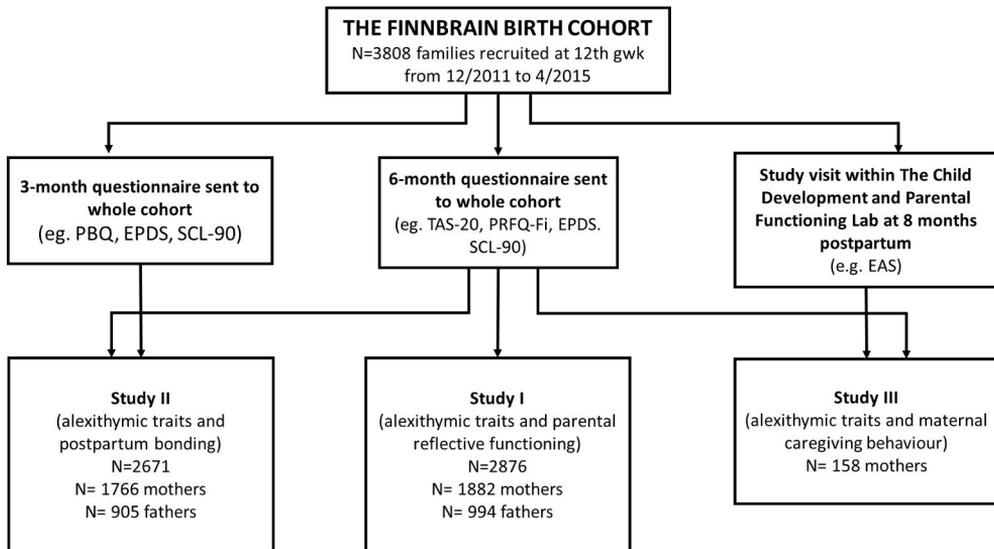


Figure 6. Flowchart of time points of data collection in Studies I-III.

Kajanoja et al. (2017) presented the results of attrition analysis regarding those participants who did not fill in the six-month questionnaire, including the TAS-20 questionnaire (Study I–III). Non-participants were more often younger and male with a low educational level. They also presented with more depressive symptoms at the prenatal time point of the study (Kajanoja et al., 2017). Regarding the observational study (Study III), the mothers participating were more often highly educated and primiparous compared to those who were invited but did not participate (Hakanen et al., 2019). For a more detailed description of the cohort profile and the representativeness of the main cohort in comparison to the general population, please see Karlsson et al. (2018).

The study samples of Studies I and II were quite similar, including both mothers and fathers and in regard to the descriptive sociodemographic characteristics of the participants. In Study III, there were many fewer mothers with a low level of education than in Studies I and II. The sociodemographic characteristics of participants in Studies I–III are presented in Table 1. In regard to other comparable variables, the distribution of age, gestational weeks and parity were very much alike in Studies I–III as presented in Table 2 in the Results. Most of the mothers were primiparous in all three studies. The vast majority of all participants were in a

relationship. Over 50% of mothers and fathers in all three studies fell into the monthly income class of €1501–€2500.

Table 1. Sociodemographic characteristics of participants in Studies I-III.

	Study I				Study II				Study III	
	Mothers n=1882		Fathers n=994		Mothers n=1766		Fathers n=905		Mothers n=158	
	%	M(SD)	%	M(SD)	%	M(SD)	%	M(SD)	%	M(SD)
Age		30.2 (4.7)		31.9 (5.4)		30.7 (4.4)		32.6 (5.4)		31.0 (5.0)
Gwks		39.3 (1.8)		39.7 (1.9)		39.4 (1.7)		39.4 (1.6)		39.9 (1.7)
Educational level										
Low	37.9		48.9		31.5		42.0		19.2	
Middle	29.1		26.4		30.4		29.1		41.0	
High	33.0		24.7		38.1		28.9		39.7	
Parity										
Primiparous	51.5		NA		54.0		NA		58.0	
Multiparous	48.5		NA		46.0		NA		42.0	
Monthly income										
≤ €1500	36.0		18.6		35.8		18.9		15.4	
€1501–€2500	53.5		54.7		53.7		54.2		53.2	
€2501–€3500	9.2		22.5		9.2		22.8		28.8	
≥ €3500	1.3		4.2		1.3		4.1		2.6	
Relationship status										
In partner relationship	98.7		99.3		98.8		99.4		96.7	
Divorced/separated	0.3		0.2		0.2		0.2		2.0	
Not in a relationship	1.0		0.4		0.9		0.4		1.3	

4.3 Questionnaires

4.3.1 Alexithymic traits

For measuring alexithymic traits we used the 20-item Toronto Alexithymia Scale (TAS-20). The TAS-20 has been proven to be reliable and valid instrument for measuring alexithymic traits (Bagby et al., 2020), and thus it is indeed one of the most-used assessment tools for this purpose in different languages and cultures. In this study we used the version that has been validated in the Finnish language by Joukamaa et al. (2001). TAS-20 is a self-report scale that consists of 20 items. All items are rated on a 5-point Likert scale of 1 (strongly disagree) to 5 (strongly agree), and the total score ranges from 20 to 100. TAS-20 can be used as a total score where a greater score indicates a higher level of the alexithymic traits. (Bagby et al., 1994a; Bagby et al., 1994b.) However, it also comprises the following three dimensions: Difficulty in Identifying Feelings (DIF), Difficulty in Describing Feelings (DDF)

and Externally Oriented Thinking (EOT) that can each be detected as a total score for the given dimension. The result can be interpreted accordingly to the total score of the whole scale: a greater score indicates a higher level of alexithymic traits in the given dimension. Usage of the dimensional approach enables the exploring of a more specific nature of alexithymic traits and their expression, as well as comparisons between the dimensions. In addition, there are established cut-off points for high (>60 points), moderate (52–60 points) and low (< 52 points) levels of alexithymic traits, and these cut-off points are drawn from the total score of the TAS-20 scale (Taylor et al., 1997).

In Studies I–III alexithymic traits were measured at six months postpartum. TAS-20 was applied in these studies as a dimensional measure instead of a categorical approach. Thus, the total score of TAS-20 as well as its dimensions DIF, DDF and EOT were used in Studies I–III.

4.3.2 Parental reflective functioning – PRFQ-Fi

In this study, parental reflective functioning was measured with a 14-item self-report questionnaire, PRFQ-Fi, derived and adjusted from the original 39-item Parental Reflective Functioning Questionnaire (PRFQ) by Luyten et al. (2017). The original PRFQ is a self-report questionnaire that was designed to assess parental reflective functioning in parents up to the child's age of five (Luyten et al., 2009 unpublished manuscript; Luyten et al., 2017). The measure used in this study, the PRFQ-Fi, was developed within the FinnBrain Birth Cohort Study especially for assessing PRF in the very early parenting phase (Pajulo et al., 2018). Each item of the scale is rated on a Likert-scale from 1 (strongly disagree) to 7 (strongly agree). Thus, the total score ranges from 14 to 98.

The 14 items of the PRFQ-Fi include four factors: Factor 1 (F1) 'Interest and curiosity in child's individual mental states', Factor 2 (F2) 'Understanding the opaque nature of mental states', Factor 3 (F3) 'Appropriateness of reasoning about mental states underlying child's reactions', and Factor 4 (F4) 'Acknowledging the uncertainty in interpreting child's mental states'. Higher factor and total scale scores indicate higher levels of parental reflective functioning. The theoretical sum index score range for the total scale as well as the factors is 1–7. (Pajulo et al., 2018.) Parental reflective functioning was measured at six months postpartum. PRFQ-Fi total score was used in Study I as a continuous variable.

4.3.3 Postpartum bonding – PBQ

The Postpartum Bonding Questionnaire (PBQ; Brockington et al., 2001; Brockington et al., 2006) is a 25-item self-report questionnaire designed to assess the quality of

early parental postpartum bonding. The PBQ is reportedly a valid and sensitive method for screening disturbances in the early parent-infant relationship (Garcia-Esteve et al., 2015), and thus, it has been widely used in different studies (e.g., Moehler et al., 2006; Muzik et al., 2013). Despite the fact that the vast majority of the studies have been conducted among mothers, the PBQ has also been used as a measure among fathers (Bieleninik et al., 2021; Edhborg et al., 2005; Klemetti et al. 2018). The English version of the scale has been translated into Finnish according to the back translation method. However, the psychometric properties of the Finnish version of the PBQ have not yet been reported thoroughly. The PBQ has been used in population-based studies (e.g., Klemetti et al. 2018; Nolvi et al., 2016; Rusanen et al., 2021).

The scoring of the items ranges from 0 ('never') to 5 ('always'), with the maximum total score for the PBQ being 125. A higher score indicates more problems in postpartum bonding. The original version includes four factors: 'a general factor' (Factor 1), 'rejection and pathological anger' (Factor 2), 'anxiety about the infant' (Factor 3) and 'incipient abuse' (Factor 4; Brockington et al., 2001; Brockington et al., 2006). The PBQ total score and Factor 1 alone have both been reported as satisfactory, and therefore they both have widely been used to identify mothers with problematic bonding. In turn, Factors 2–4 has been shown unsatisfactory in performance as independent indicators of suboptimal bonding. Therefore, these factors are not used very commonly in research. In addition to using PBQ total score and its factors as continuous variables, there are established cut-off points for both the PBQ total score (cut-off point 26) as well as Factor 1 (cut-off point 12). The score exceeding the cut-off point indicates potential bonding problems. (Brockington et al., 2001; Brockington et al., 2006.) In Study II, the PBQ total score was used as a continuous variable. The questionnaire data was collected at three months postpartum.

4.3.4 Depressive symptoms – EPDS

Depressive symptoms were measured at six months postpartum using the Finnish version of the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987; Tamminen, 1990). The scale is reportedly a sensitive self-report measure for postpartum depressive symptoms, and thus, it has been widely used in various studies. The EPDS includes 10 items. Each item is rated on a scale of 0–3 with the total score ranging from 0 to 30 points. A higher score indicates more depressive symptoms. (Cox et al., 1987.) The EPDS can be used as a continuous variable but additionally, there are defined clinical cut-off points for possible depression (10–12) and possible severe depression (≥ 13). In this thesis, the EPDS was used as a continuous variable in all three studies. In Studies I and III, the EPDS scores collected at six months postpartum were used, and Study II used the EPDS scores collected at three months postpartum.

4.3.5 Anxiety symptoms - SCL-90

Anxiety symptoms were measured with the 10-item anxiety subscale of the Finnish version of the Symptom Checklist 90 (SCL-90: Derogatis et al., 1973; Holi et al., 1998). In this self-report questionnaire, the respondent is asked about anxiety symptoms experienced within the last month. All of the 10 items are rated with a 5-point scale measuring distress from 0 (not at all) to 4 (extreme). Thus, the total score ranges from 0 to 40 points. A higher score indicates a higher level of anxiety symptoms. Again, the scale can be used as a continuous variable, but there are established cut-off points for significant anxiety symptoms (> 9 points; Derogatis et al., 1973; Holi et al., 1998). In this thesis, the SCL-90 anxiety subscale was used as a continuous variable in all three studies. In Study I and III, the SCL-90 anxiety scale scores collected at six months postpartum were used, and Study II used the SCL-90 anxiety scale scores collected at three months postpartum.

4.3.6 Sociodemographic factors

Age

Participants reported their age in the initial recruitment, when entering the FinnBrain Birth Cohort Study. Age was applied as a continuous control variable in all three studies.

Length of gestation

Data on gestational weeks at the time of birth were drawn from hospital records and complemented with data from the Medical Birth Register held by the National Institute for Health and Welfare (THL, 2021). Information of gestational weeks was used as a control variable in all three studies.

Parity

Information on parity was asked in the first trimester when entering the study. Parity was coded dichotomously as 1. Primiparous and 2. Multiparous and it was used as a control variable in all three studies.

Educational level

The information on educational level of the participating mothers and fathers was asked prenatally when entering the birth cohort study. Educational level was divided into three classes: 1) low: high school, vocational degree or lower education; 2)

middle: college degree or applied science degree; and 3) high: university education. Educational level was used as a control variable in all three studies. To be able to include educational level in the main analyses in Studies I and II, the variable was collapsed into a dichotomous form by combining college degree or applied science degree with university education as ‘high educational level’, leaving high school, vocational degree or lower education as one variable, ‘low educational level’.

Monthly income

Participants’ monthly income was asked when entering the birth cohort study. The level of monthly income in euros was divided into four different sub-classes: 1) very low <€1000; 2) low= €1001–€2000; 3) middle= €2001–€3000; and 4) high >€3000). Monthly income was used as a control variable in Study III.

Relationship status

Relationship status of the participants was asked in the first trimester when entering the study. It was divided into three classes: 1) married or in a registered relationship, 2) not married, and 3) divorced or separated. The relationship status of the participating mothers was used as a control variable in Study III.

Gender of the baby

Gender of the baby was drawn from the Medical Birth Register held by the National Institute for Health and Welfare (THL, 2021), and it was used as a control variable in Study III.

4.4 Observational method; maternal caregiving behaviour

Maternal caregiving behaviour was assessed using the Emotional Availability Scale (EAS) 4th Edition. The EAS has been developed for observational studying of the parent-infant interaction. (Biringen et al., 1998; Biringen, 2008.) As a measure, the EAS aims to describe the overall quality of a parent-child relationship by reflecting both the parent’s as well as the child’s perspective (Saunders et., 2015). It includes four dimensions measuring the adult’s perspective (Sensitivity, Structuring, Non-intrusiveness and Non-hostility) and two dimensions measuring the child’s side of the interaction (Child Responsiveness and Involvement).

Sensitivity refers to the adult’s ability to create and maintain positive and emotionally responsive behaviour towards the child. Structuring reflects the adult’s ability to support the child’s individual learning processes by guiding and

maintaining contact with the child and simultaneously enabling the child to learn independently. Non-intrusiveness refers to the adult's ability to let the child lead the play without the adult interfering, and to thus enhance the child's independence in actions, whereas Non-hostility refers to the adult's ability to regulate their own negative emotions during interaction. From the child's perspective, Responsiveness reflects the child's ability to be in contact with the adult and to enjoy the interaction, whereas Involvement reflects the actual initiatives to reach contact with the parent. (Biringen, 2008.) In Study III, we included the four dimensions measuring the parent's perspective (Sensitivity, Structuring, Non-intrusiveness and Non-hostility).

In the procedure, mother-infant interaction was observed in a 20-minute session of free play in a laboratory setting. The session was video-recorded for further analysis. In the beginning the mother and her infant were placed on a soft mat and provided with age-appropriate toys. The instructions given to the mother were: 'This is a free-play time with your infant. You can use the toys, or you can play without the toys. Try to play with your infant as you normally would at home.'

Assessments of the recordings were conducted by a trained clinical psychologist or a psychology master's student who did not take part in the interaction. The EAS coding was done by two blinded and reliable, trained coders in order to ensure the objectiveness and trustworthiness of the procedure. In the EAS, scores for each dimension ranges between 1 and 7, with scores from 1 to 2 indicating highly problematic, scores of 2.5–3.5 indicating detachment in mother-infant interaction and scores between 4 and 5 indicating somewhat problematic interaction. Scores between 5.5 and 7 are indicative of healthy interaction in the relationship (Biringen and Easterbrooks, 2012).

The EAS has reportedly showed good short-term test-retest reliability and stability (Bornstein et al., 2012). However, for the child dimensions, the EAS has not been reported to be as stable and consistent in the short term (Endendijk et al. (2019). The long-term continuity between infancy and toddlerhood has been evident, even though maternal sensitivity, structuring and non-intrusiveness have been reported to develop over time (Bornstein et al., 2012).

4.5 Statistical analyses

All statistical analyses in all the studies were conducted using the IBM SPSS software (version 24 or 26). In all studies, the limit for statistical significance was set at $p < 0.05$ (two-tailed), but additionally the significance level of $p < 0.001$ was taken into account.

4.5.1 Initial analyses of Studies I–III

Analyses in Studies I and II were performed separately for mothers and fathers. In Study III only mothers were included. All three studies (I–III) included similar steps of initial analyses before proceeding to the main analyses. Firstly, the normality of each continuous variable was assessed with the Shapiro-Wilk test, but also visually from histograms. The descriptives for parametric variables were means and standard deviations, and for non-parametric variables the descriptives used were medians and interquartile ranges. To evaluate the reliabilities and internal consistencies of each continuous variable used in Studies I–III, Cronbach’s alphas were calculated.

Studies I–III included correlation analyses conducted between the independent and dependent variables, and because in all three studies some of the variables were non-normally distributed, the method of choice was Spearman’s correlation. The variables entered in the correlation analyses in each study are declared in *Figure 7*. In Studies I–III the strengths of the correlations were interpreted with correlation coefficients in three levels (<0.5 for weak, 0.5–0.7 for moderate and >0.7 for strong correlation).

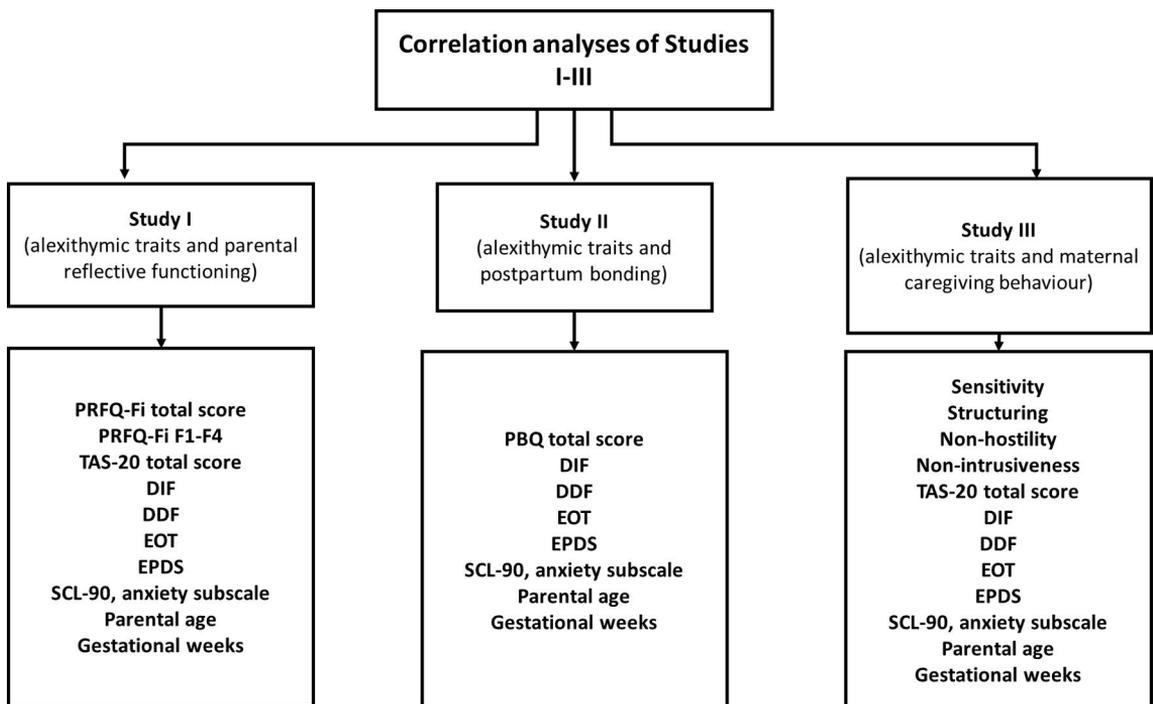


Figure 7. Variables entered in Spearman’s correlation analyses in Studies I-III.

Because Studies I–III all also included categorical variables, additional initial procedures and analyses were conducted to detect which of the variables should be entered in the main analyses. In Studies I and II, group comparisons according to the outcome variable (PRFQ-Fi total score; PBQ total score) were conducted with the independent samples t-test for parity and educational level. In Study III, categorical variables were explored with the Mann-Whitney U-test for dichotomous variables (parity and sex of the baby) and the Kruskal-Wallis test for those background variables that included more than two categories (educational level, monthly income and marital status).

In addition, in Study I the TAS-20 total scores of the current study population were compared to those presented in general population studies for both mothers and fathers separately with the independent samples t-test. Cohen's *d* values (Cohen, 1988) were calculated to further evaluate the effect sizes.

In Study II, independent sample t-tests were run to compare the means of mothers' and fathers' scores in DIF, DDF, EOT and PBQ total scores. Again, effect sizes were evaluated with calculating Cohen's *d*. In both Studies I and II, the effect sizes were evaluated in three levels (small ≥ 0.2 , medium ≥ 0.5 and large ≥ 0.8).

4.5.2 Main analyses

4.5.2.1 Study I

Multiple linear regression analyses were conducted to explore the associations more deeply between alexithymic traits, parental reflective functioning and the associated background factors. The analyses were conducted in two steps. Initially the TAS-20 total score was entered in the model in Step 1, but not the individual alexithymia dimensions, to detect whether alexithymic traits in general were associated with parental reflective functioning in the regression model. Because the association between the TAS-20 total score and PRFQ-Fi total score was detected in Step 1, the analyses proceeded to Step 2 with taking separate alexithymia dimensions into account instead of the TAS-20 total score. Additionally, other independent variables entered in the models were those detected to significantly correlate with PRFQ-Fi total score. Thus, the analyses included independent variables for age, educational level, parity, TAS-20 (Step 1) and alexithymia dimensions of DDF and EOT (Step 2) for mothers. Accordingly, the analyses for fathers included independent variables for EPDS, SCL-90 and TAS-20 (Step 1) and alexithymia dimensions of DIF, DDF and EOT (Step 2). To carefully evaluate the suitability of the regression analyses also conducted with non-normally distributed variables, assumption testing was performed, including assessment of multicollinearity (variance inflation factor, VIF) and scatterplots.

4.5.2.2 Study II

In Study II, hierarchical regression analysis was the method chosen to explore the more specific associations between alexithymic traits and postpartum bonding. Regression analyses were performed stepwise, and in all analyses PBQ total score was the dependent variable. In the regression model including mothers, the covariates of EPDS and SCL-90 were entered first in Step 1, educational level and parity in Step 2, and finally, the TAS-20 dimensions DIF and DDF in Step 3. In the regression model including fathers, covariates EPDS and SCL-90 were entered first in Step 1, educational level in Step 2 and TAS-20 dimensions DIF, DDF and EOT in Step 3.

Again, careful consideration of the suitability of the models with inclusion of non-normally distributed variables was assessed by assumption testing. No multicollinearity was observed by the variance inflation factor (VIF), and a linear relationship between the dependent and independent variables was detected by visual evaluation of scatterplots.

4.5.2.3 Study III

In Study III, four different models were built using the General Linear Model (GLM) to explore the associations between different TAS scores and EAS dimensions (Sensitivity, Non-intrusiveness and Non-hostility) and potential confounding factors. In Model 1, the association between Sensitivity and TAS-20 total score was explored by controlling for educational level. Similarly, in Model 2, the association between Sensitivity and DDF was explored by controlling for maternal educational level. In Model 3, the association between Non-hostility and EOT was explored, but no background factors were included due to lacking associations in the initial analyses. Lastly, in Model 4, the association between Non-intrusiveness and TAS-20 total score was explored and maternal depressive symptoms, parity and educational level were controlled for. To evaluate the magnitude of the association we calculated the effect sizes by partial eta squared with three levels: small (0.01), 0.09 (medium) and 0.25 (large). As in Studies I and II, there were non-normally distributed variables entered in the final analyses. The suitability of GLM was evaluated by careful exploration of distribution of residuals of each model.

4.6 Ethical considerations

Written consent was collected from each adult participant of the FinnBrain Birth Cohort Study. In the recruitment process the parents also gave written consent on behalf of their child regarding the studies that were conducted during pre- and postnatal phases as well as in early childhood. According to the study protocol of the

FinnBrain Birth Cohort Study, the children are asked to give their own written consent later at an appropriate age and developmental phase, at approximately 7–8 years old. During the recruitment process the subjects were informed that participation is voluntary, that interrupting or declining the study is possible at any phase, and that it will not have any consequences on their future treatment or health care service use. Separate consents were asked for each type of data collection. The study protocol was approved by the Ethics Committee of the Hospital District of Southwest Finland.

5 Results

5.1 Characteristics of the main variables in Studies I-III

The study samples of Studies I–III were quite similar to each other (see Table 1 in section 4.2). The descriptives of the main study variables in Studies I–III are displayed in Table 2. The overall levels of alexithymic traits among mothers were very similar across Studies I–III, and among fathers across Studies I and II. Fathers had higher total scores of alexithymic traits than mothers in both Studies I and II with a statistically significant difference (e.g., Study I: $t(2875)=-8.91$, $p<0.001$, $d=0.33$). However, the effect size was small. In addition, in Study I, fathers had lower levels of PRFQ-Fi total scores than mothers with a statistically significant but small difference ($t(1918)=6.71$, $p<0.001$, $d=0.31$). In Study II, mothers had significantly higher mean scores of DIF ($t(2879)=4.03$, $p<0.001$, $d=0.16$) compared to fathers. In contrast, mothers had significantly lower mean scores of DDF ($t(1807)=-9.53$, $p<0.001$, $d=0.38$) and of EOT ($t(2882)=-14.95$, $p<0.001$, $d=0.58$) than fathers. Furthermore, in Study II, fathers had higher levels of PBQ total scores than mothers ($t(1941)=-9.55$, $p<0.001$, $d=0.43$) indicating more problems in postpartum bonding. The distribution of depression and anxiety symptoms of participants in all three studies were very similar.

The internal consistencies were good for the TAS-20 total score in Studies I–III. For DIF the internal consistency was good, acceptable for DDF in Studies I–III and questionable for EOT in Studies I-III. The internal consistencies for PRFQ-Fi total score were questionable for mothers ($\alpha=0.68$) and for fathers ($\alpha=0.67$) in Study I. In Study II, the internal consistencies for the PBQ total score were good both for mothers ($\alpha=0.86$) and fathers ($\alpha=0.90$). In Study III, the internal consistencies were good for Sensitivity ($\alpha=0.84$) and Non-intrusiveness ($\alpha=0.83$), acceptable for Structuring ($\alpha=0.77$), and questionable for Non-hostility ($\alpha=0.63$). In addition, the inter-rater reliabilities (Cohen's kappa) were substantial for all the EAS dimensions: Sensitivity (0.80), Structuring (0.72), Non-intrusiveness (0.85) and Non-hostility (0.70). In all three studies I–III, the internal consistencies for EPDS and SCL-90 anxiety subscale were good.

Table 2. Descriptives of the main study variables of Studies I-III.

	Study I		Study II		Study III
	Md(IQR)		Md(IQR)		Md(IQR)
	Mothers	Fathers	Mothers	Fathers	Mothers
TAS-20	39.00 (12.00)	42.00 (13.00)	39.00 (12.00)	42.00 (13.00)	39.00 (14.00)
DIF	11.00 (6.00)	10.00 (5.00)	11.00 (6.00)	10.00 (5.00)	11.00 (7.00)
DDF	9.00 (5.00)	10.00 (6.00)	9.00 (5.00)	10.00 (6.00)	9.00 (6.00)
EOT	19.00 (5.00)	21.00 (6.00)	19.00 (5.00)	21.00 (6.00)	18.00 (6.00)
PRFQ-Fi	5.27 (0.67)	5.12 (0.72)	-	-	-
F1	6.20 (1.20)	5.80 (1.40)	-	-	-
F2	4.67 (2.00)	4.67 (1.67)	-	-	-
F3	6.33 (1.33)	6.00 (1.67)	-	-	-
F4	4.33 (1.33)	4.33 (1.33)	-	-	-
PBQ	-	-	8.00 (8.00)	9.00 (11.00)	-
EAS					
Sensitivity	-	-	-	-	5.50 (2.00)
Structuring	-	-	-	-	5.00 (2.00)
Non-intrusiveness	-	-	-	-	6.00 (2.50)
Non-hostility	-	-	-	-	6.00 (2.00)
EPDS	4.00 (6.00)	2.00 (4.00)	3.00 (6.00)	2.00 (4.00)	4.00 (7.00)
SCL-90	1.00 (4.00)	1.00 (4.00)	1.00 (4.00)	1.00 (3.00)	2.00 (5.00)

TAS-20= the 20-item Toronto Alexithymia Scale, DIF = Difficulty Identifying Feelings, DDF = Difficulty Describing Feelings, EOT = Externally Oriented Thinking, PRFQ-Fi = Parental Reflective Functioning Questionnaire – Finnish version, F1 = Interest in child mental states, F2 = Opacity of child mental states, F3 =Appropriate reasoning about child mental states, F4 = Uncertainty of child mental states, PBQ = Postpartum Bonding Questionnaire, EAS = Emotional Availability Scale, EPDS = Edinburgh Postnatal Depression Scale, SCL-90 = Symptom Checklist, anxiety subscale.

5.2 Correlation analyses

Alexithymic traits as the TAS-20 total score were significantly correlated with parental reflective functioning (PRFQ-Fi total score) in mothers ($\rho = -0.17$, $p < 0.001$) as well as in fathers ($\rho = -0.28$, $p < 0.001$). Higher alexithymic traits indicated a lower level of parental reflective functioning. Additionally, all the three TAS-20 dimensions (DIF, DDF and EOT) were significantly correlated with parental reflective functioning among fathers, whereas only DIF and EOT were significantly correlated with PRFQ-Fi total score among mothers.

Similarly, alexithymic traits as the TAS-20 total score were correlated with postpartum bonding (PBQ total score) in mothers ($\rho = 0.23$, $p < 0.001$) and fathers ($\rho = 0.33$, $p < 0.001$). Thus, higher levels of alexithymic traits were associated with more problems in postpartum bonding. The strengths of correlations are presented more closely in Table 3. Paternal symptoms of depression and anxiety were correlated with PRFQ-Fi total score and PBQ total score, whereas maternal symptoms of depression and anxiety were correlated with PBQ-total score, but not PRFQ-Fi total score.

Table 3. Spearman’s correlations from questionnaire data: associations between maternal and paternal alexithymic traits and parental reflective functioning and postpartum bonding, as well as selected covariates.

	Parental reflective functioning (PRFQ-Fi total score)		Postpartum bonding (PBQ total score)	
	Mothers (ρ)	Fathers (ρ)	Mothers (ρ)	Fathers (ρ)
TAS-20	-.17**	-.28**	.23**	.33**
DIF	-.04	-.12**	.33**	.34**
DDF	-.08*	-.17**	.25**	.30**
EOT	-.24**	-.32**	-.02	.15**
Age	.05*	.03	-.03	.02
Gwks	.03	-.03	-.004	-.003
EPDS	-.02	-.11**	.44**	.42**
SCL-90	-.003	-.11*	.38**	.39**

*p<0.05, **p<0.001

TAS-20= the 20-item Toronto Alexithymia Scale, DIF = Difficulty Identifying Feelings, DDF = Difficulty Describing Feelings, EOT = Externally Oriented Thinking, PRFQ-Fi = Parental Reflective Functioning Questionnaire – Finnish version, PBQ = Postpartum Bonding Questionnaire, EPDS = Edinburgh Postnatal Depression Scale, SCL-90 = Symptom Checklist, anxiety subscale, Gwks = Gestational weeks.

The correlation analyses in Study III (Table 4) revealed that the maternal TAS-20 total score was negatively correlated with the EAS dimensions Sensitivity (ρ=-0.17, p=0.03) and Non-intrusiveness (ρ=-0.18, p=0.02). Furthermore, when exploring alexithymia dimensions, it was also found that maternal DDF was negatively correlated with Sensitivity (ρ=-0.17, p=0.04), whereas maternal EOT was negatively correlated with Non-hostility (ρ=-0.16, p=0.047). Maternal anxiety symptoms did not correlate with any of the EAS dimensions. However, depressive symptoms correlated negatively with Structuring and Non-intrusiveness.

Table 4. Spearman’s correlations (ρ) between maternal alexithymic traits and observed dimensions of caregiving behaviour as well as selected covariates.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Sensitivity											
2. Structuring	.70**										
3. Non-intrusiveness	.48**	.35**									
4. Non-hostility	.60**	.38**	.45**								
5. TAS-20	-.17*	.13	-.18*	-.14							
6. DIF	-.15	-.12	-.14	-.11	.79**						
7. DDF	-.17*	-.13	-.13	-.08	.86**	.62**					
8. EOT	-.13	-.10	-.16	-.16*	.66**	.21*	.41**				
9. SCL-90	-.12	-.05	-.15	-.09	.48**	.62**	.43**	.70			
10. EPDS	-.15	-.16*	-.19*	-.15	.54**	.64**	.46**	.25	.73**		
11. Age	.04	.13	.06	.03	-.10	-.09	-.12	.28	-.19*	.10	
12. Gwks	-.74	-.09	.10	.04	-.01	.00	-.03	.71	.03	.25	-.09

*p<0.05, **p<0.001

TAS-20 = the 20-item Toronto Alexithymia Scale, DIF = Difficulty Identifying Feelings, DDF = Difficulty Describing Feelings, EOT = Externally Oriented Thinking, SCL-90 = Symptom Checklist, anxiety subscale, EPDS = Edinburgh Postnatal Depression Scale, Gwks = Gestational weeks.

5.3 Regression analyses and the main findings of Studies I-III

The main associations found between maternal and paternal alexithymic traits and parental dimensions of reflective functioning, postpartum bonding and caregiving behaviour are presented in *Figure 8*. As shown, alexithymic traits were indeed associated with all three dimensions of parenting, but there were differences in which alexithymia dimensions were mostly associated with the given outcome explored. Interestingly, there were differences in the patterns of how alexithymia dimensions were linked with parental reflective functioning and postpartum bonding in mothers and fathers.

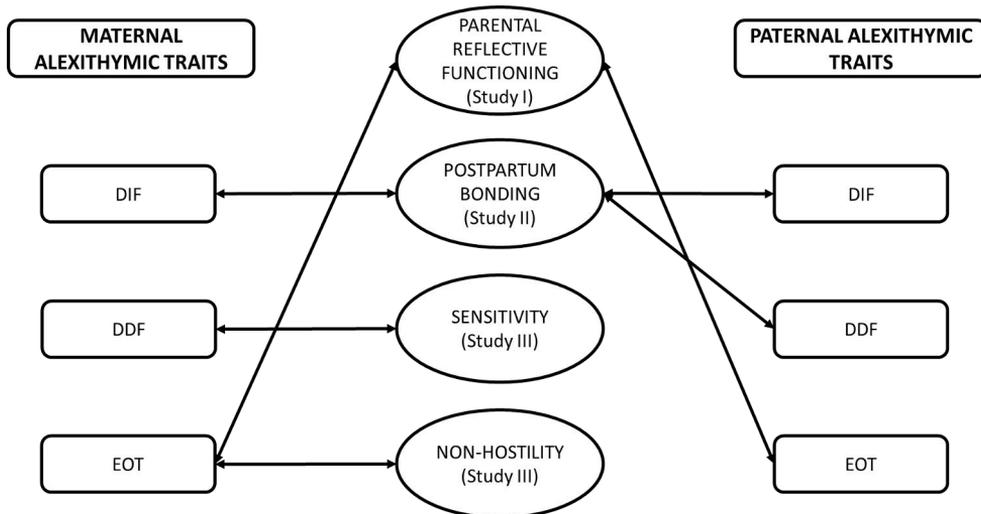


Figure 8. Main findings of the associations between alexithymic traits and parenting in Studies I-III.

5.3.1 Parental alexithymic traits and parental reflective functioning

Regression analyses were conducted to explore the association between alexithymic traits and parental reflective functioning in both mothers and fathers while controlling for correlated covariates. The results are displayed for Steps 1 and 2 for mothers and fathers in Table 5. Step 1 with the TAS-20 total score revealed that alexithymic traits indeed remained significantly associated with PRFQ-Fi total scores even when controlling for education and parity among mothers and for education, depression and anxiety symptoms among fathers. Furthermore, Step 2 indicated that EOT was the alexithymia dimension most strongly associated with the PRFQ-Fi total score both among mothers ($\beta_1 = -0.03$, $p < .001$) and also fathers ($\beta_1 = -0.04$, $p < .001$). Secondary to the initial aim of the analyses, it was found that higher

educational level was significantly associated with higher parental reflective functioning in both mothers and fathers. In addition, primiparity was associated with higher parental reflective functioning. Depression and anxiety symptoms did not show significant associations with PRFQ-Fi total score in the regression models.

Table 5. Multiple linear regression models (Steps 1 and 2) exploring the association between maternal and paternal alexithymic traits and parental reflective functioning and correlated covariates.

Mothers					Fathers				
	B	β	t	p		B	β	t	p
Step 1					Step 1				
Constant	5.39		50.91	<.001	Constant	5.71		64.52	<.001
Age	.01	.04	1.56	.12	Education	.11	.10	3.11	.002
Education	.12	.11	4.27	<.001	EPDS	.004	.03	.55	.58
Parity	-.13	-.13	-5.31	<.001	SCL-90	-.004	-.03	-.62	-.54
TAS-20	-.01	-.14	-5.93	<.001	TAS-20	-.02	-.28	-7.78	<.001
Step 2					Step 2				
Constant	5.56		53.14	<.001	Constant	5.95		61.536	<.001
Age	.01	.05	1.95	.05	Education	.08	.07	2.267	.02
Education	.09	.08	3.22	.001	EPDS	-.003	-.02	-.49	.63
Parity	-.13	-.12	-5.08	<.001	SCL-90	-.01	-.07	-1.702	.09
DDF	.001	.01	.38	.70	DIF	-.003	-.03	-.57	.57
EOT	-.03	-.22	-8.95	<.001	DDF	-.003	-.02	-.59	.56
					EOT	-.04	-.30	-8.884	<.001
<i>Step 1: R² = .06, Adj. R² = .05; F (p) = 26.27 (<.001); SE Est. = .51</i>					<i>Step 1: R² = .10, Adj. R² = .09; F (p) = 24.95(<.001); SE Est. = .53</i>				
<i>Step 2: R² = .08, Adj. R² = .08; F (p) = 32.13 (<.001); SE Est. = .50</i>					<i>Step 2: R² = .13, Adj. R² = .12; F (p) = 23.10 (<.001); SE Est. = .52</i>				

TAS-20=the 20-item Toronto Alexithymia Scale, DIF=Difficulty identifying Feelings, DDF=Difficulty Describing Feelings, EOT=Externally Oriented Thinking, EPDS= Edinburgh Postnatal Depression Scale, SCL-90 Symptom Checklist, anxiety subscale.

5.3.2 Parental alexithymic traits and postpartum bonding

The results of hierarchical multiple regression analyses for mothers and fathers are presented in Table 6. Alexithymia dimension DIF was found to significantly associate with PBQ total score ($\beta= 0.09$, $p<0.002$) among mothers, even when controlled for associated covariates. Among fathers, all three alexithymia dimensions remained positively associated with PBQ total score when controlled for associated covariates in the regression model. More closely, EOT had the strongest impact on the model ($\beta=0.11$, $p=0.001$). More moderate, but still significant, impacts were found for DIF ($\beta=0.08$, $p=0.046$) and DDF ($\beta=0.08$, $p=0.04$).

Regarding the covariates, depressive symptoms remained significantly associated with the PBQ total score both for mothers ($\beta=0.40$, $p<0.001$) and fathers ($\beta=0.32$, $p<0.001$). In addition, a sociodemographic background factor, educational level, remained significantly associated with PBQ total score among mothers ($\beta= 0.14$, $p<0.001$), and fathers ($\beta=0.12$, $p<0.001$).

Table 6. Hierarchical multiple regression models for predictors of the total score of Postpartum Bonding Questionnaire among mothers and fathers.

Model	Mothers			Fathers		
	b	SE (b)	β	b	SE(b)	β
Step 1						
Constant	5.51	0.20		7.98	0.36	
EPDS	0.69	0.05	0.41**	0.94	0.11	0.38**
SCL-90	0.20	0.05	0.11**	0.13	0.10	0.05
Step 2						
EPDS	0.71	0.05	0.43**	0.94	0.11	0.38**
SCL-90	0.20	0.05	0.11**	0.14	0.10	0.06
Education	1.78	0.29	0.13**	1.55	0.53	0.09*
Parity	-1.08	0.27	-0.09**	-	-	-
Step 3						
EPDS	0.67	0.05	0.40**	0.77	0.11	0.32**
SCL-90	0.15	0.05	0.09*	0.10	0.10	0.04
Education	1.86	0.29	0.14**	2.14	0.53	0.12**
Parity	-1.09	0.27	-0.09**	-	-	-
DIF	0.13	0.04	0.09*	0.17	0.09	0.08*
DDF	0.05	0.05	0.03	0.17	0.08	0.08*
EOT	-	-	-	0.21	0.06	0.11*

R² = 0.240 for Step 1 ΔR^2 = 0.262 for Step 2 ΔR^2 = 0.270 for Step 3

** p<0.001, *p<0.05

R² = 0.178 for Step 1 ΔR^2 = 0.183 for Step 2 ΔR^2 = 0.214 for Step 3

** p<0.001, *p<0.05

DIF= Difficulty Identifying Feelings, DDF= Difficulty Describing Feelings, EOT = Externally Oriented Thinking, PBQ = total score of the Postpartum Bonding Questionnaire, EPDS = Edinburgh Postnatal Depression Scale, SCL-90 = Symptom Checklist, anxiety subscale.

5.3.3 Maternal alexithymic traits and caregiving behaviour

Four different models using GLM were formed in order to explore the association between alexithymic traits and caregiving behaviour. The results are presented in Table 7. A significant negative association was found between Sensitivity and TAS-20 total score in Model 1 ($p=0.034$, $\eta^2p=0.029$) and DDF in Model 2 ($p=0.044$, $\eta^2p=0.026$) when controlled for maternal educational level. In addition, EOT was negatively associated with Non-hostility ($p=0.030$, $\eta^2p=0.030$). GLM's were also conducted for Non-intrusiveness and TAS-20 total score, but a significant association between the variables was not found.

Table 7. Associations between maternal alexithymic traits and the Emotional Availability scales Sensitivity, Non-hostility and Non-intrusiveness with associated covariates.

	F	p	(η^2p)	R²	Adj. R²
Model 1 – Sensitivity					
Corrected Model Predictor	5.340	.002	.095	.095	.077
TAS-20 total score	4.570	.034	.029		
Educational level	4.060	.019	.051		
Model 2 – Sensitivity					
Corrected Model Predictor	5.178	.002	.093	.093	.075
DDF	4.117	.044	.026		
Educational level	4.026	.020	.050		
Model 3 – Non-Hostility					
Corrected Model Predictor	4.790	.030	.030	.030	.024
EOT	4.790	.030	.030		
Model 4 – Non-Intrusiveness					
Corrected Model Predictor	3.053	.012	.093	.093	.062
TAS-20 total score	.460	.499	.003		
EPDS	.529	.468	.004		
Parity	3.383	.068	.022		
Educational level	3.668	.028	.047		

TAS-20 = the 20-item Toronto Alexithymia Scale, DDF = Difficulty Describing Feelings, EOT = Externally Oriented Thinking, EPDS = the Edinburgh Postnatal Depression Scale.

6 Discussion

6.1 Main findings

6.1.1 Associations between alexithymic traits and parental reflective functioning (Study I)

Study I focused on exploring the association between parents' alexithymic traits and parental reflective functioning. For instance, it was found that higher total scores on the TAS-20 were associated with lower total scores on the PRFQ-Fi among both mothers and fathers. Within the dimensional exploration, it was found that Externally Oriented Thinking (EOT) was the alexithymia dimension that had the strongest association with the reflective abilities of mothers and fathers. It is described quite extensively within parenting research that reflective functioning, also within the context of parenting, is depended on a parent's emotion regulation (Fonagy et al., 2012; Schultheis et al., 2019). Accordingly, as presented, alexithymic traits are also linked with altered emotion regulation (Luminet et al., 2006; Swart et al., 2009; Vermeulen et al., 2006), and thus deficits in emotion regulation might very well serve as one explanation for the relation between alexithymic traits and parental reflective functioning.

In more detail, as the EOT is reported to associate with deficits in automatic and further controlled attention (Luminet et al., 2021), it could be that the demands on cognitive abilities for keeping attention on an infant's yet undeveloped and rapidly changing emotional signalling might be too overwhelming for a parent with a significant tendency for externally oriented and concrete cognitive style. Because a correlational association between a parent's alexithymic traits was detected especially for the parental reflective functioning factors 'Interest and curiosity in the child's individual mental states' and 'Appropriateness of reasoning about mental states underlying the child's reactions', it might be that less interest in a child's mental states could actually be a representation of weaker attention. When the parent does not have sufficient ability to keep attention on interpreting the child's mental states, it is understandable that the conclusions on the reasoning underlying the child's mental states and thus, signalling, could later on also be less accurate and appropriate.

From the cognitive approach, attention and thus learning and memory are firmly linked together. EOT is reportedly associated with altered memory functions and especially difficulty in memorizing emotional stimuli (Luminet et al., 2021b). As parenthood and interaction with the infant, a whole new person, is basically getting to know and understand another, it could be that a parent with alexithymic traits might have increased difficulty in practice to learn and memorise the emotional cues of an infant and how best to respond to their needs. Because an infant's development is fast and diverse within the first year of life (Zubler et al., 2022), it is challenging for any parent to keep up with such frequently changing needs. For a parent with a high level of external orientation, it might be even more difficult.

6.1.2 Parental alexithymic traits and postpartum bonding (Study II)

Study II explored the relation between parental alexithymic traits and postpartum bonding with the infant. In both mothers and fathers, a significant association was indeed detected, but the alexithymia dimensions most responsible for the association were different for mothers versus fathers. Weaker maternal postpartum bonding was best explained by Difficulty Identifying Feelings (DIF) whereas weaker paternal postpartum bonding was best explained by EOT.

When talking about postpartum bonding, we refer to the emotional connectedness a parent feels towards an infant. To feel something requires awareness of the emotional state, meaning that a person is able to identify and to some extent name or describe the emotions experienced. Thus, it seems logical that difficulties in identifying the feelings and moreover the underlying emotional states are linked with experiencing an emotional connection, a bond, with the infant. Deficits in detecting, describing and naming the emotions felt could be explained by reduced emotional language. As described, altered emotional language is reportedly more common in individuals with alexithymic traits compared to those without significant alexithymic traits (Jelinek et al., 2010; Luminet et al., 2021b; Parker et al., 2000; Vanheule et al., 2011), and DIF especially is most commonly reported to explain the association. Among mothers, the relation between higher levels of DIF with weaker postpartum bonding could be partly explained by the deficits in emotional language.

This is not, however, a straightforward explanation among fathers for whom EOT presented with the strongest explanatory effect for the association. For fathers there might indeed be more practical reasons underlying the weaker postpartum bonding. Firstly, it should be acknowledged that mothers have a certain lead in the formation of the emotional connectedness with the child due to carrying the baby throughout pregnancy for nine months. Mothers typically start to form representations of the baby and themselves as mothers in the very early phases of

pregnancy (Guyon-Harris et al., 2020). Fathers may not start to develop the emotional bond more strongly until in later in the postpartum period. Therefore, fathers may start getting to know the infant with more occupation and attention towards their external and concrete needs before proceeding to the more emotionally ‘wired’ relation to the infant.

In general, a parent’s difficulties in identifying their own emotions towards the child and concentrating on fulfilling concrete needs with less attention to the emotional connectedness may lead to a situation where the parent’s and infant’s needs do not adequately meet. Specifically, the infant needs concrete care but also emotional interaction, whereas a parent with alexithymic traits might be more prone to concentrate on fulfilling the concrete needs instead of the emotional ones. Furthermore, when the parent has difficulty in fulfilling even the concrete needs due to the hardly understandable and still inconsistent signalling of the baby (which is the case for any parent), the parent’s need to feel successful in taking care of the baby is not easily reached. It becomes still more complicated when the infant is crying and fussy due to inadequate response to their emotional needs. In this case, both the parent and the infant are subject to a lack of positive feedback within the interaction. Furthermore, this discrepancy potentially increases the challenge for the parent to experience positive emotions towards the infant and, moreover, to develop and maintain an optimal postpartum bond. In conclusion, the formation of an emotional bond within the postpartum period can be delayed or especially challenging for parents with alexithymic traits and, in particular, for fathers compared to mothers due to the lead mothers have from the intense pregnancy period.

6.1.3 Relations between maternal alexithymic traits and caregiving behaviour (Study III)

In Study III the association between maternal alexithymic traits and caregiving behaviour was explored. As the main finding, a higher level of Difficulty Describing Feelings (DDF) was associated with less sensitivity in maternal caregiving behaviour whereas a higher level of EOT was associated with more hostile caregiving behaviour.

Sensitivity in caregiving behaviour is closely linked with parental reflective ability, i.e., the skill to consider an infant as a thinking and feeling individual, that enables the parent to respond to the infant’s needs accurately and timely enough. In Study I, it was detected that parental alexithymic traits were associated with weaker reflective abilities, and therefore, the relation between these two may serve as a potential explanation for the association between alexithymic traits and caregiving behaviour as well. Correlational associations were found between all three

alexithymia dimensions, but EOT was the only dimension remaining a significant explanator to reflective functioning in Study I, not DDF, which seems to associate more strongly with sensitivity in caregiving behaviour in Study III.

DDF is associated with altered emotion regulation (Luminet et al., 2021b) and may therefore be associated with caregiving behaviour through the mechanism of deficits in appraisal. DDF is reportedly associated with lower intensity of positive emotions (Fantini-Hauwel et al., 2015), which may influence an individual's perception of what situations within an interaction are important, meaning a parent with higher level of DDF might not evaluate the interaction with the infant as pleasant and thus, important, whereas a parent without prominent DDF traits would. Moreover, this could lead to less effort in interpreting the infant's cues and signals and thus more problems in accurately responding to the infant's needs. It has been suggested that DDF would be linked to avoidance in negative situations (Luminet et al., 2004). This could become evident in less sensitivity in mother-infant interaction, if the parent is less emotionally available after situations linked to negative or stressful experiences and discomfort in social situations. The association between maternal alexithymic traits and weaker sensitivity has been reported previously also by Porreca et al. (2020). However, the association was diminished to a non-significant level when controlling for depressive symptoms, and the study was conducted within mother-toddler dyads.

Higher levels of EOT being associated with more hostile caregiving behaviour within mother-infant interaction is somewhat in line with previous findings indicating that EOT is linked with higher proneness for aggression and impulsiveness in social interaction (Edwards and Wupperman, 2017; Velotti et al., 2016). However, such evidence in the context of parenting is still lacking. It is hypothesised that, again, emotion dysregulation could be the underlying mechanism. This is relevant because emotional dysregulation is likely to lead more often to behavioural responses instead of emotional ones (Edwards and Wupperman, 2017; Velotti et al., 2016), and individuals with alexithymic traits are reportedly prone to manifesting their emotions via behaviour instead of feeling them mentally, which would require sufficient cognitive processing of emotions (Luminet et al., 2021b). Hostile caregiving behaviour among mothers scoring high with EOT could indeed be a representation of a deficit in emotion regulation that furthermore leads to a defensive behavioural response in reacting to overwhelming situations with the infant. A weaker ability for parental reflective functioning may also be relevant concerning the association between EOT and hostility, since it is reported that mothers with a better capacity for parental reflective functioning are less hostile towards their 12-month-old infants compared to mothers with weaker reflective abilities (Lok and McMahon, 2006).

6.1.4 General remarks on the main findings

In Studies I and II we had the opportunity to explore both mothers and fathers, which is a great benefit in the field of parenting research. Gender differences have also been reported regarding the prevalence of alexithymia (Franz et al., 2008; Mattila, 2009) and accordingly, in Studies I and II the level of alexithymia total scores was higher among fathers than mothers. Regarding the dimensions of parenting, mothers showed better parental reflective functioning abilities and stronger postpartum bonding than fathers, which is in concordance with previous literature (Benbassat and Priel, 2015; Bieleninik et al., 2021). The potential explanations for gender differences regarding reflective abilities and postpartum bond formation is, as Guyon-Harris et al. (2020) describe, that mothers start to develop representations of the baby and of themselves as a parent in very early stages of pregnancy. Being pregnant and giving birth are such extensive, physically and mentally capturing experiences that it is understandable that they might influence the parental capacity from very early on. Fathers are probably as capable in their reflective functioning and forming an emotional connectedness with the baby, but it could be that the development is not significantly enhanced until the baby is born.

It should also be acknowledged that parental leave in Finland is still mostly spent by the mother, and mothers are seen as the primary caregivers (Gislason & Guðný, 2011). However, a slight shift to a more equal distribution of parental leave is currently happening in the country. During the data collection for this study, the tendency was still that most of the mothers spent their maternal leave with the infant, at least for the first six months, during which the father typically spent first one to three weeks at home with the infant so that both parents were together at home. During the first months the infant is very attached and dependent on the mother, and the father does not necessarily have the room to interact with the infant as much as the mother (Premberg et al., 2008). In addition, mothers, as the expected primary caregivers and the ones spending the most time with the infant, are usually met in our health care systems as the parent to whom most of the information and education regarding child's development as well as the mental and physical aspects of parental well-being is provided. Thus, it could be that fathers are not necessarily receiving enough knowledge and attention in the context of their parental role, which may later be reflected in the relationship they form with their infant. Moreover, the society's expectations of the father's more active role and contribution to parenting have increased, especially in recent years (Opondo et al., 2016). This is a positive direction of development, but it comes with the responsibility for the society to further develop and provide adequate support and knowledge for both mothers and fathers.

Exploring parenting during the first year of the infant's life is not an easy task. Much is dependent on the parent's personality, previous experiences, mental and physical health, sleep deprivation and, in this context, also on partner support and

the family's emotional climate, just to name a few factors. From the infant's perspective, their developing temperament, sleeping patterns, quite common allergies and other somatic complaints, such as colic, may influence greatly the relationship between the parent and infant, especially during the first months. Thus, it is an indisputable fact that it is not possible to control for all the possible associated factors when exploring associations between certain hypothesised risk factors or explanators and parental dimensions. However, it is important to acknowledge that especially in the study design, which is cross-sectional, most probably some important covariates are lacking, the associations are not straightforward, and they do not provide absolute truths and answers. The complexity of the phenomena explored might be the reason why the magnitude of the associations found remained only small to moderate; so many factors potentially influence the relationship between a caregiver and infant that it is impossible to be able to control all of them. Within the given study population, the overall level of alexithymic traits was not very high; it could be that within a study population with higher levels of alexithymic traits, the association with parenting and its dimensions could also have been more evident through greater influence on emotion-linked interaction with the infant.

6.2 Strengths and limitations

As in any study, this one has several limitations that should be addressed. For instance, the study population in the FinnBrain Birth Cohort study and thus also within Studies I–III had a relatively low level of alexithymic traits in comparison to those reported previously in population-based studies (e.g., Franz et al., 2008; Salminen et al., 1999). It could be that a birth cohort study attracts more participants who are in steady relationships and particularly interested in children's and their own well-being. Therefore, individuals with alexithymic traits who are reportedly more likely to have interpersonal problems and possibly less interest in exploring such things are not as likely to participate in such studies as likely as individuals without pronounced alexithymic traits. Thus, the relatively low level of alexithymic traits in this study population might be due to selection bias. However, there might also be benefits in a lower level of alexithymic traits when parenting abilities are studied in a context in which psychopathology is considered as a covariate but not the focus of the study. As presented, there are numerous potential confounding factors related to the context of early parenting, and thus, conducting a study within a relatively healthy general population sample enables less controlled factors to be considered. In addition, alexithymic traits are not considered as a pathology but a dimensional personality construct, and therefore, a convenience sample in studying alexithymic traits and parenting abilities could indeed be beneficial. A general population sample including participants quite engaged in the study serves as a good source for studying

subclinical traits in light of increasing knowledge for possible future preventive methods/interventions on families' well-being. As described by Karlsson et al. (2018) the FinnBrain cohort population has been evaluated as representative even after loss of attrition.

In addition, there was a relatively high number of participants in all Studies I–III who could be considered adequate in this context, especially regarding fathers' participation as well as observational study. Studies I and II included mothers and fathers, but a limitation regarding the study population is that Study III included only mothers. Whereas inclusion of fathers can be considered a great strength in Studies I and II because the knowledge of paternal parenting abilities is still scarce, it would have been very interesting to include fathers in the observational study of caregiving behaviour. This is because father's caregiving behaviour is not studied extensively enough and especially not with objective, observational methods. All in all, it could be considered that providing new information on any aspect of paternal parenting abilities contributes to filling the gap in parenting research.

As a limitation of the study design, it could be discussed whether mothers and fathers should have been studied together and not separately. However, exploring some main gender differences regarding the alexithymia dimensions as well as parenting dimensions was possible by the combined section of the data. It was considered important to explore mothers and fathers separately also, to gain detailed information of the dimensionality of alexithymic traits in regard to parenting abilities. Thus, it was decided to conduct the main analyses separately for mothers and fathers. It should be noted that there were fewer fathers than mothers, and therefore, comparing the results between genders should be done with caution.

Some critique could be directed to using self-reports in measuring phenomena like alexithymic traits, parental reflective functioning and postpartum bonding. It has been questioned whether self-reports are adequate measures for detecting problems in people's own emotional abilities, such as alexithymic traits, since the deficit itself may influence the way a person reports to the questionnaire (Lane, 1997). Regarding usage of self-reports in measuring parental reflective functioning, there has been discussion on how much verbal abilities and educational level might affect performance in the self-report questionnaire (Shai and Belsky, 2011). However, TAS-20 has been the gold standard of measuring alexithymic traits for years and has repeatedly been shown as a reliable and valid measure (Bagby et al., 2020). Accordingly, questionnaires for measuring parental reflective functioning have been developed in large population studies and to date, are the most widely used methods for this purpose (Luyten et al., 2017; Pajulo et al., 2018). As studies focusing on alexithymic traits and parenting are still scarce and new to the field, it is important to carefully evaluate the performance of the measures used within this context in future studies.

In regard to the measures used, EOT showing only questionable internal consistency could influence the reliability of the measure. This should be noted when evaluating the associations between EOT and maternal and paternal reflective functioning in Study I, EOT and paternal postpartum bonding in Study II and EOT and maternal hostility in Study III. All in all, in Studies I–III the magnitude of associations found were small to moderate, and thus, further studies are definitely needed to deepen our understanding of alexithymic traits and emotion-linked parenting. Concerning the methods used, it is clearly a strength that in Study III maternal caregiving behaviour was evaluated by observational methods, thus improving the objectivity of the study.

As a limitation it should be noted that Studies I–III were based on cross-sectional study designs and thus, were not able to establish causality of the associations found. In addition, in Study II postpartum bonding was measured at three months postpartum whereas alexithymic traits were measured at six months postpartum. This discrepancy is due to the fact that this was a secondary sub-study of a larger birth cohort population study. However, alexithymic traits are reportedly as relatively stable among adult populations (Hiirola et al., 2017) and even during pregnancy (Le et al., 2007).

6.3 Clinical implications and future directions

As this study serves to fill the gap in both alexithymia and parenting research, it is important to discuss the future directions and clinical implications related to the main findings of this study. Alexithymic traits as relatively common personality features can potentially influence more families than we know. Thus, better detection of mothers and fathers with alexithymic traits could provide a tool for preventive health care. The TAS-20 is a relatively short and easily administered questionnaire that could be used in maternity clinics and primary health care for a general population with the object of better identification of those parents who are potentially at risk for deficits in emotion-linked parenting.

To date, no specific program has been developed for alexithymic traits. However, interventions for enhancing parenting abilities among the general population are a relatively new approach but have been reported to show promising results. For example, enhancing maternal sensitivity with video-feedback intervention has reportedly been beneficial (Alsancak-Akbulut et al., 2020), as has been a mentalisation-based program among first-time parents (Kalland et al., 2016; Sourander et al., 2021). Future studies are needed to assess whether it would be beneficial and effective to direct these kinds of parenting interventions specifically to parents with alexithymic traits. One still unsolved question is whether alexithymic traits need to be treated, and if so, what would be the method of choice. It is suggested

in the literature that even if one parent exhibits an optimal parenting style, it may very well prevent the development of alexithymic traits in the child (Kooiman et al., 2004). Thus, the question is if an intervention were applied, to whom in the family it should be provided in order to gain the best results.

In addition to the clinical implications related to the findings of this study, many future directions of the studies needed can be addressed. It would be interesting and improve our knowledge on parental alexithymic traits to study parent-infant dyads or even triads in the context of alexithymic traits and parenting. Since sensitivity especially in caregiving behaviour has been previously linked to parental reflective functioning ability, it could be that reflective functioning potentially mediates the relationship between parental alexithymia and weaker sensitivity. This hypothesis could be further tested in future studies by including mediation analyses.

Furthermore, there is a lack of knowledge on the mechanisms underlying the associations between parental alexithymic traits and emotion-linked parenting. Depressive symptoms seem to be linked with both alexithymic traits and dimensions of parenting. Therefore, whether depressive symptoms are mediating the associations between alexithymic traits and parenting could be tested. In addition, as oxytocin is reportedly beneficial in many interrelational situations, possibly even in therapeutic processes (Quirin et al., 2014), and a key hormone in parenting (Feldman and Bakermans-Kranenburg, 2017), it could be considered a relevant focus of future studies in the context of parental alexithymic traits.

As presented in section 2.2.5.2, numerous potential mechanisms in the interface of emotions and cognitions could hypothetically serve as explanations for the associations between alexithymic traits and parenting. In future studies these mechanisms should be further explored, especially by observational methods in, e.g., caregiving behaviour and verbal and nonverbal interaction. In this study we found gender differences between alexithymia dimensions and parenting dimensions, and thus it may be suggested that future studies on parental alexithymia should consider alexithymic traits dimensionally to increase our knowledge more profoundly.

7 Conclusions

This study aimed to explore possible associations between parental alexithymic traits and emotion-linked parenting dimensions. Previous knowledge on parental alexithymia is scarce, and therefore this study aimed to fill the gap in both alexithymia and parenting research. The main findings of the current study imply that higher levels of both maternal and paternal alexithymic traits are indeed associated with weaker parental reflective functioning and more problems in postpartum bonding. In addition, maternal alexithymic traits were shown to associate with weaker sensitivity and higher hostility in maternal caregiving behaviour. Because research on these specific topics is greatly lacking, the findings of the current study cannot be reflected to previous knowledge in a straightforward manner. However, according to the results of this study, different dimensions of alexithymic traits were associated with different dimensions of parenting, implying that alexithymic traits should indeed be seen as dimensional personality constructs with different facets. Recent studies and reviews suggest that alexithymic traits lie at the interface of emotions and cognitions. Moreover, different potential mechanisms, e.g., altered emotion regulation, also underlying the association between alexithymic traits and parenting, are linked with specific dimensions of alexithymic traits (DIF, DDF and EOT). Therefore, it would be relevant to take different alexithymia dimensions into account in future studies and explore the mechanisms more closely. As a clinical implication, firstly better recognition of alexithymic traits could provide a tool to identify those families at risk for suboptimal parenting. Subsequently, possible future interventions and the question of whether alexithymic traits should be treated or whether the focus should be on enhancing parenting abilities remain to be solved in future studies.

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