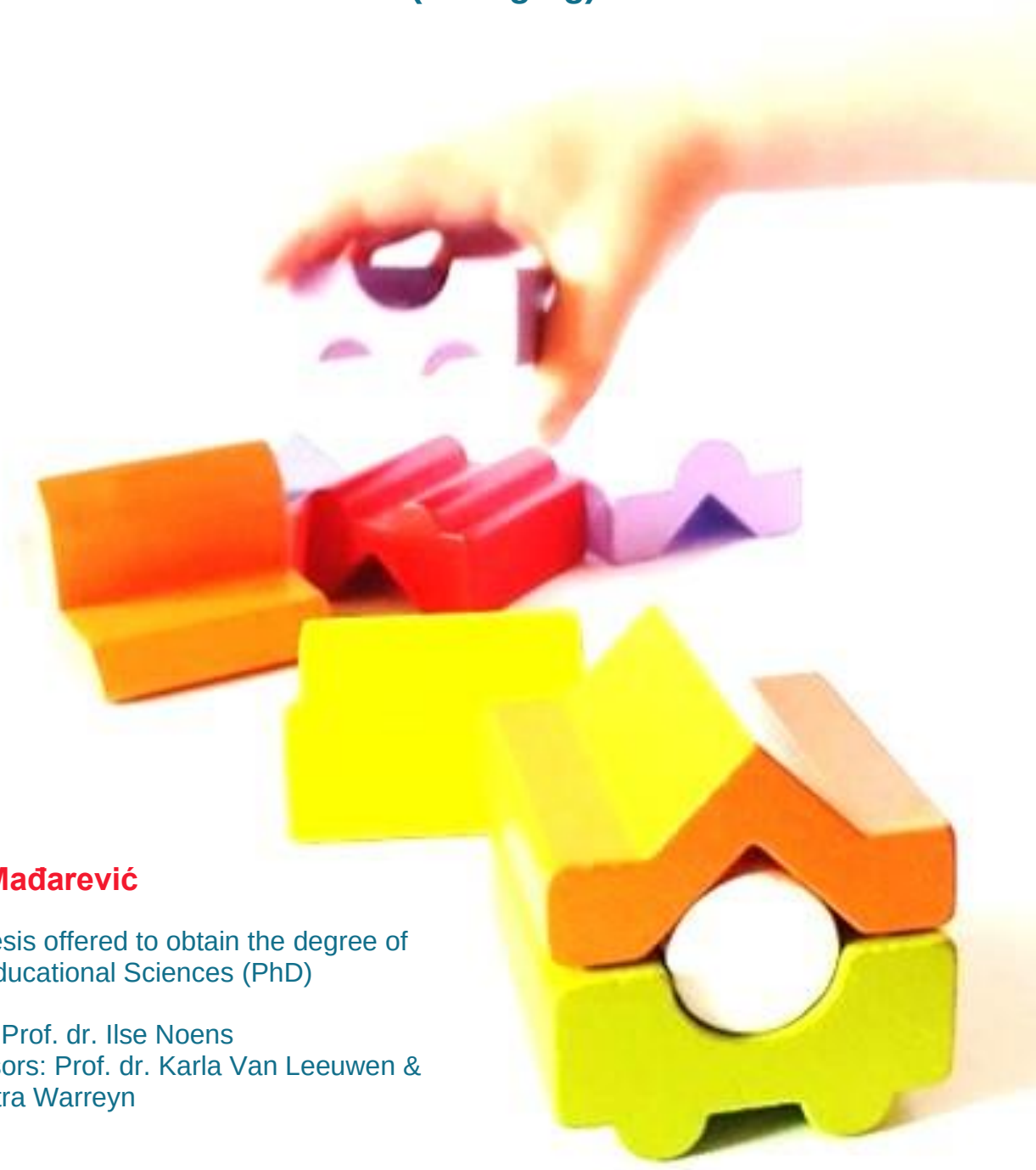
KU LEUVEN

FACULTY OF PSYCHOLOGY AND
EDUCATIONAL SCIENCES

PARENTING AND SPECIAL EDUCATION RESEARCH UNIT

In all its colours and complexity

A conceptual and methodological study on parenting young children in the context of (emerging) autism



Melinda Mađarević

Doctoral thesis offered to obtain the degree of
Doctor of Educational Sciences (PhD)

Supervisor: Prof. dr. Ilse Noens
Co-supervisors: Prof. dr. Karla Van Leeuwen &
Prof. dr. Petra Warreyn

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Melinda Mađarević – In all its colours and complexity. A conceptual and methodological study on parenting young children in the context of (emerging) autism

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Parenting can be viewed as a relationship in which parent and child influence each other over an extended period of time, creating a spiral of intertwined reciprocal influences. In the context of autism, the hypothesis was formulated that genetic factors associated with autism, present at birth, may alter a child's interaction with its social environment (including parenting), and that this gene-environment interaction may amplify early susceptibilities and contribute to a later autism phenotype. The development of parenting and autism can be investigated with prospective longitudinal follow-up studies. To date, these mainly included (parents of) younger siblings of autistic children ("siblings"), although very and extremely prematurely born infants ("preterms") are also at elevated likelihood (EL) of autism. As siblings and preterms share an increased likelihood of autism but differ in other aspects, an exploration of their similarities and differences could help us better understand heterogeneity in autism.

In five chapters, this doctoral dissertation painted a picture of parenting among (mothers of) infants, toddlers, and pre-schoolers with or at EL of autism. We conceptualised parenting as an interplay between action-oriented (i.e., parent and child behaviours) and meaning-oriented (i.e., parenting stress, maternal well-being) components, that are influenced by child characteristics. Both observational measures and questionnaires were used in this doctoral project, as they are two complementary methods for the assessment of parenting.

The first two chapters focused on the conceptualisation of parenting behaviours. Our systematic review indicated that large heterogeneity exists in parenting constructs used in observational research in the autism field, and that descriptions of parenting constructs lack uniformity (**Chapter 1**). However, it was possible to create seven overarching categories of parenting behaviours, suggesting that some common core concepts exist. Partly based on these findings, we developed a coding scheme (CoPIT) to explore parenting behaviours in more detail, by assessing multiple specific behaviours in a neutral way (**Chapter 2**). By examining correlations within the CoPIT and between the CoPIT and a second coding scheme (PInTCI), we found evidence for an overarching 'warmth/support' parenting dimension, but not for a 'control/directivity' dimension. In the three subsequent chapters, we studied group differences in action- and meaning-oriented parenting components and the role of child characteristics. Overall, we observed more similarities than differences between (mothers of) siblings and preterms and between (mothers of) autistic and non-autistic pre-schoolers. In the first year of life, we found changes in child temperament, but temperament was not associated with mother-child interactions (**Chapter 3**). Preterms received higher Surgency scores, providing some preliminary evidence for the value of temperament as transdiagnostic construct. During the second year of life, we found more stability than change in reported parenting behaviours (**Chapter 4**). However, mothers from both EL groups reported an increase in disciplinary behaviours, in line with findings from the general population. Mothers of preterms also reported an increase in warm and supportive behaviours, while mothers of siblings reported no change. Exploration of the well-being trajectories indicated no group differences in initial well-being or change over time. Contrary to our hypotheses, maternal well-being was not associated with any of the parenting behaviours. Finally, we investigated whether parenting stress and externalising behaviour problems were similarly associated to observed and reported parenting behaviours among mothers of autistic and non-autistic pre-schoolers (**Chapter 5**). We found that mothers of autistic pre-schoolers demonstrated fewer sensitive and more negative behaviours during interaction with their child, and that they reported more parenting stress than mothers of non-autistic pre-schoolers. These differences could be explained by additional externalising behaviour problems, suggesting that this transdiagnostic factor may provide more insight in the dynamics between mother and child than autism characteristics or an autism diagnosis alone.

This doctoral dissertation shows us how colourful parenting in the context of (emerging) autism is, but also how complex the study of parenting can be. We provided insights in the mother-child relationship by comparing individual trajectories of children with or at EL of autism at the group level. Future research could focus on qualitative research and the application of a person-centred analytical approach. Our work will impact clinical practice as well as future scientific research.

Melinda Mađarević – Kleurrijk en complex. Een conceptuele en methodologische studie naar het opvoeden van jonge kinderen met (verhoogde kans op) autisme

Proefschrift aangeboden tot het verkrijgen van de graad van Doctor in de Pedagogische Wetenschappen, 2023

Promotor: Prof. dr. Ilse Noens, Copromotoren: Prof. dr. Karla Van Leeuwen, Prof. dr. Petra Warreyn

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Opvoeding kan worden begrepen als een relatie waarin ouder en kind elkaar beïnvloeden doorheen de tijd, waardoor een spiraal van met elkaar verweven, wederkerige invloeden gecreëerd wordt. De hypothese werd geformuleerd dat een genetische aanleg voor autisme, aanwezig bij geboorte, de interactie van een kind met zijn of haar sociale omgeving (waaronder opvoeding valt) zou kunnen veranderen, en dat deze gen-omgevingsinteractie vroege gevoeligheden kan versterken en kan bijdragen tot een later autismefenotype. De ontwikkeling van opvoeding en autisme kan worden onderzocht met prospectieve longitudinale studies. Tot nu toe gingen deze studies vooral over (ouders van) jongere broers en zussen van autistische kinderen ("siblings"), hoewel ook zeer en extreem vroeggeboren kinderen ("prematuren") een verhoogde kans (VK) hebben op het ontwikkelen van autisme. Aangezien zowel siblings als prematuren een verhoogde kans op autisme hebben maar verschillen in andere opzichten, kan het onderzoeken van hun gelijkenissen en verschillen ons meer leren over heterogeniteit in autisme.

In vijf hoofdstukken schetste dit proefschrift een beeld van de opvoeding bij (moeders van) baby's, peuters en kleuters met (VK op) autisme. We zagen opvoeding als een wisselwerking tussen een handelingsgerichte (gedragingen van ouder en kind) en een betekeniscomponent (opvoedingsstress, welzijn van moeders), die beïnvloed worden door kindkenmerken. We gebruikten zowel observatie als vragenlijsten, aangezien deze twee methodes elkaar aanvullen bij het onderzoeken van opvoeding.

De eerste twee hoofdstukken focusten op het conceptualiseren van opvoedingsgedragingen. Uit een systematisch literatuuronderzoek concludeerden we dat er grote heterogeniteit bestaat in opvoedingsconstructen die gebruikt worden voor observatie en dat beschrijvingen niet uniform zijn (**Hfst. 1**). We konden evenwel zeven overkoepelende categorieën van opvoedingsgedragingen vormen, wat aangeeft dat er toch kernconcepten bestaan. Deels gebaseerd op deze bevindingen ontwikkelden we een codeersysteem (CoPIT) om deze gedragingen in meer detail te onderzoeken (**Hfst. 2**). Correlaties binnen de CoPIT en tussen de CoPIT en een tweede schema (PInTCI) suggereerden een overkoepelende 'warmte/ondersteuning'-dimensie, maar geen 'controle/sturing'-dimensie. In de drie volgende hoofdstukken onderzochten we groepsverschillen in de handelingsgerichte en betekeniscomponenten van opvoeding en de rol van kindkenmerken. In het algemeen vonden we meer gelijkenissen dan verschillen tussen (moeders van) siblings en prematuren en (moeders van) autistische en niet-autistische kleuters. Temperament van kinderen veranderde in het eerste levensjaar, maar temperament was niet geassocieerd met moeder-kindinteracties (**Hfst. 3**). Prematuren kregen hogere Surgency-scores, wat de waarde van temperament als transdiagnostisch construct lijkt aan te tonen. We vonden meer stabiliteit dan verandering in gerapporteerd opvoedingsgedrag in het tweede levensjaar (**Hfst. 4**). Er was een stijging in disciplinerend gedrag bij moeders van beide VK-groepen, in lijn met de algemene populatie. We stelden bij moeders van prematuren een stijging in warm en ondersteunend gedrag vast, maar niet bij moeders van siblings. We vonden geen groepsverschillen in welzijn van moeders. Tegen onze verwachtingen in was welzijn niet geassocieerd met opvoedingsgedrag. Tot slot onderzochten we of opvoedingsstress en externaliserend probleemgedrag op dezelfde manier geassocieerd waren met geobserveerd en gerapporteerd opvoedingsgedrag bij moeders van autistische en niet-autistische kleuters (**Hfst. 5**). We vonden dat moeders van autistische kleuters minder sensitieve en meer negatieve gedragingen toonden in interactie met hun kind en dat ze meer opvoedingsstress rapporteerden dan moeders van niet-autistische kleuters. Deze verschillen zouden verklaard kunnen worden door bijkomend externaliserend probleemgedrag, wat suggereert dat deze transdiagnostische factor meer inzicht biedt in moeder-kinddynamieken vergeleken bij enkel autismekenmerken of een autismediagnose.

Dit proefschrift toont hoe kleurrijk opvoeden is in een (mogelijke) autismecontext, maar ook hoe complex de studie ervan kan zijn. We presenteerden inzichten in de moeder-kindrelatie door individuele trajecten van kinderen met (VK op) autisme te vergelijken op groepsniveau. Dit kan aanknopingspunten bieden voor de klinische praktijk. Toekomstig onderzoek zou kunnen focussen op kwalitatief onderzoek en persoonsgerichte data-analysetechnieken.

Table of contents

Table of contents		1
General introduction		3
Chapter 1	Conceptualisation of parenting in research on young children with or at elevated likelihood of autism: A systematic review of observational measures	19
Chapter 2	Coding parenting behaviours among mothers of infants at elevated likelihood of autism: An exploratory pilot study	51
Chapter 3	Child temperament changes during the first year of life but does not predict mother-child interactions among infants at elevated likelihood of autism	71
Chapter 4	Well-being does not predict change in parenting behaviours among mothers of young children at elevated likelihood of autism	95
Chapter 5	Parenting behaviours among mothers of pre-schoolers on the autism spectrum: Associations with parenting stress and children's externalising behaviour problems	129
General discussion		149
References		173

General introduction

The importance of early environmental experiences, such as parenting, is more and more acknowledged in research on emerging autism. The present doctoral dissertation aims to paint a picture of parenting young children in the context of autism, in all its colours and complexity. As general introduction, I will first introduce the concepts of autism and parenting. Next, I will describe two methods that are commonly used to investigate parenting (i.e., observations and questionnaires), before I turn to a summary of what previous studies have found regarding parenting in the context of (emerging) autism. Finally, an overview will be provided of the research aims and designs of the studies conducted within this doctoral project.

Concepts of autism and parenting

Autism

Autism has many meanings, and, hence, different people may mean different things when they talk about autism (Hens, 2019). Clinical practitioners and researchers generally describe autism as a neurodevelopmental disorder with biological origins and a strong genetic component, that can be diagnosed following the DSM-5 criteria (American Psychiatric Association, 2013). These criteria include deficits in social communication and interaction across multiple contexts, and restricted, repetitive patterns of behaviour, interests, or activities, that must be present in the early developmental period and cause clinically significant impairment. However, autism is also a lived and shared experience, that allows autistic people or parents of autistic children to relate and to give meaning to their lives (Hens, 2019). To acknowledge the heterogeneity of autism in behavioural characteristics but also in meanings, I will write "autism" throughout this dissertation, unless it is relevant to mention that an autism spectrum disorder (ASD) diagnosis has been given based on DSM-5 criteria. I will use a combination of identity-first (e.g., autistic child) and person-first (e.g., child with autism, child on the autism spectrum) language, as preferences differ within and between English-speaking and Dutch-speaking communities (e.g., Bottema-Beutel et al., 2021; Buijsman et al., 2022).

Parenting

Parenting can be viewed as a relationship in which parent and child influence each other over an extended period of time, creating a spiral of intertwined reciprocal influences (Pettit & Loulis, 1997; Sameroff, 2010). In addition, parenting can be seen as an interplay between an action-oriented and a meaning-oriented component (Colpin, 1999). The action-oriented component of parenting includes all

behaviours that parent and child demonstrate during their interactions, while the meaning-oriented component comprises parenting-related feelings, beliefs, and goals. These aspects influence each other, as well as the action-oriented component of parenting. Moreover, the bidirectional process of parenting is embedded in a social context that has an impact on the parent-child relationship (Colpin, 1999; Taraban & Shaw, 2018; Sameroff, 2010). The social context includes the couple relationship, the broader social network, and the work environment, that may be experienced by the parent as sources of stress and support (Taraban & Shaw, 2018). Despite its importance for parenting, I will not discuss the role of the social context in the General Introduction.

Parenting and autism

Parenting has been investigated in the context of autism from different angles and in several stages, reflecting the prevailing theories at the time. While parenting was once believed to play a primary role in the aetiology of autism, the notion of a biological neurodevelopmental origin became more dominant after the 1970s (McCauley et al., 2019). More recently, both pre- and perinatal environmental factors, including the parent-child relationship, and genetic factors associated with autism have been viewed as important components in the development of autism. The hypothesis was formulated that genetic factors associated with autism, present at birth, may alter a child's interaction with its social environment, and that this gene-environment interaction may amplify early susceptibilities and contribute to a later autism phenotype (Dawson, 2008; Mandy & Lai, 2016).

One way in which researchers can attempt to understand the development of autism and the role of the parent-child interaction herein, is to use a prospective design and start at an early stage of the parent-child relationship. Although autism can in some cases be reliably diagnosed at two years of child's age (Steiner et al., 2012), the mean age at diagnosis in Europe is 42 months (Salomone et al., 2016). Therefore, prospective studies typically include children at elevated likelihood (EL) of autism. The most commonly included group in these studies consists of younger siblings of a child on the autism spectrum ("siblings"), who have a 7-19.5% chance of developing autism themselves (Messinger et al., 2015; Ozonoff et al., 2011; Szatmari et al., 2016), compared to 1% in the general population (Zeidan et al., 2022). More recently, very and extremely prematurely born infants (i.e., infants born at a gestational age of less than 32 and 28 weeks, respectively, "preterms") have been identified as another EL group, having a chance of 7-13% to develop autism (Agrawal et al., 2018; Laverty et al., 2021; Vermeirsch et al., 2021). Their EL is related to the "preterm behavioural phenotype", a combination of biological and environmental factors associated with very or extremely preterm birth (Montagna et al., 2016).

Methods of parenting research

As described above, parenting can be understood as a spiral of intertwined reciprocal influences of parent and child behaviours, feelings, beliefs, and goals, that develops within a social context. To investigate parenting in the autism context, prospective longitudinal studies are highly valuable, as they can explore how parenting trajectories develop.

Parenting behaviours are most often assessed with observation of parent-child interactions or self-report questionnaires. For the assessment of feelings, beliefs, and goals, researchers mainly rely on self-report questionnaires or interviews, although experimental designs are also conceivable. In addition, physiological measures can be used to assess stress levels, as an approximation of parenting-related feelings. In the next section, I will describe the assessment of parenting behaviours in more detail.

Observation of parent-child interactions

Observation is a key method to study parenting behaviours, but no "gold standard" exists when it comes to which parenting constructs should be studied and how they should be operationalised. Three studies reviewed research that compared parenting behaviours between children with and without (EL of) autism and their parents, and independently concluded that large heterogeneity exists in observation protocols and measurement tools, making it difficult to compare research findings and to draw strong conclusions (Ku et al., 2019; Uzonyi et al., 2023; Wan et al., 2019). For example, studies may differ in terms of setting, tasks, positioning of the dyad, instructions, interaction length, parent-child interaction aspects, and analysis. As observational data are usually intended to be representative for interactions outside the research setting, researchers should make well-considered choices regarding setting, task, length, and parenting constructs (Aspland & Gardner, 2003).

Observation of parent-child interactions can take place at the family home or in a lab-setting. Visiting parent and child in their own house and observing naturalistic and unstructured interactions may show greater ecological validity (Jacob et al., 1995). The advantage of a laboratory setting is that the interactions take place in a standardised environment, which facilitates comparison between (groups of) children and their parents. Parent and child can be instructed, for example, to play on a mat, at the table, or in a (wheel)chair, depending on the task and possibilities of the dyad.

Play tasks can be more or less structured. During an unstructured task, parent and child may freely play with any of the materials provided by the researcher as they would do at home. Structured tasks could include tidying up, making a puzzle, or building a Lego house similar to a provided example. Different tasks may target different behaviours. Free play could assess if and how children initiate interactions with their parents, and how parents follow their child's lead. During a challenging task, children may ask for help and feedback, or get frustrated, while parents may demonstrate more directive behaviours, including verbal suggestions and physical help, verbal encouragement, and limit-setting

behaviours. Kwon and colleagues (2013) found that parent-child interactions differed according to the play task. Parents demonstrated more scaffolding (i.e., a parent's efforts to enhance the child's cognitive development at the child's level) and fewer intrusive and negative parenting behaviours, and children were more engaged and showed more complex play behaviours during free play compared to a structured task.

Parent-child interactions can be interpreted at many different levels, including interactional quality (e.g., parental sensitivity, dyadic reciprocity), and frequency and quality of specified behaviours (e.g., providing suggestions, limit-setting, disciplinary behaviours). As observations are usually rather short (five to 30 minutes), it is important to choose behaviours that are common enough to be observed during the session (Aspland & Gardner, 2003). For example, disciplinary behaviours, such as giving a time-out, may not occur during five minutes of free play, while scaffolding behaviours will more likely be demonstrated. The target behaviours should also be related to the researcher's or clinician's aims. If a researcher or clinician wants to explore how a parent deals with challenging behaviours, they may want to choose a structured task and assess proactive (e.g., structuring, limit-setting), directive (e.g., physical help, providing suggestions), or disciplinary (e.g., giving a time-out) behaviours. To explore dyadic reciprocity or synchrony, on the contrary, initiations and timely and adequate parental responses could be assessed.

Parent-child interactions are usually recorded, to enable the coding of parenting constructs afterwards. *Grosso modo*, there are two families of coding methods, macro-level and micro-level methods, that complement each other (Mesman, 2010). Macro-level coding, or global ratings, are typically used to assess the quality and frequency of certain behaviours over the whole observation period. Behaviours are scored on a Likert-type rating scale, based on a subjective estimate. The subjectivity can be decreased by providing detailed descriptions of behaviours and corresponding scores, and by intensive training. Although the coding itself is quite efficient, the training procedure is often intense and may be costly. The alternative, micro-analysis, is relatively objective, and training may be shorter. Behaviours are coded moment-by-moment for each given interval, yielding detailed information about the frequencies, durations, and sequences of behaviours. The coding process may however be very time-consuming. Given their different nature, it may not be surprising that overlap between conceptually similar constructs measured by micro-level and macro-level coding schemes is inconsistent (Bontinck et al., 2018).

Self-report questionnaires

Self-report questionnaires can be used to obtain information about parenting in a great variety of circumstances outside the laboratory setting, and might therefore be more ecologically valid. However, parental self-report is likely influenced by systematic biases, like mood or expectations of the parent, and responses may be subject to social desirability (Morsbach & Prinz, 2006). Observation and

self-report questionnaires each seem to provide unique information on parenting behaviours, as they are only weakly correlated (Boonen et al., 2015).

Although questionnaires on parenting-related feelings and cognitions are very common, self-reports are used less often in the assessment of parenting behaviours, especially among parents of very young children. Moreover, only a few questionnaires are available that assess a broad range of parenting behaviours instead of specific aspects of parenting or parenting styles.

Two of the questionnaires that have been used to assess a broad range of general parenting behaviours among a Dutch-speaking population are the Ghent Parental Behaviour Scale (Van Leeuwen & Vermulst, 2004), that was later adapted for use among parents of toddlers (PBS-T; Van Leeuwen et al., 2011), and the Comprehensive Early Childhood Parenting Questionnaire (CECPAQ; Verhoeven et al., 2017). Both questionnaires include warm and supportive parenting behaviours (e.g., When my child is scared, I'm able to comfort him/her; CECPAQ), structuring behaviours (e.g., I make sure my child's daily routine is the same day in, day out; PBS-T), and disciplinary behaviours (e.g., When my child does something I do not like, I raise my voice; PBS-T), that are scored on a Likert scale ranging from (almost) never to (almost) always.

While these questionnaires were developed for use in the general population, the included parenting constructs could also be used in atypically developing populations. The PBS has been administered to parents of autistic pre-schoolers, school-aged children, and adolescents (Boonen et al., 2015; Lambrechts et al., 2015; Lambrechts et al., 2011; Maljaars et al., 2014; van Esch et al., 2018), while the CECPAQ has been used among parents of young children with significant developmental delay (Vandesande et al., 2019).

Parenting and emerging autism

In the previous two sections, I have introduced the concepts of autism and parenting that will be used throughout this doctoral dissertation, and described which methods are commonly used to investigate parenting behaviours. In this section, I will summarise previous findings regarding the action- and meaning-oriented components of parenting in the context of (emerging) autism.

The action-oriented component of parenting: Parent and child behaviours

Three different traditions in parenting research can be described, each with their own emphasis: (a) the importance of parental bonding and attachment, (b) the importance of sensitive and responsive parenting behaviours, and (c) the timing of social interactions and the bidirectional or transactional nature of development (Gattis, 2019). In this section, the focus will be on the investigation of parenting in line with the second and third tradition. I will describe studies that investigated sensitive and responsive, but also directive or intrusive parenting behaviours, and research that studied interactive

behaviours of both parent and child, including child engagement and dyadic mutuality. As parenting behaviours and parent-child interactions have not yet been studied among EL siblings and preterms combined, I will discuss findings separately. As most, but certainly not all, studies included only mothers, I will use 'parental' behaviours and 'parent-child interactions', unless the focus was exclusively on mothers.

Findings from observational studies: EL siblings

Prospective longitudinal studies typically compare interactions between infants at EL of autism and infants at typical likelihood (TL; i.e., infant siblings of a non-autistic child) of autism and their parents. These comparisons have yielded mixed findings during the first years of life, suggesting more similarities than differences. In the first year of life, EL siblings demonstrated less liveliness at 6-10 months (Wan et al., 2012), fewer initiations at 10 months but not five months (Pijl et al., 2021), and less intense engagement at six months (Del Rosario et al., 2023), compared to TL siblings. However, they were equally attentive and responsive (Del Rosario et al., 2023; Kellerman et al., 2020; Pijl et al., 2021; Wan et al., 2012), and showed equal amounts of positive and negative affect (Del Rosario et al., 2023; Pijl et al., 2021; Wan et al., 2012). In the second year of life, EL siblings showed less attentiveness and less positive affect (Wan et al., 2013) and less responsiveness (Kellerman et al., 2020) at 12–15 months. With regard to parental behaviours, parents of EL siblings were found to be more directive than parents of TL siblings in some studies (Harker et al., 2016; Wan et al., 2012), but not in others (Del Rosario et al., 2023; Pijl et al., 2021). No differences in parental sensitivity were found (Baker et al., 2010; Del Rosario et al., 2023; Harker et al., 2016; Pijl et al., 2021; Wan et al., 2012).

Studies that investigated parent-child interactions among parents of toddlers and pre-schoolers on the autism spectrum found that parents of autistic pre-schoolers demonstrated similar levels of responsiveness and sensitivity, compared to parents of non-autistic children (Baker et al., 2010; Blacher et al., 2013; Campbell et al., 2018; Kasari et al., 1988; van IJzendoorn et al., 2007). In addition, some studies found that mothers of autistic children were more intrusive and controlling (e.g., leading the interaction without considering the child's signals) than mothers of non-autistic children (Blacher et al., 2013; Kasari et al., 1988). Finally, mothers used more supportive, responsive, and structuring behaviours and clearer instructions in interaction with their (younger) non-autistic children compared to their autistic children (Bontinck et al., 2018; Meirsschaut et al., 2011).

Findings from observational studies: Preterms

Several differences in interactive behaviours between (mothers of) preterms and full-terms have been found. Compared to full-terms, preterms demonstrated fewer facial expressions and made less (eye)contact during interaction (Bozzette, 2007). In addition, Hall and colleagues (2015) found that very preterm infants showed less positive mood compared to full-term infants (but similar negative mood) at six months, and demonstrated lower levels of activity and sustained attention. Finally, preterms

demonstrated less responsiveness (Stack et al., 2019) and less involvement (Harel-Gadassi et al., 2020; Stack et al., 2019), and mother-child dyads demonstrated less reciprocity (Harel-Gadassi et al., 2020). However, Muller-Nix and colleagues (2004) observed no differences in cooperation, compliance, difficult behaviours, or passivity. In her review of parenting preterms, Gattis (2019) concluded that parents of preterms have generally been found to be more attentive and engaged than parents of full-terms, and to stimulate their child more often during interaction. These stimulatory behaviours may at times be intrusive or controlling, although this seems to be related to higher levels of stress and anxiety among parents of preterms compared to full-terms. Most studies found no differences in maternal sensitivity (Bilgin & Wolke, 2015; Stack et al., 2019).

Findings from questionnaire studies: EL siblings and preterms

To our knowledge, no studies have used self-report questionnaires to investigate parenting behaviours among parents of EL siblings, and only very few studies have included pre-schoolers with autism (Lambrechts et al., 2015; Osborne & Reed, 2010).

Osborne and Reed (2010) investigated self-reported parenting behaviours among parents of pre-schoolers with autism, aged two to 16 years, divided in different age-groups. No control group was included, but self-reported parenting behaviour scores were compared to general population scores. They found that parents of autistic pre-schoolers (aged two to six years) reported less involvement (e.g., I spend very little time talking with my child) and substantially less communication (e.g., If I have to say no to my child, I try to explain why) with their children than the general population mean at baseline and at follow-up, 9-10 months later. However, self-reported limit-setting and autonomy support scores were comparable to the general population scores. The authors did not discuss these differences in detail, but they may be related to the fact that some of the items may not apply to autistic pre-schoolers, as it may be difficult for some children to discuss behaviours or feelings (Communication subscale) or to physically and verbally interact (Involvement subscale).

Lambrechts and colleagues (2015) compared mothers of pre-schoolers with autism to mothers of non-autistic pre-schoolers. Self-reported parenting behaviours were assessed with the PBS-T (Van Leeuwen et al., 2011), and two additional scales were used that assessed parenting behaviours specifically relevant for parents of children with autism, namely Stimulating the Development and Adapting the Environment. No group differences were found for autonomy support, rewarding, supervisory behaviours, and adapting of the child's environment, but mothers of autistic pre-schoolers reported significantly fewer disciplinary behaviours and lower scores for Stimulating the Development, compared to mothers of non-autistic pre-schoolers. The latter finding does not mean that mothers of autistic pre-schoolers do not stimulate their child's development, but rather suggests that not all items may apply to young children on the autism spectrum (e.g., "When a person is crying, I explain to my child how this person is feeling and why", and "I stimulate pretend play").

Among preterms, parental self-reports have been used to evaluate interventions for infants (Schappin et al., 2013) and pre-schoolers (Bagner et al., 2010), to understand associations with better-than-expected cognitive and motor outcomes in pre-schoolers (Neel et al., 2022), and to examine associations with sensory threshold and behaviour problems (Neel et al., 2019). No group differences in parenting styles were found between parents of preterms and full-terms at pre-school age (Neel et al., 2019).

The meaning-oriented component of parenting: Feelings and cognitions

The meaning-oriented component of parenting comprises feelings, beliefs, and goals in relation to parenting. As this doctoral project explored parenting among *young children* with or at EL of autism and their parents, and self-reports of children below the age of five may not be reliable or valid (Varni et al., 2007), I will focus on *parental* feelings and cognitions in this section.

Parenting stress, psychological distress, and parental well-being

One of the most well-studied affective concepts among parents of a child with autism is parenting stress, i.e. stress related to the parenting role. This is more specific than psychological distress, which could be caused by daily hassles, financial problems, job insecurity, or other environmental factors. Research on parenting stress consistently demonstrates higher levels of parenting stress among parents of autistic children, compared to parents of non-autistic children (for a meta-analysis, see Hayes & Watson, 2013). However, studies that investigated self-reported psychological distress yielded contrasting results. Some found that parents of children on the autism spectrum reported significantly higher levels of stress, anxiety and depression, compared to parents of non-autistic children (Padden & James, 2017; Teague et al., 2018), while Estes and colleagues (2013) found that parents of autistic toddlers reported increased parenting stress compared to parents of non-autistic toddlers, but no differences regarding psychological distress.

Although the above-mentioned findings demonstrated that parents of autistic children experience quite some parenting stress, this does not necessarily imply low well-being. The absence of stress is merely a proxy for well-being, as well-being is a subjective concept in itself, that includes a positive mood, vitality, and general interest (Topp et al., 2015). Previous studies however found that, at the group level, parents of autistic children also reported lower psychological well-being (Likhitweerawong et al., 2020) and lower family well-being (Tint & Weiss, 2016) than parents of non-autistic children. Research on well-being among parents of young children at EL of autism has remained very limited, but studies that included parents of autistic pre-schoolers suggest lower mental health and well-being levels (Green et al., 2021) and lower quality of life (Eapen et al., 2014) compared to general population norms.

Despite the challenges that they encounter, parents of autistic children also report growth experiences, such as gaining patience and tolerance, feeling empowered, becoming closer as a family, and changing their perspective on life (DePape & Lindsey, 2014; De Clercq et al., 2022).

Parenting cognitions and goals

Although several studies have investigated parents' adaptations and beliefs regarding autism, their family, health, and educational services (for a meta-synthesis, see Ooi et al., 2016), only very few studies have explicitly focused on their parenting cognitions, including thoughts, expectations, attitudes, goals, and beliefs about the parenting role. Parenting cognitions develop before a child is born, based on a parent's own upbringing and experiences throughout life, and are modified through interaction with their child once it is born (Kuhn & Carter, 2006).

Self-efficacy, defined as a feeling of competence in carrying out the parenting role, is among the best-studied cognitions. One of the first studies on this topic found that reported parenting stress, depression, and guilt were all negatively correlated with self-efficacy among mothers of autistic children, while self-efficacy was positively correlated with agency (i.e., the extent to which a parent assumes an active role in the child's development) (Kuhn & Carter, 2006). These findings were extended in a qualitative study by Meirsschaut and colleagues (2010) among mothers who had both an autistic and a non-autistic child. As hypothesised, they found that mothers reported a lower sense of self-efficacy, higher levels of stress and depressive symptoms, and more stress related to parenting incompetence towards their autistic child, compared to their non-autistic child. A trend was seen for feelings of guilt, which mothers reported having more frequently towards their non-autistic child than towards their child with autism. In half of the cases, mothers reported that these feelings of guilt interfered with their parenting competency towards their autistic child, but in only 15% of the cases mothers reported an interference with their parenting competency towards their non-autistic child. No significant associations were found between feelings of guilt and other parenting cognitions. A recent study suggests that parenting self-efficacy may be boosted through parental involvement in child interventions (Kurzrok et al., 2021). Greater involvement in and satisfaction with their child's interventions within a clinical trajectory was namely associated with greater parenting self-efficacy, while self-reported caregiver burden was associated with a lower sense of self-efficacy.

Another set of parenting cognitions regards parenting goals, or "the outcomes that parents hope to achieve while they are interacting with their children" (Hastings & Grusec, 1998, p. 465). Parenting goals may be parent-centred, child-centred or relationship-centred (Hastings & Grusec, 1998). Conti (2015) compared parent-centred goals (self-image oriented) and child-centred or relationship-centred (compassion oriented) goals between mothers of autistic and non-autistic children aged five to 18 years. She found that mothers of autistic children reported more compassionate parenting goals (e.g., having compassion for your child's mistakes or weaknesses) than mothers of non-autistic children, but similar self-image goals (e.g., getting your children to behave in a way that makes you proud). O'Nions and

colleagues (2021) further investigated parenting goals among parents of seven to 18-year-old children on the autism spectrum in relation to parenting behaviours. They found evidence for a division into 'norm adherence' and 'autonomy support and relationship' goals, that resembled but were not the same as the parent-centred and child-centred/relationship-centred goals mentioned above. Neither goal type was associated with autism characteristics, but norm adherence goals were more endorsed by higher educated parents and parents of children going to mainstream schools (i.e., no special education or home-schooling).

Relationships between action-oriented and meaning-oriented parenting components

Very few studies have investigated parenting stress and parental well-being among parents of pre-schoolers with autism, and even fewer have investigated the relationship with parenting behaviours. An exception, however, is the study of Osborne and Reed (2010), who explored this relationship among parents of autistic children aged two to 16 years at baseline and follow-up (9-10 months later). Results were analysed both for the total sample and for each age group separately. Parents of pre-schoolers with autism (aged two to six years) reported "extremely elevated levels of parenting stress" at baseline (p. 411), and these high initial levels of parenting stress were related to less self-reported involvement and poorer communication at follow-up. Moreover, less self-reported limit-setting at baseline was related to more parenting stress at follow-up, suggesting a bidirectional relationship between parenting stress and parenting behaviours. Research including school-aged children found that higher levels of parenting stress were associated with more use of material rewarding and (harsh) punishment, and more negative and criticising behaviours during interaction among mothers of autistic school-aged children (Boonen et al., 2015). Moreover, lower parental well-being was associated with less authoritative (i.e., high in responsiveness, high in demand), and more authoritarian (i.e., low in responsiveness, high in demand) and permissive (i.e., high in responsiveness, low in demand) parenting behaviours (Likhitweerawong et al., 2020).

An explanation for the higher parenting stress and lower well-being levels among parents of autistic children compared to parents of non-autistic children may be a lower sense of self-efficacy. Higher levels of parenting self-efficacy were namely related to lower levels of parenting stress and higher levels of parental well-being, mental health and family quality of life among parents of autistic children (Chen et al., 2022; Feng et al., 2022; Hastings & Brown, 2002; Taylor et al., 2021). Social support has been proposed as a possible mediator (Feng et al., 2022), as parents who reported a higher sense of self-efficacy were more likely to seek social support, which in turn increased their quality of life. Importantly, autism characteristics and adaptive behaviours were associated with parenting self-efficacy but not with parental well-being (Salomone et al., 2018; Taylor et al., 2021). This prompted further investigation of the self-efficacy construct, yielding preliminary findings suggesting that higher receptive language levels and fewer child emotional and behavioural problems were each related to a

different subdomain of parenting self-efficacy (Taylor et al., 2021). In addition, research on parenting goals showed that compassionate goals positively predicted personal and family life satisfaction and having meaning in life, whereas self-image goals only predicted seeking meaning (Conti, 2015).

In the general population, parenting self-efficacy has been found to be associated with adaptive parenting, more sensitive and responsive parenting (for a review, see Albanese et al., 2019). In the context of autism, parenting self-efficacy has been studied in the context of interventions (e.g., Russell & Ingersoll, 2021; Schrott et al., 2019; Taylor et al., 2021), but, as to my best knowledge, associations between self-efficacy and parenting behaviours have not yet been studied. However, as mentioned above, O'Nions and colleagues (2021) investigated parenting goals in relation to parenting behaviours and strategies. They found positive associations between norm adherence goals and reported use of reinforcement approaches, rules and discipline, but no significant associations between autonomy support and relationship goals and parenting behaviours.

A very interesting approach to the investigation of action- and meaning-oriented parenting components in the context of autism was adopted by Greenlee and colleagues (2023). They identified profiles of parenting experience, separately for fathers and mothers of autistic children (aged five to 12 years), based on parenting style, parenting stress, and parenting competence. Mothers could be grouped according to three profiles: *Adaptive* (41.1%; high authoritative parenting, lowest stress, and highest competence), *Average* (42.1%; sample average of all parenting indicators), and *Distressed* (16.8%; high stress, low competence, maladaptive parenting strategies). Among fathers, four profiles were identified: *Adaptive* (33.3%), *Average* (37.7%), *Distressed-Permissive* (15.3%; high stress, low competence, permissive parenting strategies), and *Distressed-Authoritarian* (13.6%; some stress, lowest competence, authoritarian parenting strategies). These profiles were differently associated with child externalising and internalising behaviour problems, with children of mothers classified as adaptive or fathers classified as adaptive or average demonstrating the fewest behaviour problems and autism characteristics.

Concluding remarks

This literature review has shown us the rich colour palette of parenting in the context of (emerging) autism. Parenting can be understood as a spiral of intertwined reciprocal influences of parent and child behaviours, feelings, and cognitions, that develops within a social context. Within autism research, most studies have compared action- and meaning-oriented components of parenting between autistic children and non-autistic children and their parents, except for parenting behaviours, that have also been studied among young children at EL of autism and their parents.

As early environmental factors, including parenting behaviours, can have a large impact on a child's long-term physical and psychosocial development (Hochberg et al., 2011; Vaiserman, 2015), it seems however essential to investigate parenting in all its facets during the first years of life, before an

autism diagnosis is generally given (Salomone et al., 2016). To investigate the development of parenting in the context of emerging autism, prospective longitudinal studies are needed that follow children at EL of autism from early life on. Many studies of this kind have been or are currently conducted (e.g., BASIS, https://www.basisnetwork.org/; BSRC, https://www.babysiblingsresearchconsortium.org/), that are typically following younger siblings of autistic children (except for the AICES study, that prospectively followed infants showing early autism signs; Whitehouse et al., 2019). However, as mentioned above, extremely and very prematurely born children are also at EL of autism. Although siblings and preterms share an increased likelihood of developing autism, they may differ in many other aspects. Apart from the origins of their possible autism development and their behavioural characteristics, they may, as a group, have had diverse experiences with regard to pregnancy and birth, medical and developmental trajectory, and family situation. An exploration of their similarities and differences with regard to parenting could help us better understand heterogeneity in autism. Moreover, parenting research among young children at EL of autism has mainly focused on an investigation of observed parenting behaviours, while far less is known about reported parenting behaviours and parenting-related feelings, such as parenting stress and parental well-being.

The outlines have already been sketched, but further steps need to be taken to explore the colours of the parenting experiences among parents of young children with or at EL autism. To paint a more detailed picture of parenting in the context of emerging autism, this doctoral dissertation provides the findings of five studies that investigated action- and meaning-oriented parenting components among (mothers of) infants, toddlers, and pre-schoolers with or at EL of autism.

Research aims

In this doctoral project, I explored parenting among two groups of children at EL of autism (i.e., younger siblings of an autistic child and very and extremely prematurely born children) and their mothers, and among autistic and non-autistic pre-schoolers and their mothers. I attempted to deepen our understanding of this topic by addressing the following five research aims: (a) to study how parenting has been conceptualised in observational measures that are used to assess parent-child interactions among children with or at EL of autism (**Chapter 1**), (b) to develop and test a coding scheme that would allow for a detailed investigation of parenting behaviours during parent-child interactions among parents of young children at EL of autism (**Chapter 2**), (c) to investigate the development of both action- and meaning-oriented parenting components, and explore possible differences between (mothers of) siblings and preterms, and between (mothers of) autistic and non-autistic pre-schoolers (**Chapters 3, 4, 5**), (d) to explore how child factors, such as temperament, externalising behaviour problems, and autism characteristics are associated with the different parenting components (**Chapters 3 and 5**), (e) to explore relationships between the action- and meaning-oriented components of parenting (**Chapters 4 and 5**).

Despite their importance for our understanding of parenting in the context of (emerging) autism, parenting cognitions and a family's social context were beyond the scope of this doctoral project.

Design and outline of this doctoral dissertation

This doctoral dissertation includes five different manuscripts. Three of these manuscripts are currently published or under review in international peer-reviewed journals. An overview of all studies and their samples, designs, methods, and focus is provided in Table 1. In this section, I will provide an outline of the remainder of this dissertation, followed by a description of the included samples.

Chapter 1 focuses on parenting behaviour constructs in autism research. Many studies have already investigated parenting behaviours in the context of (emerging) autism, but they differ greatly in terms of observational measures and parenting constructs under study. To synthesise these findings and inspire our future parenting research, we reviewed which parenting constructs were used in observational research studies including samples of children with or at EL of autism.

Chapter 2 looks at parenting behaviours in more detail. We developed and tested the Coding Parenting of Infants and Toddlers (CoPIT) coding scheme, based on the findings of our systematic review, parenting constructs from self-report questionnaires, and parent-child interaction constructs. We also compared the CoPIT to the parent scales of another recently developed and tested coding scheme, the Parent-Infant/Toddler Coding of Interaction (PInTCI; Pijl et al., 2016), to examine (a) whether the CoPIT scales correlated significantly and positively to the PInTCI scales they were based on or that measured similar theoretical constructs, and (b) which CoPIT scales could provide additional information on parenting behaviours during mother-child interactions. For this pilot study, we used recorded observations of mother-child interactions from the second wave of the TIARA study (see 'Study samples' here below).

Temperament could be a relevant transdiagnostic construct for understanding heterogeneity in autism. **Chapter 3** explores whether mother-reported child temperament was associated with observed mother-child interactions among a group of infants at EL of autism and their mothers. We investigated (a) differences in child temperament between five and 10 months of child's age and between siblings and preterms, (b) differences in mother-child interactions between five and 10 months of child's age and between siblings and preterms, and (c) associations between child temperament and mother-child interactions. Although child temperament and mother-child interactions had been studied before among siblings and preterms separately, these two EL groups had never been compared.

Previous studies consistently demonstrated higher levels of parenting stress among parents of autistic children. However, far less is known about parental well-being, especially among parents of children at EL of autism. In **Chapter 4**, growth trajectories were modelled to investigate how reported parenting behaviours and maternal well-being changed between 10 and 24 months of child's age, and

whether mothers of siblings differed from mothers of preterms. Next, we explored whether maternal well-being was associated with parenting behaviours.

Pre-school age is challenging for any parent, and may be even more so for parents of a pre-schooler on the autism spectrum. Building on previous research that investigated parenting using a multimethod approach, **Chapter 5** aimed to gain insight in parenting pre-schoolers on the autism spectrum. More specifically, we wanted to investigate whether associations between children's externalising behaviour problems and self-reported parenting stress on the one hand, and observed and reported parenting behaviours on the other hand, differed between mothers of autistic and non-autistic pre-schoolers. Moreover, we investi group differences in parenting stress, children's autism characteristics and externalising behaviour problems, and explored associations between these variables.

Study samples

Three of the empirical studies included in this doctoral dissertation (**Chapters 2, 3, and 4**) have been conducted as part of the Tracking Infants At Risk for Autism (TIARA) study, a multi-site longitudinal study that aims to identify and understand the factors that play a role in the early development of autism (www.tiara-onderzoek.be), and that included three groups of children at EL of autism: (a) infant siblings of children with an established autism diagnosis (Messinger et al., 2015; Ozonoff et al., 2011), (b) infants born prematurely, at a gestational age of less than 30 weeks (Agrawal et al., 2018; Laverty et al., 2021, Vermeirsch et al., 2021), (c) children with persistent and medically insufficiently explained idiopathic feeding difficulties (Field, 2003). TIARA is a collaboration between KU Leuven, Ghent University, and several societal partners, that is conducted in Flanders, Belgium. As part of the TIARA study, participants and their (grand)parent(s) visited one of the labs in Leuven or Ghent at five assessment waves (i.e., at the (corrected) age of 5, 10, 14, 24 and 36 months). During each lab visit, several assessments took place, among which developmental, behavioural, and neurophysiological tests, and observation of mother-child interactions. Parents filled in multiple questionnaires prior to or following each visit, reporting on their child's functioning as well as their own. Following the assessment at 36 months, a best-estimate categorical research autism diagnosis was given, based on established diagnostic assessments, multiple questionnaires, and expert judgement. As the group of children with persistent idiopathic feeding difficulties was too small for meaningful group comparisons, this EL group was only included in our pilot study (**Chapter 2**).

The fourth empirical study (**Chapter 5**) includes Flemish pre-schoolers with and without autism (26 to 66 months old) and their mothers, to bridge the gap between research in the context of emerging autism and studies including young children diagnosed with autism. These data had been collected by fellow researchers (Dr. Greet Lambrechts and Dr. Rianne Jansen) in the context of their doctoral project, but had never been fully analysed or published in a peer-reviewed journal.

Table 1

Overview of Study Designs and Participants of This Doctoral Dissertation

	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5
Aim	a	b	c, d	c, e	d, e
Parenting component	Action-oriented	Action-oriented	Action-oriented	Action-oriented, meaning-oriented	Action-oriented, meaning-oriented
Focus	Parenting constructs used in observational measures	Development of a coding scheme to assess parenting behaviours	Associations between child temperament and mother-child interactions	Associations between maternal well-being and parenting behaviours	Associations between parenting behaviours, parenting stress, child behaviour problems, and child autism characteristics
Design	/	/	Two-wave longitudinal study	Three-wave longitudinal study	Cross-sectional study
Approach	Systematic review	Quantitative	Quantitative	Quantitative	Quantitative
Method	Literature search, consensus decision-making	Observation of mother-child interaction	Observation of mother-child interaction, questionnaire	Questionnaire	Observation of mother-child interaction, questionnaire
Data analysis	Narrative analysis	Spearman correlations	Linear mixed models, generalised linear mixed models with logit link function	Linear mixed models	Mann-Whitney *U* tests, covariance pattern models
Participants	/	TIARA: siblings, preterms, feeding difficulties	TIARA: siblings, preterms	TIARA: siblings, preterms	Pre-schoolers with and without formal autism diagnosis
Age	/	10 months	5, 10 months	10, 14, 24 months	26 to 66 months
N	/	*N* = 23 (16 siblings, 3 preterms, 4 with feeding difficulties)	*N* = 155 (89 siblings, 58 preterms)	*N* = 121 (80 siblings, 41 preterms)	*N* = 42 (21 autistic, 21 non-autistic)

Chapter 1

Conceptualisation of parenting in research on young children with or at elevated likelihood of autism: A systematic review of observational measures

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Abstract

Research on emerging autism increasingly uses observational measures to investigate parenting of young children with or at elevated likelihood of autism. This systematic review analysed 21 papers narratively, including 13 unique "coding approaches" and 63 parenting constructs. Through a comprehensive consensus decision-making process, parenting constructs were classified under nine overarching categories, identified based on prior categorisation: Warmth, Responsiveness, Scaffolding, Proactive Control, Intrusiveness, Negativity, Dyad, Other, Multiple. We found large heterogeneity in observational measures, and descriptions of parenting constructs lacked uniformity. The complex categorisation process demonstrates the need for a solid conceptual framework that can inform theory and practice. This review provides a first step, but further research should investigate applicability among young children of different ages.

Introduction

The importance of early environmental experiences, such as parenting, is now more and more acknowledged in research on emerging autism. Parenting is widely viewed as a bidirectional process, in which parent and child reciprocally influence each other (Pettit & Loulis, 1997), and several studies have been following young children and their families over an extended period of time in order to gain more understanding in how parenting and child characteristics influence each other, and how this leads to different developmental trajectories (e.g., Campbell et al., 2015, 2018; Harker et al., 2016; Siller & Sigman, 2002, 2008; Wan et al., 2012; Wan et al., 2013; Watson et al., 2017; Yirmiya et al., 2006). These studies generally follow children from birth into toddlerhood and pre-school age, to fully capture the development of bidirectional parent-child interactions as well as the early development of parenting behaviour. Although most of these studies have been focusing on interactive behaviours (i.e., parent-child interaction), the heterogeneity of studied variables, sample characteristics and observational measures makes it difficult to compare them and to draw strong conclusions (for a systematic review, see Wan et al., 2019). Hence, no "gold standard" exists when it comes to which parenting constructs should be studied and how they should be operationalised in observational measures. This may have serious consequences for both research and clinical practice, as parenting assessment outcomes are needed for and used in the development and empirical testing of theories, and in the design of parenting interventions.

One very recent example of the difficulties with comparing research findings on parenting behaviour, is the meta-analysis of Ku and colleagues (2019). They compared parental behaviour between parents of children with and without autism aged 1 year 6 months to 11 years 9 months, and found that all 16 observational studies included in their analysis used different protocols and measurement tools. To solve this issue, they selected four parental behaviour categories (Warmth/Support, Behavioural Control, Negativity, and Neutral Parental Behaviour) and categorised all parenting constructs into these parenting dimensions. However, they excluded behaviours that could not be categorised under any dimension and synthesised multiple parental behaviours that tapped into the same dimension. Consequently, they suggested that clear definitions of parental behaviours and a standardised measurement tool for observing concrete parental behaviours are needed to move forward. The heterogeneity of observational measures has been addressed more in depth by Lotzin and colleagues (2015). In a comprehensive systematic review, they compared the psychometric quality of 24 observational tools for measuring parent-infant interaction. These observational tools covered a broad range of constructs, assessed at parent, child or dyadic level. Most tools included aspects of responsive caregiving, but also facets of learning support and behaviours that interfered with infant development. They found that most tools demonstrated a valid rating procedure, reproducibility and discriminant validity, but that the tools lacked factorial and predictive validity, and standardised norms. Moreover, the authors stated that observational tools often lacked a manual with clear guidelines on scoring and

interpretation. They concluded with practical recommendations for tool selection and stated that decisions should be guided by the particular purpose of the assessment, evidence for the validity of the tool, practical constraints, and the feasibility of implementing the tool in clinical practice. As the focus of this review was on psychometrics, the "wide range of heterogeneous constructs" (p. 109) was only briefly addressed by the authors.

Precisely this lack of clear parenting constructs has been discussed by Bohr and colleagues (2018), who evaluated the correspondences among four standardised measures of caregiver sensitivity. Through the computation of Pearson's zero-order one-tailed correlations and, based on these zero-order correlations, percentages of unshared variance, they discovered that large proportions of variance were unshared and that these measures may therefore evaluate different aspects of sensitivity. The authors concluded that there is "much work left to be done in standardizing and harmonizing the definition, operationalization, and, by extension, assessment of sensitivity" (p. 14). It can be expected that this lack of uniformity in the definition and operationalisation of sensitivity is similar for other parenting constructs, such as support or directiveness, that are nonetheless commonly used in research on parenting and developmental outcomes.

The operationalisation of parenting into concrete and observable behaviours is rather challenging and as a consequence, observational tools differ considerably in the parenting constructs they use to measure parenting behaviour. It may thus be problematic if heterogeneous results are treated as representative for parenting behaviour in a certain group of research participants, or used to draw conclusions about the relationship between parenting behaviour and developmental outcomes. This is even more true when participants are parents of a child with or at elevated likelihood of autism. Due to the inaccurate historical notion of "refrigerator mums", blaming cold and distant parents for their child's autism, research into the relationship between parenting and the development of autism has been limited for many decades (Reed & Osborne, 2014). Even though the bidirectional relationship between parent and child behaviour is now also studied in the development of autism (e.g., Campbell et al., 2015, 2018; Harker et al., 2016; Siller & Sigman, 2002, 2008; Wan et al., 2012; Wan et al., 2013; Yirmiya et al., 2006), with many interventions focusing on parenting behaviour (e.g., Green et al., 2017; Watson et al., 2017), it is important to be careful when addressing (the influence of) parenting behaviour in this group and to remain far from any "scapegoating" of parents.

As more and more longitudinal studies are investigating parenting of young children with or at elevated likelihood of autism (e.g., Campbell et al., 2015, 2018; Wan et al., 2012; Wan et al., 2013; Yirmiya et al., 2006), a clear conceptual framework can provide a solid foundation for the observation of parenting behaviour and thus inform theory and practice. However, this framework should consist of transparently defined and operationalised parenting constructs that are related to child developmental outcomes.

The aim of this systematic review is to take a first step towards a common language for parenting research, by critically reviewing the parenting constructs that are currently used in research on parenting

behaviour among parents of children with or at elevated likelihood of autism. As empirical studies that investigate parenting behaviours in samples of young children with or at elevated likelihood commonly use observational measures to assess parenting behaviours, we will limit our review to those parenting behaviours that are assessed with observational measures.

Methods

Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009), the following steps were taken: (a) definition of the scope of the review, (b) search strategy and study selection, and (c) analysis of relevant data.

Search strategy, study selection, and analysis of relevant data were done in four steps: (a) literature search, (b) first categorisation of the parenting constructs into categories of parenting behaviour, (c) independent categorisation of the parenting constructs into the categories defined in the second step, (d) final categorisation of the parenting constructs. In the first, second and fourth step, consensus decision-making was used to come to agreements. The second step consisted of individual and independent categorisation of the parenting constructs by three researchers.

Definition of the scope of the review

Parenting

Only papers were included that studied parenting constructs, and that used these as overarching labels for concrete, observable, interactive parenting behaviours. This means that parenting behaviours should be behaviours that can be assessed *independently*. For example, we included the construct of parental sensitive responsiveness, that assesses observable parenting behaviours as "appropriate, timely responding to infant behaviour" and "an attentive attitude, warmth, and appropriate engagement, support and structuring" (Manchester Assessment of Caregiver-infant Interaction; Wan, 2017, p. 44). We excluded interactive behaviours such as gaze of the parent, as this is only one piece of the puzzle that makes a parenting behaviour (i.e., gaze to the infant is no independent behaviour, but has to be combined with a smile and a warm tone of voice to be assessed as a 'sensitive behaviour').

Observational measures

Only papers were included that reported observations of interaction taking place either in a naturalistic or a lab setting and that were observed during free play, structured, or semi-structured observation. Since observations are usually videotaped and coded afterwards, we also included papers that used or re-used videos of parent-child interactions. We excluded papers that reported on parent-child interaction during the *Strange Situation* procedure, as this procedure uses a very specific protocol

for studying the concept of attachment. Intervention studies were included only when they reported observational measures at baseline.

Young children with or at elevated likelihood of autism

Papers were selected that investigated child development in samples from birth up to a maximum mean chronological age of three years (36 months), to fully capture the start of bidirectional parent-child interactions. Moreover, earlier research findings demonstrated that it is crucial to include children up to an age of 36 months, as autism diagnoses are not always stable at this young age (Ozonoff et al., 2015; Woolfenden et al., 2012). We included only papers that described the results of young children with a diagnostic classification in the autism spectrum (ASD, autism, Pervasive Developmental Disorder, not otherwise specified [PDD-NOS], or Asperger syndrome), either as a group or as a subgroup, and studies investigating young children without a formal diagnosis but at elevated likelihood of autism, having an older autistic sibling.

Search strategy and study selection

The search procedure and study selection were carried out by the first and the last author. Search terms, inclusion and exclusion criteria were agreed upon through consensus decision-making, after which the first author conducted a literature search through three electronic databases (Web of Science, PubMed, Scopus). Articles from database inception until the 17th January 2018 were included, using the following combination of key words: observ* AND (infant OR "young child" OR toddler) AND ("parent-child interaction" OR "mother-child interaction" OR "parent-infant interaction" OR "mother-infant interaction" OR parenting) AND (ASD OR autis* OR "PDD-NOS" OR "pervasive developmental disorder" OR Asperger). Specific key words, hyphens and quotation marks were used to obtain a relevant selection of papers that could contribute to further identification of papers. This database search yielded 168 papers (Figure 1).

After duplicates were removed, title and abstract of the remaining 118 papers were screened by the first author against the inclusion criteria (Table 1), but final decisions were made through consensus decision-making. Intervention studies and papers using data from the same sample of participants were included in the review. Of these, 74 papers were excluded on the basis of title and abstract (e.g., no group or subgroup of children with or at elevated likelihood of autism was included, the study was not available in English, the study sample did not consist of humans, the study did not investigate parenting, or the study only reviewed parenting), and the remaining 44 papers were reviewed in full. Another 34 papers were excluded because they did not meet the inclusion criteria (e.g., participants were too old, no parenting constructs were assessed), resulting in a total of 10 papers that were selected for further review.

Figure 1

PRISMA-Flow Chart Describing the Different Phases of Systematic Study Identification (Figure based on Moher et al., 2009)

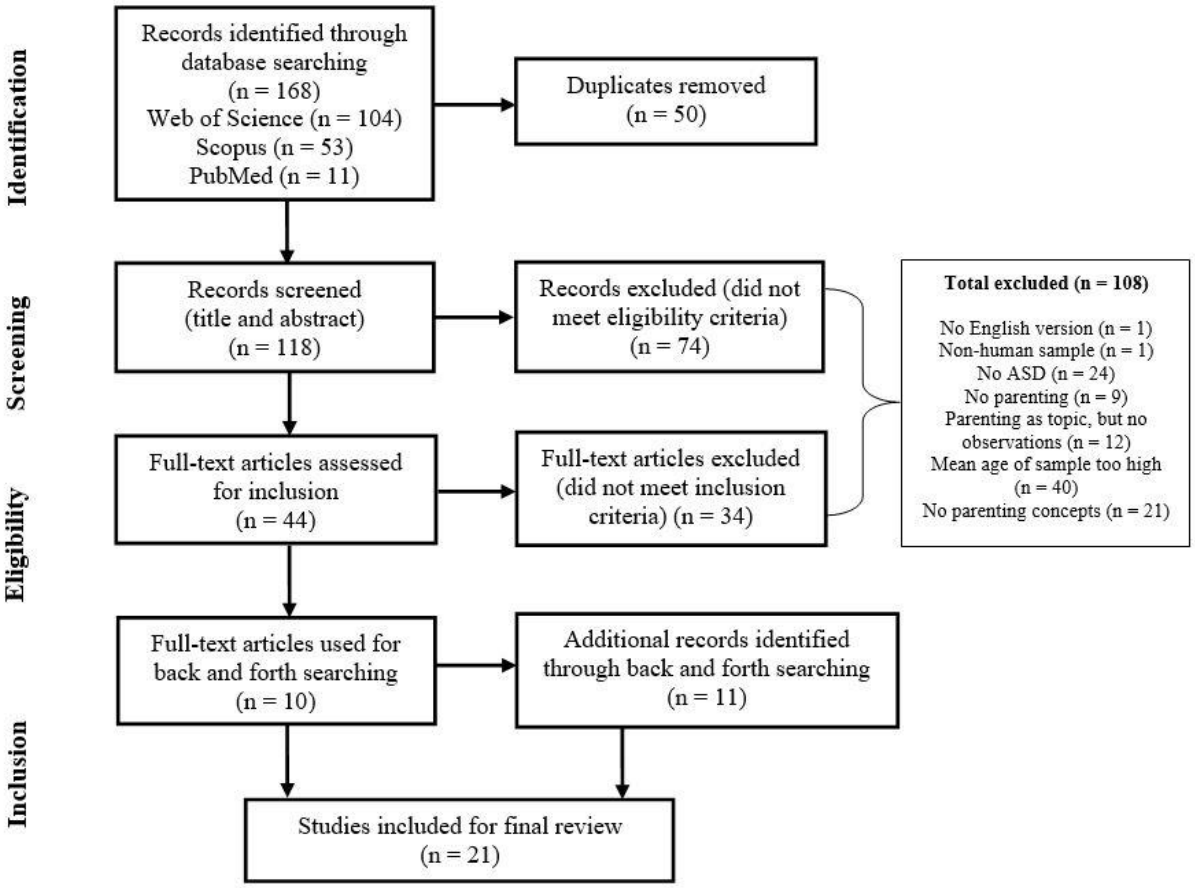

Table 1

Inclusion Criteria for the Systematic Review

a)	English language peer-reviewed journal articles, reporting empirical findings or case reports
b)	Reporting observation of parenting behaviours during parent-child interaction
c)	Focus on concepts of parenting, using overarching labels for concrete, observable parenting behaviours
d)	Including a group or subgroup of young children diagnosed with or at elevated likelihood of autism spectrum disorder (ASD), autism, Asperger or PDD-NOS
e)	Sample of children with a maximum mean chronological age of 36 months or younger

In a next step, reference lists of the 10 selected papers were "backward searched" for additional references, and both Web of Science's "Times cited" and Google Scholar's "Cited by" features were used to "forward search", identifying papers that cited the selected papers. This back and forward searching, conducted in June 2018, was done in two subsequent steps in order to identify the most relevant papers on the topic. Through a first search, six papers were identified after full-text reading.

These six papers were then back and forward searched in return, which yielded another five papers. Adding these 11 papers to the prior selection, a total sample of 21 papers was included in this review.

Analysis of relevant data

First, details about observational measures and parenting constructs were extracted from the papers included in this review by the first author (see Supplement 1.1). If the meaning of a construct was unclear, additional papers and coding manuals were searched for better descriptions of the parenting constructs and one author was contacted for further information. Papers were then grouped according to the coding system used (either a formal coding system or a combination of selected parenting constructs), leading to 13 unique "coding approaches." In total, these 13 coding approaches included 63 parenting constructs. Only the parenting constructs that were mentioned in the selected papers were included in this review, regardless of whether the coding system consisted of additional constructs. This approach was chosen to highlight those parenting constructs thought to be meaningful in this research area. As per the nature of this study, i.e., to review the conceptualisation of parenting in research on infants with or at elevated likelihood of autism, it was decided to use a narrative approach to synthesise the data.

The categorisation process included three steps: (a) bottom-up categorisation of the parenting constructs into categories of parenting behaviour, (b) independent top-down categorisation of the parenting constructs into the categories defined in the first step, (c) final categorisation of the parenting constructs.

All 63 parenting constructs were first grouped together based on their description by three of the authors (MM, IN, KVL), through a consensus decision-making process. This first step resulted in seven groups of parenting constructs, that were viewed as overarching categories of parenting behaviour (Table 2). Although these categories of parenting constructs are parenting constructs as well, and can be viewed as "umbrella constructs", we will use the term 'category' for the group of parenting constructs, and 'construct' for the individual constructs. The seven categories were labelled Warmth, Responsiveness, Scaffolding, Proactive Control, Intrusiveness, Negativity and Dyadic. An eighth category, Other, was added for parenting constructs that could not be grouped under any of the seven categories.

In a second step, two of the authors (MM, KVL) and a fellow researcher (EO) independently assigned one or more codes to the parenting constructs. In total, 57 out of 63 parenting constructs were coded by all three raters (6 missing: 9.52%). Total interrater agreement (exact and partial agreement) was obtained for 85.96% of the parenting constructs. Exact interrater agreement was obtained for 30 out of 57 constructs (52.63%), meaning that all three coders assigned either one or more similar codes to the construct. Partial interrater agreement was obtained for 19 out of 57 constructs (33.33%), meaning that all coders assigned at least one similar code to the construct. See Supplement 1.2 for details.

A synthesis of the results was then presented to the other authors (IN, PW). In a final step, again through a process of consensus decision-making, the remaining categorisation issues were resolved between the authors. As it turned out to be impossible to classify all parenting constructs under just one category, a ninth category, Multiple, was added for constructs tapping multiple categories. The parenting constructs classified as Multiple were then further categorised.

Table 2

Descriptions of the Overarching Categories of Parenting Constructs

Construct		Description
Warmth	W	Positive regard and a supportive presence through verbal and non-verbal behaviours
Responsiveness	R	Consistent sensitive and supportive responses that match the child's actions, requests and intentions, feelings, focus of interest
Scaffolding	S	Guiding child's development to promote independence (teaching behaviour)
Proactive control	P	Establishment of rules and limitations in order to encourage desired child behaviour
Intrusiveness	I	Parent-centred behaviour, not recognising and/or respecting child's signals and needs
Negativity	N	Negative regard towards the child
Dyadic	D	Dyadic behaviours
Other	O	Parenting concepts that cannot be grouped under any other overarching concept
Multiple	M	Parenting concepts that can be grouped under multiple overarching concepts, depending on interpretation

Results

Study characteristics

The 21 papers included in this review were published between 2005 and 2018. Ten of the selected studies were conducted in the USA, eight in the UK, two in The Netherlands, and one in Israel. Five studies included the same sample of British participants, which were recruited within the context of the prospective longitudinal observational British Autism Study of Infant Siblings (BASIS; Elsabbagh et al., 2015; Green et al., 2015; Green et al., 2017; Wan et al., 2012; Wan et al., 2013). Two studies included the same sample of North American participants, but at a different age (Campbell et al., 2015, 2018). Two studies used videos of parent-infant interaction from the Avon Longitudinal Study of Parents and Children (ALSPAC; Marwick et al., 2013; Puckering et al., 2014).

Most studies compared infants at elevated likelihood of autism with infants at typical likelihood (Baker et al, 2010; Blasi et al., 2015; Campbell et al., 2015, 2018; Elsabbagh et al., 2015; Harker et al., 2016; McDonald et al., 2016; Wan et al., 2012; Wan et al., 2013). Five studies included only children with or at elevated likelihood of autism (Green et al., 2015, 2017; Oosterling et al., 2010; Shire et al., 2016; Watson et al., 2017) and one study followed up children at typical likelihood that had been screened positive for autism likelihood (Suma et al., 2016). The remaining studies included children with a diverse background of autism, other developmental disorders, or a typical development (Blacher et al., 2013; Feldman et al., 2013; Mahoney et al., 2005; Marwick et al., 2013; van IJzendoorn et al.,

2007). Maximum mean age of the samples was 36 months, with the age of participants ranging from 4 (Blasi et al., 2015) to 40 months (Feldman et al., 2013).

As presented in Table 3, the 21 papers yielded 13 coding approaches, with four coding approaches used in more than one paper (GRS, MACI, MBRS, NICHD/ECCRN). Two studies used more than one coding approach (Campbell et al., 2015; Wan et al., 2012). The number of parenting constructs used per coding approach ranged from one (CIB) to 12 (MBRS), with a total of 63 parenting constructs included in this review. Ten of these constructs were classified as Multiple, nine as Responsiveness, seven as Warmth, nine as Scaffolding, two as Proactive Control, six as Intrusiveness, five as Negativity, eight as Dyadic, and seven as Other (categories indicated with an X). The 10 parenting constructs under Multiple were further categorised under one of the other categories (indicated with an O).

Descriptions of parenting constructs were extracted from the papers included in this review, additional papers, correspondence with the first author, or a combination of sources (Supplement 1.1). In the following, quotations from these descriptions are used to explain the categorisation of the construct or to illustrate a concept. For reasons of clarity, the name of the coding approach is mentioned instead of the quotation's source.

Warmth

This group of constructs shares notions of warmth, acceptance, support and positive regard. Names of the constructs differ a lot, and carry in general the name of one dimension of the construct while being further described by the other dimensions. For example, Positive Affect (PCIRS) is described as "the degree to which mothers verbally and nonverbally expressed positive regard, warmth, and affection toward the child (e.g., hugging, kissing, praising)."

Behaviours that are categorised as warm and positive need to be more than just performance: they also have to express honest affection. This has been stated explicitly for the constructs Warmth (MBRS) and Sensitivity (EAS), whose descriptions mention the rating of "both the overt behaviour of the parent and the quality of fondness conveyed" (MBRS) and "much genuine, authentic, and congruent interest, pleasure and amusement with the infant (as opposed to performing these behaviors)" (EAS). These behaviours can be verbal or non-verbal and include kisses and hugs, but also tone of voice and interested eye contact.

Warmth and support are also prevalent in descriptions of other constructs, that have been categorised as Multiple. Praise (Campbell, 2015; MBRS) conveys a notion of responsiveness (e.g., timing, appropriateness), but is also a positive statement that can be delivered with a warm tone of voice and shows acceptance and support. Non-intrusiveness (EAS) is created by negation of the negative behaviour Intrusiveness, thus reflecting "the ability to be available to the child without being intrusive to him/her" and "the quality of emotionally 'being there.'"

Table 3

Categorisation of Parenting Constructs into Overarching Categories Grouped per Coding Approach

Coding approach	Study	Concepts	W	R	S	P	I	N	D	O	M
Coding of Attachment-Related Parenting in Autism (CARP-A; Blazey et al., 2008)	Wan et al., 2012	Dyadic mutuality							X		
		Sensitive responsiveness		X							
Coding Interactive Behavior manual (CIB; Feldman, 1998)	Feldman et al., 2013	Social reciprocity							X		
Communication Play Protocol (CPP; Adamson et al., 2001, 2009)	Suma et al., 2016	Fluency and connectedness							X		
		Scaffolding			X						
		Sustainability of shared topics							X		
The Emotional Availability Scales (EAS; Biringen et al., 1998)	van IJzendoorn et al., 2007	Non-hostility						X			
		Non-intrusiveness	O				O				X
		Sensitivity	X								
		Structuring			O	O					X
Erickson scales (Erickson et al., 1985)	Oosterling et al., 2010	Supportive presence	X								
		Respect for child's autonomy					X				
		Effective structure and limit-setting				X					
		Quality of instructions			X						
		Non-hostility						X			
The Global Rating Scales (GRS; Murray et al., 1996)	Blasi et al., 2015	Depressive affect								X	
	Wan et al., 2012	Intensity of engagement							X		
		Intrusiveness					X				
		Remoteness								X	
		Sensitivity	O	O			O				X
Manchester Assessment of Caregiver-Infant Interaction (MACI; Wan et al., 2012, 2013)	Elsabbagh et al., 2015	Non-directiveness					X				
	Green et al., 2015	Sensitive responsiveness		X							
	Green et al., 2017										
	Wan et al., 2013										
Maternal Behavior Rating Scale (MBRS; Mahoney, Powell, & Finger, 1986; Mahoney, 1999; MBRS-Revised: Mahoney, 2008)	Harker et al., 2016	Acceptance	X								
	Mahoney et al., 2005	Achievement			X						
	Shire et al., 2016	Directiveness			O	O	O				X
		Effectiveness			X						
		Enjoyment	X								
		Expressiveness	O	O				O			X
		Inventiveness			X						
		Pace		O			O				X
		Praise	O	O	O						X

		Responsivity			X					
		Sensitivity	O		O					X
		Warmth	X							
Mellow Parenting Observational System (MPOS; Puckering et al., 2010)	Puckering et al., 2014	Anticipation of child's needs				X				
		Autonomy					X			
		Containment of child's distress			X					
		Control/conflict						X		
		Cooperation							X	
		Responsiveness							X	
Parent–Child Interaction Rating System (PCIRS; Belsky et al. 1995; Fenning et al. 2007)	Blacher et al., 2013	Detachment			X					
		Intrusiveness					X			
		Negative affect						X		
		Positive affect	X							
		Sensitivity			X					
		Stimulation of cognition				X				
Scales developed by the National Institute of Child Health and Human Development (NICHD) Early Child Care Research Network (ECCRN), 1999	Baker et al., 2010 Campbell et al., 2015 Campbell et al., 2018 McDonald et al., 2016	Affective mutuality							X	
		Negative regard, Hostility						X		
		Respect for child's autonomy, Lack of intrusiveness					X			
		Sensitivity, Responsiveness			X					
		Stimulation of cognitive development, Structuring				X				
		Warmth, Positive Regard	X							
Frequency coding	Campbell et al., 2015	Initiate/Direct play				O		O			X
		Praise	O		O						X
		Scaffold play				X					
Scales adapted from the categories of interpersonal interaction developed by Marwick and Trevarthen (1982, 1986)	Marwick et al., 2013	Activity								X	
		Contingent responsiveness			X						
		Cooperativeness			X						
		Fussiness						X			
		Involvement								X	
		Playfulness								X	
		Speech								X	
		Wellbeing								X	

Note. W = Warmth, R = Responsiveness, S = Scaffolding, P = Proactive Control, I = Intrusiveness, N = Negativity, D = Dyadic, O = Other, M = Multiple, X = main category that the parenting construct taps, O = further categorisation of constructs classified as Multiple

Responsiveness

Parenting constructs categorised as Responsiveness include both the identification of and behavioural response to the child's signals. Sensitivity and responsiveness are closely intertwined but not the same. A parent can be sensitive and identify the signals of a child accurately, but an appropriate and timely behavioural response has to follow in order to be responsive.

The close relationship of both elements is most prominent in the CARP-A and MACI, that use the construct Sensitive Responsiveness. The NICHD/ECCRN scale on the other hand has a different name in different studies, being named Sensitivity according to the NICHD (1999) and in Campbell and colleagues (2015, 2018) but Responsiveness in Baker and colleagues (2010). Detachment (PCIRS) can be seen as the opposite of Sensitive Responsiveness, being described as "marked non-responsiveness and a lack of awareness of the child's needs."

Despite the large variety in names, Responsivity (MBRS), Sensitivity (PCIRS), Containment of Child's Distress (MPOS), Contingent Responsiveness (Marwick, 2013), and Cooperativeness (Marwick, 2013) all stress the behavioural component of responsiveness (e.g., Responsivity, MBRS: "the appropriateness of the parent's responses to the child's behaviours"). The appropriateness of responses can also be found in the interpretation of the constructs Expressiveness and Pace (MBRS), as a responsive parent would adapt the intensity, frequency and pace of expression and behaviour to the child's needs.

Verbal statements, whether neutral, negative or positive, could also be considered responsive to a greater or lesser extent. According to this interpretation, Praise (Campbell, 2015; MBRS) could be viewed as a behavioural response following the identification of the child's needs (e.g., need for acknowledgement or encouragement).

Scaffolding

Constructs that describe teaching behaviour, as demonstrated by structuring the interaction or stimulating the cognitive development of a child, have been categorised as Scaffolding. Scaffolding means that the parent only helps the child when necessary, and withdraws when support is no longer required. Two constructs out of nine already carried this name, namely Scaffolding (CCP) and Scaffold Play (Campbell, 2015). The CCP assesses communication, and thus interprets scaffolding as "how well a partner supports the child's activities and provides opportunities for learning about shared objects and events and about communicating, including language." On the other hand, Scaffold Play (Campbell, 2015) refers to "ways in which the parent supports the child's play (…). A scaffold would be defined by actions or statements such as labelling or describing the child's actions, elaborating verbally on what the child is doing, demonstrating (…) or facilitating play (S. Campbell, personal communication, October 30, 2018)." Scaffolding is also mentioned in the description of the NICHD/ECCRN scale Stimulation

of Cognitive Development/Structuring: "The mother's ability to provide sensitive and developmentally appropriate scaffolding for her child." The notion of fostering the child's development at a developmentally appropriate level is shared by the Stimulation of Cognition scale of the PCIRS.

Other constructs, such as Quality of Instructions (Erickson Scales) and Structuring (EAS) focus on the structuring of the situation. For example, Quality of Instructions is described as "the degree to which the parent structures the situation so that the child knows what the task objectives are and receives hints or corrections while solving the problems that are well-timed and paced, graded in logical steps, and stated clearly." The advanced preparation that is given to a child, is also mentioned in the description of Anticipation of Child's Needs (MPOS).

The MBRS includes the scale Achievement Orientation, that consists of the subscales Achievement and Praise. Achievement is described as "the parent's encouragement of sensorimotor and cognitive achievement," and Praise is the amount of verbal praise that is given to a child. Praise is an example of how to stimulate a child during a teaching process, and could thus be categorised as Scaffolding. Two other scales from the MBRS involve dimensions of teaching behaviour, namely the ability to gain the child's attention, cooperation and participation (Effectiveness) and the ability to find different things to interest the child to maintain the child's involvement in the interaction (Inventiveness). However, these constructs are part of the MBRS scales Responsiveness and Affect, respectively.

Proactive control

Both constructs categorised as Proactive Control include the encouragement of desired behaviour: Effective Structure and Limit-Setting (Erickson Scales) assesses "the degree to which the parent attempts to establish his/her expectations for the child's behaviour," while Control/Conflict (MPOS) assesses if the "parent intervene[s] appropriately to achieve legitimate compliance." The establishment of rules is also mentioned in the description of Structuring (EAS), whereas Directiveness (MBRS) includes the direction of the child's immediate behaviour.

Intrusiveness

Constructs categorised as Intrusiveness describe adult-centred rather than child-centred behaviour. This is well described in the PCIRS: "The intrusive parent sought to impose an agenda upon the child without regard to the child's signals and may have been overly stimulating or unable or unwilling to relinquish control." Lack of respect for the child's autonomy or supporting the child's autonomy is prominent in four constructs (Respect for Child's Autonomy, Erickson Scales, NICHD/ECCRN; Non-directiveness (MACI); Autonomy, MPOS). Two coding approaches assess the

opposite of intrusiveness: Non-directiveness (MACI) describes respecting the child's autonomy, and Non-intrusiveness (EAS) focuses on the ability to be available to the child without being intrusive.

Descriptions of Sensitivity (GRS), Directiveness (MBRS), Pace (MBRS), and Initiate/Direct Play (Campbell et al., 2015) have been categorised as Multiple. Their descriptions also hint at adult-centred, intrusive behaviour without respect for the child's autonomy. For example, the parent's rate of behaviour (Pace, MBRS) could be well matched to the child's needs and thus be coded as Responsiveness, but poorly matched arousal would be coded as Intrusiveness.

Negativity

Constructs categorised as Negativity assess negative affect and hostility of a parent "through verbal means (e.g., harsh tone of voice) or nonverbal behaviour (e.g., strained expression, look of disgust)" (Negative Affect, PCIRS). The EAS and the Erickson Scales use the construct Non-hostility, but describe hostile behaviour (e.g., "Reflects the parent's expression of anger, discounting or rejecting of the child", Erickson Scales). Fussiness (Marwick, 2013) is described as "restlessness, negativity and lack of compliance" with the wishes of the child. The MBRS describes "the tendency of the caregiver to express and react emotionally towards the child" (Expressiveness), which could range from the expression of positive to negative emotions.

Dyadic

Dyadic constructs focus on responsive and reciprocal behaviour that takes place between parent and child. This can mean active behaviour, where parent and child "co-operate/negotiate together" (Cooperation, MPOS), or "togetherness, 'tunefulness', and sharedness of the play experience" (Dyadic Mutuality, CARP-A). Sharing of affection (Affective Mutuality, NICHD/ECCRN), attention (Dyadic Mutuality, CARP-A; Intensity of Engagement, GRS), and topics (Sustainability of Shared Topics, CPP) would result in an "interactive flow" (Dyadic Mutuality, CARP-A) and "cohesion" (Fluency and Connectedness, CPP), with the dyad "moving in harmony" (Social Reciprocity, CIB).

Multiple

Ten parenting constructs were categorised as Multiple, because their descriptions included both poles of a construct and/or contained elements of more than one parenting construct.

The description of Sensitivity (GRS) literally contains two opposite elements, being a "measurement of the quality of maternal interaction on a scale from sensitive to insensitive." In turn, Directiveness (MBRS), Expressiveness (MBRS), Pace (MBRS), and Indirect/Direct Play (Campbell, 2015) are not described as bipolar constructs, but can be interpreted in contrasting ways. For example,

Pace is described as "This item examines the parent's rate of behaviour," and can therefore be categorised as either a responsive or intrusive behaviour towards a child.

Descriptions of Non-intrusiveness (EAS), Structuring (EAS), Praise (MBRS), Sensitivity (MBRS), and Praise (Campbell, 2015) include elements of multiple parenting constructs that are quite close in content. For example, Structuring (EAS) assesses "the degree to which the parent appropriately structures the child's play by taking care to follow the child's lead, and sets limits for appropriate child behavior and/or misbehavior. These qualities also may be observed in the parent's establishing rules and requesting or demanding compliance with them." This description contains both elements of Scaffolding (structuring play) and Proactive Control (setting limits, establishing rules).

Other

Seven constructs could not be categorised under one of the overarching parenting constructs. The majority of these constructs tap personality characteristics or emotional states of the parent, rather than parenting behaviours. Remoteness and Depressive Affect (GRS) rate "psychological or verbal disengagement" and the "display of depressive affect, through sadness, slowness and focus on the self rather than the infant." Activity, Involvement, Playfulness and Wellbeing (Marwick et al., 2013) assess more positive maternal states. Speech (Marwick et al., 2013) is "a judgement on the overall speech or vocalisation levels of (…) adult throughout the segment."

Discussion

The present study provides a review of the parenting constructs that are currently used in observational research including children below an age of four with or at elevated likelihood of autism. Through a consensus decision-making process, seven overarching categories of parenting behaviour − Warmth, Responsiveness, Scaffolding, Proactive Control, Intrusiveness, Negativity, Dyadic − and two categories for other parenting behaviours (Other) and behaviours tapping multiple categories (Multiple) were identified. The challenging categorisation process demonstrates the complexity of studying parenting behaviour, both at a methodological and conceptual level, and thus reflects the findings of this systematic review.

Methodological level

Our most prominent finding at a methodological level is the large heterogeneity in observational measures, and hence, in parenting constructs, that are used in research on young children with or at elevated likelihood of autism, confirming prior research (Bohr et al., 2018; Ku et al., 2019; Wan et al., 2019). A first and obvious explanation for this heterogeneity is the different research focus of the

included studies. Observation of parent-child interaction is not exclusively used to study parenting behaviour, but is also a variable in studies on, for example, brain activity (e.g., Elsabbagh et al., 2015), intervention programmes (e.g., Green et al., 2017; Suma et al., 2016) or play behaviour (e.g., Campbell et al., 2018).

An alternative explanation is that research projects often develop their own observational measures to suit the particular interest of the project or for practical reasons (e.g., training costs). Many of the studies included in this review are indeed part of a large longitudinal and multidisciplinary project. For example, all five studies from the BASIS group include the same parenting constructs, eventually characterising the Manchester Assessment of Caregiver–infant Interaction (MACI; Wan et al., 2017). Because the development of an observational measure requires time and energy, Lotzin and colleagues (2015) suggest that researchers channel their resources into the refinement of existing measures with evidence of validity, rather than into the development of a new tool. Apart from the benefits this would have for the validity of observational measures, it would also make it easier to compare results across studies (Bohr et al., 2018).

A second methodological complication is the lack of uniformity in the definitions of parenting constructs, confirming the findings of Bohr and colleagues (2018) and extending them to constructs other than sensitivity. Our analysis demonstrates that parenting constructs with the same name could have different descriptions, and vice versa, and that descriptions could be interpreted in multiple ways. Moreover, observational measures or parenting constructs sometimes changed names throughout the course of a longitudinal project. For example, the first studies from BASIS used a combination of constructs originating from the GRS and the CARP-A (Wan et al., 2012), while subsequent studies used the combined and refined new MACI (Elsabbagh et al., 2015; Green et al., 2015, 2017; Wan et al., 2013). It also happened that names of constructs differed from study to study, with or without providing the rationale behind this decision (Baker et al., 2010; Campbell et al., 2015, 2018). Lastly, descriptions of assessed constructs were not always provided in the papers.

Conceptual level

Despite these methodological challenges, it turned out to be possible to create categories of parenting behaviour using a bottom-up approach, and to categorise most of the parenting constructs into one of the seven categories using a top-down approach. This suggests that some common core concepts of parenting behaviour exist. For example, most observational measures assessed sensitive, supportive and responsive parenting behaviour, and many assessed negative and intrusive parenting behaviour. Both conceptual overlap and high correlations between parenting behaviours have led several researchers to combine parenting constructs a priori, or in their analyses, suggesting that core constructs of parenting behaviour exist (e.g., Baker et al., 2010; Wan et al., 2017). Future research should therefore

further investigate what the core constructs of parenting behaviour are, especially when applying these parenting constructs to parents of children with or at elevated likelihood of autism.

The abovementioned work of Baker and colleagues (2010) already points towards such core constructs. They used a composite score of Emotional Supportiveness, a construct that represents behaviours that "convey warmth and acceptance, reflected responsiveness to the child's needs, and balanced maternal involvement with a respect for the child's desires and emergent independence" (p. 994). The second construct, Structuring, captures "the mother's ability to provide sensitive and developmentally appropriate scaffolding for her child" (p. 994). Due to a low occurrence rate, the Hostility construct was removed from the analyses. This raises the question of how suitable a construct is that measures hostile behaviour and punishment.

Another important observation is that some parenting constructs included in this review do not seem to measure parenting behaviour per se, but rather parental characteristics like temperament or emotional state of the parent. As behaviour is closely intertwined with emotions, cognitions, and goals, it is to be expected that this is also the case for parenting behaviour. This may have led researchers to develop observational measures that also take dimensions like emotional state into account, which may be hampering comparability of research findings. For conceptual clarity, it is mandatory to distinguish parenting behaviours clearly from other dimensions of parenting. The observation of parenting behaviour in research should be as objective and reliable as possible, and results can only later be interpreted against a background of parent and child characteristics, circumstances, and culture.

Strengths

This study is the first to review observational measures used in research on parenting children with or at elevated likelihood of autism. It confirms previous research findings concerning heterogeneity of observational measures and lack of uniformity in parenting constructs used in the field of parenting research. A major strength of this study is the comprehensive methodology, using both a bottom-up and top-down approach to categorise parenting constructs. Moreover, researchers from different backgrounds (parent-child interaction, parenting behaviour, autism, typical development) have been collaborating closely throughout the whole categorisation process.

Contrasting our work to that of Ku and colleagues (2019), it appears that we have both categorised parenting behaviours, but used a different methodology and hence, reached different outcomes. On the one hand, Ku and colleagues (2019) used a theory-driven approach and selected four parenting dimensions prior to the categorisation process. As per the heterogeneity of constructs, they had to exclude some parenting constructs and synthesise others to be able to analyse the data statistically. On the other hand, our answer to the heterogeneity of observational measures and parenting constructs was to use a data-driven approach and to analyse the results narratively, in order to do justice to the

complexity of the topic and to demonstrates the urgency of the matter. However, both studies included a different age group and results may therefore be difficult to compare.

Limitations

A first and important limitation of this study is its exclusive focus on observational measures. As parenting behaviour can be investigated using self-report questionnaires as well, this means that a large amount of studies was excluded. Parental self-report questionnaires have the advantage of assessing parenting behaviours outside the research setting, which would have added to our understanding of parenting behaviour in our sample. However, it can be expected that the inclusion of questionnaires would have added considerably to the heterogeneity in parenting constructs, which could have complicated the categorisation process even further.

A second limitation is our choice to include only concrete and observable interactive parenting behaviours, such as sensitive responsiveness or scaffolding, hereby excluding for example communicative behaviours, such as verbal responsiveness or directives. We are aware of the value of communicative behaviours in the investigation of parenting, but we had to limit ourselves in order to present a coherent review. Studies that investigate communicative behaviours namely differ considerably in the constructs that they assess. Some studies assess responsive or directive comments, that could be viewed as interactive parenting behaviours, while others investigate how parents introduce new words. Further research should investigate how communicative behaviour is conceptualised, and compare this to the conceptualisation of interactive parenting behaviours.

Third, we have only included studies until June 2018, which means that more recent studies could have been missed. As research on parenting behaviour among parents of a child with or at elevated likelihood of autism is increasing, it is not unlikely that new observational measures have been developed in the meantime.

A fourth limitation concerns the bottom-up categorisation of the parenting constructs. As this was done in very close collaboration between three of the authors, the interrater reliability was not calculated. However, the interrater reliability for the top-down categorisation, that was done independently by two of the authors and a fellow researcher, was excellent.

At a conceptual level, it is important to note that the observation of parenting behaviour does not assess the intention of the behaviour. Objective observation of parenting behaviour is necessary in research, but does not take into account that the reasoning behind seemingly same behaviour may greatly differ from parent to parent and child to child. Behaviours that might be warm to one child could be intrusive to another, but would still receive the same objective score. A focus on intentions is especially important for parents of a child with or at elevated likelihood of autism, as these children may have different needs than typically developing children. Future research should therefore take into account

the beliefs of parents and their intentions regarding parenting of their autistic child or their child at elevated likelihood of autism.

Conclusion

The heterogeneity in observational measures and the lack of uniformity in parenting constructs complicate the understanding of research on parenting of young children with or at elevated likelihood of autism. This is a potential problem for the assessment of parenting behaviour and the comparison of results across studies. Moreover, the observation of parenting behaviour does not assess the intentions behind parenting behaviour among parents of a child with or at elevated likelihood of autism. Since research findings are used to develop and test theories and to design interventions, future studies should define their parenting constructs clearly and carefully. This review provides a first step towards a conceptual framework, but further research is needed to investigate applicability among different ages and samples.

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Supplement 1.1

Table 1

Descriptions of Parenting Constructs per Coding Approach Including References

Study	Coding Approach	Parenting Construct	Description	Reference
Baker et al., 2010 Campbell et al., 2015 Campbell et al., 2018 McDonald et al., 2016	NICHD/ECCRN; NICHD Early Child Care Research Network (1999). Child care and mother–child interaction in the first three years of life. *Developmental Psychology*, *35*(6), 1399–1413.	Sensitivity (to non-distress), Responsiveness	Ratings of *sensitivity* assessed the degree to which the parent followed the child's lead and was tuned into the child's interests.	Campbell, S. B., Leezenbaum, N., Mahoney, A., Day, T., & Schmidt, E. (2015). Social engagement with parents in 11-month-old siblings at high and low genetic risk for autism spectrum disorder. *Autism*, *19*, p. 918
		Warmth, Positive Regard	Affectionate behaviour and enjoyment of the interaction.	
		(Lack of) intrusiveness	The degree to which parents directed or controlled the interaction, following their own agenda rather than the child's lead.	Campbell et al. (2015), p. 918 Baker, J. K., Messinger, D. S., Lyons, K. K., & Grantz, C. J. (2010). A pilot study of maternal sensitivity in the context of emergent autism. *Journal of Autism and Developmental Disorders*, *40*, p. 992
		Respect for Child's Autonomy	Balanced maternal involvement with a respect for the child's desires and emergent independence.	
		Stimulation of Cognitive Development	Teaching and scaffolding play.	Campbell et al. (2015), p. 918
		Structuring	The mother's ability to provide sensitive and developmentally appropriate scaffolding for her child.	Baker et al. (2010), p. 992

		Negative regard /Hostility	Caregiver expresses negative feelings in interaction with theinfant.	Vandell, D. L. (1996). Characteristics of infant child care: Factors contributing to positive caregiving: NICHD early child care research network. *Early Childhood Research Quarterly*, *11*(3), p. 281
		Affective Mutuality	The availability and mutuality of emotion between the child and parent, and the degree of shared positive affect and affective synchrony within the dyad.	McDonald, N.M., Baker, J.K., & Messinger, D.S. (2016). Oxytocin and parent–child interaction in the developmentof empathy among children at risk for autism. *Developmental Psychology*, *52*(5), p. 736
Campbell et al., 2015	Campbell, S. B., Leezenbaum,N., Mahoney, A., Day, T., & Schmidt, E. (2015). Social engagement with parents in 11-month-old siblings at high and low genetic risk for autism spectrum disorder. *Autism*, *19*, 915–924.	Praise	PRAISE was defined as follows - positive statements about the child or thee child's behavior such as "good job", "that's a good boy", "aren't you smart", "you did it." Clapping when the child master's a toy or activity may also be considered as praise.	S.B. Campbell, personal communication, 30 October 2018
		Initiate/Direct Play	INITIATE/DIRECT PLAY means that the parent (and not the child) is leading the play by initiating an activity and focusing the child's attention to a toy. This might include the parent bringing a wandering child back to play with a specific toy, trying to get a child interested in a specific toy, or redirecting a child from one activity to another.	
		Scaffold Play	SCAFFOLD refers to ways in which the parent supports the child's play. For something to be coded as scaffold, the child's attention and actions must be on the toy, for example, the stacking rings or shape sorter. Once the child is engaged with a toy, a scaffold would be defined by actions or statements such as labeling or describing the child's actions, elaborating verballyon what the child is doing, demonstrating to the child how to put a ring on the ring stacker or a shape in the shape sorter, or facilitating play, for example, by helping the child put a shape into the shape sorter.	

Suma et al., 2016	Communication Play Protocol (CCP); e.g., Adamson, L. B., Bakeman, R., Deckner, D. F., & Romski, M. (2009). Joint engagement and the emergence of language in children with autism and Down syndrome. *Journal of Autism and Developmental Disorders*, *39*, 84–96.	Scaffolding	The rating item *parent scaffolding* captured how well a partner supports the child's activities and provides opportunities for learning about shared objects and events and about communicating, including language.	Suma, K., Adamson, L.B., Bakeman, R., Robins, D.L., & Abrams, D.N. (2016). After Early Autism Diagnosis: Changes in Intervention and Parent–Child Interaction. *Journal of Autism and Developmental Disorders*, *46*(8), p. 2723
		Sustainability of Shared Topics	How long a dyad focused on a shared topic.	
		Fluency and Connectedness	The rating item *fluency and connectedness* assessed the overarching flow and cohesion of the parent–child interaction. Observers attended to the balance between partners' contributions, how well the partners negotiated shifting the floor, and how smoothly the interaction progressed.	
Harker et al., 2016 Mahoney et al., 2005 Shire et al., 2016	Maternal Behavior Rating Scale (MBRS); Mahoney, G. (2008). Maternal Behavior Rating Scale (Revised). Cleveland, OH: Case Western Reserve University	Sensitivity	This item examines the extent to which the parent seems aware of and understands the child's activity or play interests. This item is assessed by the parent's engaging in the child's choice of activity, parent's verbal comments in reference to child's interest and parent's visual monitoring of child's behaviour or activity. Parents may be sensitive but not responsive - such as in situations where they describe the child's interests but do not follow or support them.	Maternal Behavior Rating Scale (MBRS); Mahoney, G. (2008). Maternal Behavior Rating Scale (Revised). Cleveland, OH: Case Western Reserve University
		Responsivity	This item rates the appropriateness of the parent's responses to the child's behaviours such as facial expression, vocalizations, gestures, signs of discomfort, body language, demands, intentions.	
		Effectiveness	This item refers to the parent's ability to engage the child in the play interaction. It determines the extent to which the parent is able to gain the child's attention, cooperation and participation in a reciprocal exchange characterized by balanced turn taking in play or conversation.	
		Directiveness	This item measures the frequency and intensity in which the parent requests, commands, hints or attempts in other mannersto direct the child's immediate behaviour.	
		Pace	This item examines the parent's rate of behaviour.	

		Achievement	This item is concerned with the parent's encouragement of sensorimotor and cognitive achievement.	
		Praise	This scale assesses how much verbal praise is given to the child.	
		Acceptance	This item assesses the extent to which the parent approves of the child and the child's behaviour. Acceptance is measured by the intensity of positive affect expressed toward the child and the frequency of approval expressed either verbally or nonverbally.	
		Enjoyment	This item assesses the parent's enjoyment of interacting with the child. Enjoyment is experienced and expressed in response to the child himself -- his spontaneous expressions or reactions, orhis behaviour when interacting with his parent. There is enjoyment in child's being himself rather than the activity the child is pursuing.	
		Expressiveness	This item measures the tendency of the caregiver to express and react emotionally toward the child. It assesses the voice quality to express a range of emotions toward the child. Both intensity, animation and frequency are considered in these ratings.	
		Inventiveness	This item assesses the range of stimulation parents provide their child; the number of different approaches and types of interactions and the ability to find different things to interest the child, different ways of using toys, combining the toys and inventing games with or without toys. Inventiveness is both directed toward and effective in maintaining the child's involvement in the situation. Inventiveness does not refer merely to a number of different, random behaviours, but rather to a variety of behaviours which are grouped together and directed towards the child.	
		Warmth	This item rates the demonstration of warmth to a child which is positive attitude revealed to the child through pats, lap-holding, caresses, kisses, hugs, tone of voice, and verbal endearments. Both the overt behaviour of the parent and the quality of fondness conveyed are included in this rating. It examines positive affective expression; the frequency and quality of	

			expression of positive feelings by the parent and the parent's show of affection.	
Elsabbagh et al., 2015 Green et al., 2015 Green et al., 2017 Wan et al., 2013	Manchester Assessment of Caregiver-Infant Interaction (MACI); Wan, M.W., Brooks, A., Green, J., Abel, K., & Elmadih, A. (2017). Psychometrics and validation of a brief rating measure of parent-infant interaction: Manchester assessment of caregiver–infant interaction. *International Journal of Behavioral Development*, *41*(4), 542–549.	Sensitive Responsiveness	Appropriate, timely responding to infant behaviour (or lack thereof) at the service of meeting the infant's immediate, interactive and developmental needs; an attentive attitude, warmth, and appropriate engagement, support and structuring.	Wan, M.W., Brooks, A., Green, J., Abel, K., & Elmadih, A. (2017). Psychometrics and validation of a brief rating measure of parent-infant interaction: Manchester assessment of caregiver–infant interaction. *International Journal of Behavioral Development*, *41*(4), p. 544
		Non-directiveness	A behavioural and mental ''acceptance'' of and focus on the infant's experience, rather than using directiveness, which includes implicit and explicit demanding and intrusive behaviours, and negative comments.	
Wan et al., 2012	Coding of Attachment-Related Parenting in Autism (CARP-A); Blazey, L., Leadbitter, K., Holt, C., & Green, J. (2008). Attachment behaviours and parent–child interaction in pre-school autism. London, UK: International Meeting for Autism Research.	Sensitive Responsiveness	The identification of, and behavioural response to, infant behaviour and signals that are contingent and appropriate to meet the infant's immediate and developmental needs. Responsiveness includes the appropriate engagement, support and structuring of the infant when the infant is lacking behaviour.	Wan, M.W., Green, J., Elsabbagh, M., Johnson, M., Charman, T., Plummer, F., & the BASIS Team (2012). Parent–infant interaction in infant siblings at risk of autism. *Research in Developmental Disabilities*, *33*, p. 931
		Dyadic Mutuality	Dyadic togetherness, 'tunefulness', and sharedness of the play experience, including shared attention, infant acceptance of maternal involvement, playing together, interactive flow, and shared body orientation	
van IJzendoorn et al., 2007	The Emotional Availability Scales (EAS); Biringen, Z., Robinson, J.L., & Emde, R.N., (2000). Appendix B: The Emotional Availability Scales (3rd ed.; an abridged Infancy/Early Childhood	Sensitivity	The highly sensitive parent displays much genuine, authentic, and congruent interest, pleasure, and amusement with the infant (as opposed to performing these behaviours), as demonstrated by warm smiles and giggles, interested eye contact, and comforting and playful physical contact.	Biringen, Z., Robinson, J.L., & Emde, R.N., (2000). Appendix B: The Emotional Availability Scales (3rd ed.; an abridged Infancy/Early Childhood Version). *Attachment & Human Development*, *2*(2), p. 257

	Version). *Attachment & Human Development*, *2*(2), 256–270.	Structuring	This scale assesses the degree to which the parent appropriately structures the child's play by taking care to follow the child's lead, and sets limits for appropriate child behaviour and/or misbehaviour. These qualities also may be observed in the parent's establishing rules and requesting or demanding compliance with them.	Biringen et al. (2000), p. 260
		Non-hostility	The *parental non-hostility scale* assesses the degree of hostility.	Biringen et al. (2000), p. 265
		Non-intrusiveness	Optimal non-intrusiveness refers to the ability to be available to the child without being intrusive to him/her. The quality of emotionally 'being there' and available when needed is indicative of non-intrusiveness. Intrusiveness refers to qualitiesof overdirectiveness, overstimulation, interference, or overprotectiveness.	Biringen et al. (2000), p. 263
Blacher et al., 2013	Parent–Child Interaction Rating System (PCIRS); e,g,, Belsky, J., Crnic, K., & Woodworth, S. (1995). Personality and parenting: Exploring the mediating role of transient mood and daily hassles. *Journal of Personality*, *63*, 905–929.	Negative Affect	*Negative Affect* indicates the expression of negative affect, disapproval, and hostility through verbal means (e.g., harsh tone of voice) or nonverbal behaviour (e.g., strained expression, look of disgust).	Blacher, J., Baker, B. L., & Kaladjian, A. (2013). Syndrome specificity and mother–child interactions: Examining positive and negative parenting across contexts and time. *Journal of Autism and Developmental Disorders*, *43*, p. 765
		Sensitivity	*Sensitivity* indicates the degree to which the mother was ''child-centred'' and thus responded quickly, appropriately, and consistently to the child's needs.	
		Positive Affect	*Positive Affect* indicates the degree to which mothers verbally and nonverbally expressed positive regard, warmth, and affection toward the child (e.g., hugging, kissing, praising).	
		Intrusiveness	*Intrusiveness* indicates parent behaviour that was adult centred rather than child centred. The intrusive parent sought to impose an agenda upon the child without regard to the child's signals and may have been overly stimulating or unable or unwilling to relinquish control.	
		Detachment	*Detachment* indicates maternal passivity or disengagement, represented by marked non-responsiveness and a lack of awareness of the child's needs.	

		Stimulation of Cognition	*Stimulation of Cognition* indicates parental attempts to foster the child's cognitive development at a developmentally appropriate level.	
Puckering et al., 2014	Mellow Parenting Observational System (MPOS); Puckering, C., McIntosh, E., Hickey, A., Longford, J. (2010). Mellow Babies: a group intervention for infants and mothers experiencing postnatal depression. *Counselling Psychology Review*, *25*, 28–40.	Containment of Child's Distress	Is comfort/support offered to a crying child who is upset or hurt? (positive, e.g. noise startles infant who cries, mother cradles child 'did you get a fright?')	Puckering, C., McIntosh, E., Hickey, A., Longford, J. (2010). Mellow Babies: a group intervention for infants and mothers experiencing postnatal depression. *Counselling Psychology Review*, *25*, p. 33
		Responsiveness	Are the parent and child responsive/reciprocal with each other?	
		Anticipation of Child's Needs	Is the child given advanced preparation for a change in activity?	
		Autonomy	Does the parent show awareness of the child's individuality?	
		Cooperation	Do parent and child co-operate/negotiate together?	
		Control/Conflict	Does parent intervene appropriately to achieve legitimate compliance?	
Blasi et al., 2015 Wan et al., 2012	The Global Rating Scales (GRS); Murray, L., Fiori-Cowley, A., Hooper, H., & Cooper, P. (1996). The Impact of Postnatal Depression and Associated Adversity on Early Mother-Infant Interactions and Later Infant Outcome. *Child Development*, *67*(5), 2512–2526.	Sensitivity	Measurement of the quality of maternal interaction on a scale of sensitive to insensitive	Blasi, A., et al. (2015). Atypical processing of voice sounds in infants at risk for Autism Spectrum Disorder. *Cortex*, *71*, supplementary material
		Intrusiveness	Interruption of the infant's activity either verbally or through physical activity around the infant	
		Remoteness	Psychological and verbal disengagement	
		Depressive Affect	Display of depressive affect, through sadness, slowness and focus on the self rather than the infant	
		Intensity of Engagement	The intensity (not quantity) of mutual engagement, either directly or through mutual focus on a third object. Intensity rateshigher with level of interest and positivity, and includes smiles, vocalisations, deepening of interest, and peaks of infant excitement, with laughter or mirroring	Wan et al. (2012), p. 930
		Non-directiveness[1]	A focus on the infant's experience and agenda as opposed to a parent-directed focus. A high rating includes non-directive behaviour that accepts and encourages the infant to lead interaction and positive comments that reflect the infant's experience. A low rating includes demanding, intrusive, and	

			negative behaviours and comments directed at the infant not at the service of promoting infant-initiated behaviour.	
Feldman et al., 2013	Coding Interactive Behavior manual (CIB); Feldman, R. (1998). Coding Interactive Behavior Manual. Bar Ilan University, Ramat Gan, Israel.	Social Reciprocity	*Social Reciprocity* defines interactions where the two partners are moving in harmony, each contributes to the mutual dialog, and exchanges are the end product of inputs from both partners. Reciprocity was the average of following codes: partners engage in give-and-receive interactions that are sensitive to verbal and nonverbal cues, adapt to each other's needs, communications, and requests; engaged in shared activity; and interaction is fluent and rhythmic.	Feldman, R., Gordon, I., Influs, M., Gutbir, T., & Ebstein, R.P. (2013). Parental Oxytocin and Early Caregiving Jointly Shape Children's Oxytocin Response and Social Reciprocity. *Neuropsychopharmacology*, *38*(7), p. 1157
Oosterling et al., 2010	Erickson Scales; Erickson, M. F., Stroufe, L. A., & Egeland, B. (1985). The relationship between quality of attachment and behavior problems in preschool in a high-risk sample. *Monographs of the Society for Research in Child Development, 50*, 147–166.	Supportive Presence	The provision of positive regard and emotional support	Oosterling, I., Visser, J., Swinkels, S., Rommelse, N., Donders, R., Woudenberg, T., … Buitelaar, J. (2010). Randomized controlled trial of the focus parent training for toddlers with autism: 1-year outcome. *Journal of Autism and Developmental Disorders*, *40*(12), p. 1453
		Respect for Child's Autonomy	Respect for the child's autonomy or the degree to which the parent acts in a way that recognizes and respects the validity of the child's individuality, motives, and perspectives in the session	
		Effective Structure and Limit-setting	Degree to which the parent attempts to establish his/her expectations for the child's behaviour	
		Quality of Instructions	Degree to which the parent structures the situation so that the child knows what the task objectives are and receives hints or corrections while solving the problems that are well-timed and paced, graded in logical steps, and stated clearly	
		Non-hostility	Reflects the parent's expression of anger, discounting or rejecting of the child	Oosterling et al. (2010), p. 1454
Marwick et al., 2013	e.g., Trevarthen, C., & Marwick, H. (1982). Cooperative understanding in infancy. Project report to the Spencer Foundation. Chicago: University of Edinburgh.	Wellbeing	A judgement on the overall positive emotional state of the infant and adult throughout the segment (is each happy and relaxed?).	Marwick, H., Doolin, O., Allely, C.S., McConnachie, A., Johnson, P., Puckering, C., … Wilson, P. (2013). Predictors ofdiagnosis of child psychiatric disorder in adult-infant social-communicative interaction at 12
		Contingent Responsiveness	Definition: a judgement of the overall contingent responsivenessof infant and adult to each other throughout the segment (are they responsive to each other's expressiveness and communication?).	

		Cooperativeness	A judgement on the overall cooperativeness of infant and adult in relation to each other throughout the segment (do they comply with each other's wishes and coordinate their actions?).	months. *Research in Developmental Disabilities*, 34(1), p. 568
		Involvement	A judgement of the overall involvement of infant and adult in the task or focus of activity throughout the segment (is each engaged in the activity?).	
		Activity	A judgement on the overall activity levels of infant and adult throughout the segment (is there energy and movement?).	
		Playfulness	A judgement on the overall playfulness of infant and adult throughout the segment (is there fun, games, smiling and laughter?).	
		Fussiness	Definition: a judgement on the overall fussiness of infant and adult throughout the segment (is there restlessness, negativity and lack of compliance with each other's wishes?).	
		Speech	A judgement on the overall speech or vocalisation levels of infant and adult throughout the segment (is there vocal expressiveness?).	

[1] This construct is named "Intrusiveness" in the Global Rating Scales (Murray et al. 1996) and in Blasi et al. (2015), but "Non-directiveness" in Wan et al. (2012). As this construct isnot described in Murray et al. (1996) or Blasi et al. (2015), the term "Non-directiveness" has been chosen and the corresponding description reported.

Supplement 1.2

Categorisation of parenting constructs

Construct		Description
Warmth	W	Positive regard and a supportive presence through verbal and non-verbal behaviours
Responsiveness	R	Consistent sensitive and supportive responses that match the child's actions, requests and intentions, feelings, focus of interest
Scaffolding	S	Guiding child's development to promote independence (teaching behaviour)
Proactive control	P	Establishment of rules and limitations in order to encourage desired child behaviour
Intrusiveness	I	Parent-centred behaviour, not recognising and/or respecting child's signals and needs
Negativity	N	Negative regard towards the child
Dyadic	D	Dyadic behaviours
Other	O	Parenting concepts that cannot be grouped under any other overarching concept
Multiple	M	Parenting concepts that can be grouped under multiple overarching concepts, depending on interpretation

Total amount of constructs:	63	100
Missing:	6/63	9.52%
Total amount of constructs coded:	**57**	**90.48%**
Exact agreement:	30/57	52.63%
Partial agreement:	19/57	33.33%
No agreement:	8/57	14.04%
Total agreement:	**49/57**	**85.96%**

	Coder 1	Coder 2	Coder 3	Consensus
Sensitivity (to nondistress), Responsiveness	R	R	R	R
Warmth, Positive regard	W	W	W	W
Respect for child's autonomy, lack of intrusiveness	I	I	I	I
Stimulation of cognitive development, Structuring	S	S	S	S
Negative regard, Hostility	N	N	N	N
Affective mutuality	D	D	D	D
Praise	W	W	W/P	M
Initiate/Direct play (opposite of Scaffold play)	S	P/S	I	M
Scaffold play (opposite of Direct play)	S/R	S/R/I	S	S
Scaffolding	S	S	S	S
Sustainability of shared topics	D	D	D	D
Fluency and connectedness	D	D	D	D
Sensitivity	R	R	W/R	
Responsivity	R	R	R	R
Effectiveness	S/D	S/D	S/D	S
Directiveness	I/P	I/P	I	M
Pace	O	O	O	M

Achievement	S/P/W	R/W/P/S	S	S
Praise	W/P/R	R/W/P	P/W	M
Acceptance	W	W	W	W
Enjoyment	W	W	W	W
Expressiveness	O	W/N	R	M
Inventiveness	S	S	S	S
Warmth	W	W	W	W
Sensitive responsiveness	R/W/S	R/S	R	R
Non-directiveness	I/W/N	I/N	I	I
Sensitive responsiveness	R	R	R	R
Dyadic mutuality	D	D	D	D
Sensitivity	W	W	W	W
Structuring	P/S	S/R/P	S/P	M
Non-hostility	N	N	N/W	N
Non-intrusiveness	I/W/R	I/R/W	I	M
Negative affect	N	N	N	N
Sensitivity	R	R	R	R
Positive affect	W	W	W	W
Intrusiveness	I	I	I	I
Detachment	R	R	R	R
Stimulation of cognition	S	S	S	S
Containment of child's distress	W/R	W/R	R	R
Responsiveness	D	D	R/D	D
Anticipation of child's needs	R/S	S	S	S
Autonomy	I/R	R/I	S	I
Cooperation	D	D	D	D
Control/conflict	P/I	?	P	P
Sensitivity	R	R/I	R	M
Intrusiveness	I	I/W	I	I
Remoteness	R	R	O	O
Depressive affect	N/R	R	N	O
Intensity of engagement	D	D	D	D
Social reciprocity	D	R	?	D
Supportive presence	W	W	W	W
Respect for child's autonomy	I/R	R	I	I
Effective structure and limit-setting	P	P	P	P
Quality of instructions	S	S	S/P	S
Non-hostility	N	N	N	N
Wellbeing	O/D	W/D	W	O
Contingent responsiveness	D	D	R/D	R
Cooperativeness	D	D	O	R
Involvement	O/W/R	?	O	O
Activity	O	?	O	O
Playfulness	W/D/O	W/R	W/D	O
Fussiness	N/I	?	N/D	N
Speech	O	-	O	O
	63	**58**	**62**	

Note.
Grey colour indicates full agreement between raters.

Chapter 2

Coding parenting behaviours among mothers of infants at elevated likelihood of autism: An exploratory pilot study

Abstract

In this pilot study, we developed and tested the Coding of Parenting Infants and Toddlers (CoPIT) among 10-month-old infants at elevated likelihood (EL) of autism and their mothers. We investigated its applicability and usability, and explored if assessing multiple specific behaviours in a neutral way (i.e., fewer/more, instead of adaptive/maladaptive) could provide more insight into the 'warmth/support' and 'control/directivity' dimensions in light of emerging autism. 23 videos were coded with the CoPIT or the Parent-Intant/Toddler Coding of Interaction (PInTCI). We found that interrater agreement for the CoPIT ranged from good to excellent, and that range and variance were sufficiently large for 10 out of 14 scales. We also found significant associations between most – but not all – theoretically similar constructs within the CoPIT and between the CoPIT and PInTCI. Our findings suggest that an overarching 'warmth/support' dimension exists, but we did not find evidence for a 'control/directivity' dimension. However, we could not fully investigate this hypothesis, due to the limited range and variance of the scales that measured limit-setting, disciplinary, intrusive, and overstimulatory parenting behaviours. The CoPIT scale Structure seems a useful addition to the PInTCI, as it was already observed in this pilot study (although at this young age related to maternal positive affect and not to any other subscale) and would likely be observed more often as children grow older. Further inspection of directive and controlling behaviours is needed to investigate when these behaviours are neutral, intrusive, or supportive for young children with or at EL of autism.

Introduction

Parenting is an environmental factor that receives increasing attention in research on emergent autism. Several prospective studies have followed young children and their families longitudinally in order to gain more understanding in parenting and interactive behaviours and to investigate whether these behaviours are predictive for a range of developmental outcomes, among which an autism diagnosis (for a review, see Wan et al., 2019). These studies generally included infant siblings of a child diagnosed with autism, who have a chance of up to 20% to be diagnosed with autism themselves by the age of 36 months (i.e., EL siblings; Messinger et al., 2015; Szatmari et al., 2016), and compared them to infants with an older sibling but without a family history of autism (i.e., TL siblings).

Observation of parent-child interaction is a commonly used method to assess parenting behaviours, both in samples of typically developing and autistic children. However, a large heterogeneity exists in observational measures used in autism research to measure parent-child interaction (Ku et al., 2019; Madarevic et al., 2021; Wan et al., 2019), which makes it difficult to compare findings and draw firm conclusions. Observational measures differ in terms of content (i.e., which parenting/interactive behaviours are studied), methodology (i.e., micro-level or macro-level coding, free play or structured interaction), and validity (Lotzin et al., 2015; Uzonyi et al., 2023), and the choice for a coding scheme depends on multiple factors, such as research aims and available resources.

The Coding Parenting of Infants and Toddlers (CoPIT) coding scheme

The CoPIT was developed as a global rating measure to characterise parenting behaviours among parents of young children with or at elevated likelihood (EL) of autism as well as typically developing children. With its focus on characterisation of parenting behaviours, instead of investigating the predictive value of parenting or interactive behaviours, the CoPIT differs from coding schemes that have already been used in autism research (e.g., Manchester Assessment of Caregiver-infant Interaction (MACI), see Wan et al., 2013; Wan et al., 2017; Parent-Infant/Toddler Coding of Interaction (PInTCI), see Pijl et al., 2021). The aim was to develop a coding scheme with a broad range of specific parenting behaviours, rather than overarching parenting behaviour constructs, of which the administration would not require too much time (for example, the Coding Interactive Behaviour (CIB) of Feldman and colleagues (1998) includes many subscales that are coded individually and then taken together, which renders the coding process rather time-consuming). We wanted to explore if a more in-depth investigation of the specific behaviours that could be grouped under a 'warmth/support' or a 'control/directivity' dimension could provide more insight in how parenting behaviours are correlated, and provide suggestions for assessing them. The parenting behaviours were chosen based on the results of our systematic review (Madarevic et al, 2021); the results of the JOnG! report, that investigated

parenting behaviours among parents of infants and toddlers from the general population using a self-report questionnaire (Van Leeuwen et al., 2011); and the PInTCI, a coding scheme used to investigate the predictive value of interactive behaviours in the context of autism. As we were interested in the quality of parenting behaviours, a macro-level coding approach was selected.

The CoPIT includes seven parenting behaviour constructs, divided in 14 scales: Warmth (Affective behaviour, Supportive Presence), Responsivity (Sensitivity, Following Child's Lead, Appropriateness), Scaffolding (Technical Scaffolding, Motivational Scaffolding), Proactive Control (Structure, Limit-setting), Directivity (Direction of Behaviour, Direction of Interaction), Reactive Control (Discipline), and Intrusiveness (Overstimulation, Intrusiveness). For a detailed description of all CoPIT scales, we refer to the Methods section.

For the coding anchors, we used several anchors of the PInTCI: the anchors of Affective Behaviour and Supportive Presence are based on the PInTCI-scale Positive Affect; the anchors of Sensitivity, Following Child's Lead, and Appropriateness are based on the PInTCI scales Sensitive Responsiveness and Negative Control; and the anchors of Technical Scaffolding and Motivational Scaffolding have almost fully been taken from the PInTCI-scale Scaffolding. The PInTCI-scale Negative Control was not used in the CoPIT, but the concept of parental control was included in two different constructs, Intrusiveness (the scales Overstimulation and Intrusiveness) and Directivity (the scales Direction of Behaviour and Direction of Interaction), to distinguish between thwarting directive (i.e., intrusive) behaviour and neutral directive (i.e., non-intrusive) behaviour. Based on the results of Van Leeuwen and colleagues (2011), the constructs Proactive Control (Limit-setting and Structure) and Reactive Control (Discipline) were added to the coding scheme. The CoPIT thus decompounds the parenting behaviour constructs from the PInTCI on the one hand, and adds parenting behaviour constructs stemming from general as well as autism-specific parenting research on the other hand.

The CoPIT was first piloted among mothers of 10-month-old children participating in the control group of the Resilience+ study, a study that investigates attachment and development among prematurely born infants. The first author checked whether it was possible to code all CoPIT scales and whether different behavioural examples needed to be added to the descriptions of the scales. Two Master students were then trained by the first author, again using videoclips from the Resilience+ study. Discussions during the training led to minor adjustments in the descriptions of the anchors of the Structure scale.

The present study

This pilot study was a first exploration of the CoPIT among mothers of infants at EL of autism participating in the TIARA ('Tracking Infants At Risk for Autism spectrum disorder') study. First, we wanted to investigate the applicability of the CoPIT among 10-month-old infants at EL of autism and their mothers. We wanted to (a) investigate whether the mother-child interactions could be coded

reliably using the CoPIT, (b) inspect the range, mean and variance of the CoPIT scales to assess their usability, and (c) explore correlations between all CoPIT scales to learn how parenting behaviours were intercorrelated in our sample. We expected a sufficient range and variance for most scales, but we expected that scores on the scales assessing controlling and intrusive behaviours (i.e., Discipline, Overstimulation, and Intrusiveness) would show floor effects, due to the nature of the play task, the age of the participating infants, and the laboratory setting. Moreover, mothers may not yet demonstrate proactive controlling behaviours, such as limit-setting, with infants aged 10 months, and a floor effect was therefore expected for the scale Limit-setting as well. We hypothesised that parenting behaviours that were grouped together for theoretical reasons would also be associated empirically.

Second, we compared the CoPIT to the parent scales of an established coding scheme, the PInTCI, to examine (a) whether the CoPIT scales correlated significantly and positively to the PInTCI scales they were based on or that measured similar theoretical constructs, and (b) which CoPIT scales could provide additional information on parenting behaviours during parent-child interaction, being uncorrelated or only weakly correlated to the PInTCI scales. Regarding the first hypothesis, we predicted significant positive correlations between Sensitive Responsiveness from the PInTCI and Affective Behaviour, Supportive Presence, Sensitivity, Following Child's Lead, and Appropriateness from the CoPIT, between Scaffolding from the PInTCI and Technical Scaffolding and Motivational Scaffolding from the CoPIT, and between Negative Control from the PInTCI and Direction of Behaviour, Direction of Interaction, Discipline, Overstimulation, and Intrusiveness from the CoPIT. With regard to the second hypothesis, we expected that additional information could be provided by splitting the Scaffolding scale of the PInTCI into a Technical Scaffolding and a Motivational Scaffolding scale for the CoPIT, and that breaking down the construct of "parental control" (also labelled "parent-led interaction" or "directiveness" in the parenting literature) would add to our understanding of directive parenting behaviours. We expected Direction of Interaction and Direction of Behaviour to assess *neutral* (i.e. non-intrusive) directive behaviours, and Overstimulation and Intrusiveness to assess *intrusive* directive behaviours.

Methods

Participants

In total, 23 infants (7 girls, 16 boys) participated together with their biological mother. All participants belonged to one of three groups that were part of the TIARA study (see 'Procedure'), each with an EL of developing autism, namely (a) infant siblings of children with an established autism diagnosis (Messinger et al., 2015; Szatmari et al., 2016), (b) infants born prematurely, with a gestational age of less than 30 weeks (Agrawal et al., 2018; Laverty et al., 2021; Vermeirsch et al., 2021), (c) and infants with persistent, medically insufficiently explained, idiopathic feeding problems (Field et al.,

2003). All infants were approximately 10 months old (corrected age for the preterms) during collection of the data, as their visit was scheduled around this time-point (+/- 2 weeks). Demographic characteristics of the participants are shown in Table 1. No group differences were found for infant or maternal age, biological sex of the infant, or educational level of the mother.

Table 1

Demographic Characteristics of the Participants

Child characteristics		**Sibling (*n* = 16)**	**Preterm (*n* = 3)**	**Feeding (*n* = 4)**	**Test statistic**	***p***	**Effect size**
Chronological (corrected) age (in months)	*M* (*SD*)	9.7 (1.2)	10.2 (0.8)	10 (0.1)	$H = .75$	.69	$\eta^2 = .06$
Sex (%)	Female	6 (37.5)	0	1 (25)	$\chi^2 = 1.75$	.42	$\phi_c = .19$
	Male	10 (62.5)	3 (100)	3 (75)			
Maternal characteristics		**Sibling (*n* = 16)**	**Preterm (*n* = 3)**	**Feeding (*n* = 4)**			
Chronological age (in years)	*M* (*SD*)	35.7 (4.2)	32.6 (1.5)	33.1 (3.6)	$H = 2.93$	.23	$\eta^2 = .05$
Education level (%)	Primary education	1 (6.25)	0	0	$\chi^2 = 9.99$	.44	$\phi_c = .21$
	Secondary education						
	General	2 (12.5)	0	0			
	Technical	0	0	1 (25)			
	Vocational	2 (12.5)	0	0			
	Bachelor's degree	8 (50)	1 (33.3)	1 (25)			
	Master's degree	3 (18.75)	2 (66.7)	2 (50)			

Note. Effect size of $\eta^2 = .00 – .01$: no effect; $\eta^2 = .01 – .06$: small effect; $\eta^2 = .06 – .14$: intermediate effect; $\eta^2 = .14 – .20$: large effect. Effect size of Cramér's Phi: $\phi_c = .00 – .10$: negligible association; $\phi_c = .10 – .20$: weak association; $\phi_c = .20 – .40$: moderate association; $\phi_c = .40 – .60$: relatively strong association; $\phi_c = .60 – .80$: strong association; $\phi_c = .80 – 1.00$: very strong association.

Procedure

Our data have been collected within the TIARA study, a multi-site longitudinal study that aims to identify and understand the factors that play a role in the early development of autism. Detailed information about the TIARA study can be found in Chapter 4.

This pilot study includes data of the 10 months' visit. The visit lasted approximately half a day, and could be split in two visits if necessary. Data for this pilot study comprised the first five minutes of the videotaped free play interaction of mother and child. Mother and child played together for 15 minutes, during which they would first read a book, then perform a difficult task (shape sorter), and finally play together with a standard set of age-appropriate toys. This set contained a baby doll with

bottle, a bear, two telephones (without batteries), a truck, wooden building blocks, and an exploratory toy. Mothers were instructed to play with their child as they would usually do at home. During the play interaction, the researcher would leave the room and knock on the door when the dyad needed to switch to the next task. The interaction was videotaped with two high quality surveillance cameras on two opposite walls, to minimise distraction of the dyad.

The 23 video clips were coded afterwards by a team of Master's students in Psychology or Educational Sciences that were blind to EL group. Two Master students were trained in the PInTCI by the first author (MM), under supervision of one of the developers of the coding scheme (PW), and two other Master students were trained in the CoPIT by the developer of the coding scheme (MM). Training videos did not include participants of the TIARA study. Each student coded 14 video clips. Five video clips were coded by all students (21.74%), and interrater reliability (IRR) was calculated per coding scheme and per scale.

Instruments

Parent-Infant/Toddler Coding of Interaction (PInTCI)

The PInTCI (Pijl et al., 2016) was developed as a coding scheme that would include parenting constructs that were found to play an important role in child development, and that could be used across early childhood (5 to 36 months) in both typically and atypically developing groups of children. The PInTCI is a global coding scheme that includes five child scales, five parent scales, and one dyadic scale, which are scored on a 7-point Likert scale. Higher scores reflect more adaptive behaviours, while lower scores reflect more maladaptive behaviours. In this pilot study, only the five parent scales were used, and the scores of Absence of Negative Control and Absence of Negative Affect were reversed after the coding process, to facilitate comparisons with the CoPIT scales. For a description of the child scales and the dyadic scale, we refer to Pijl and colleagues (2021).

Five scales assess the parent's behaviour during interaction with his or her child, namely Sensitive Responsiveness, (Absence of) Negative Control, Scaffolding, Positive Affect, and (Absence of) Negative Affect. The Sensitive Responsiveness scale assesses the accuracy of identification and interpretation of the child's cues (i.e., is the parent aware of the child's needs, based on observation of the child's behaviour) and the extent and appropriateness of the parent's responses to these cues (i.e., are the responses in line with the child's developmental level, affective state, behaviour, etc.). The Absence of Negative Control scale assesses the extent to which a parent determines the course of the play interaction in a directive, controlling, and/or intrusive way. Controlling the interaction may take the form of a high amount of suggestions or commands (e.g., the parent offers a new toy while the child is still playing with his/her own toy), but also the form of intrusions or physical manipulations (e.g., the parent pulls a toy out of the child's hand, or grabs the child by the arm to move it against his/her will).

The Scaffolding scale assesses how the parent adequately facilitates the child's development, by providing opportunities for the child to achieve things he or she would likely not achieve without guidance. Two types of scaffolding are included, namely Technical Scaffolding (e.g., parent demonstrates a task, labels objects, or describes sub steps that are too difficult for a child to conceptualise on its own) and Motivational Scaffolding (e.g., the parent focuses on the perseverance of the child, by helping it to become engaged and remain focused). The Positive Affect scale assesses parental positive affect, that can be defined in terms of positive and relaxed body language, physical affection, enthusiasm and the demonstration of smiles or laughter. The Absence of Negative Affect scale assesses parental negative affect, as communicated by tense body language, negative tone of voice, tightened or angry facial expressions, or hostile acts.

IRR in a larger study (Pijl et al., 2021) ranged from good to excellent for all scales at 10 months (ICC values between 0.68 and 0.95, $p < .01$). In this pilot study, IRR (measured as percentage agreement within one point) ranged from .60 (Negative Control and Positive Affect) to 1.00 (Scaffolding, Negative Affect). However, this agreement was based on the coding of only five videos. Although percentage agreement is deemed acceptable only from .70 on (Stemler, 2004), we decided to include the scales Negative Control and Positive Affect in the correlational analyses but to interpret our results with caution. As the Negative Affect scale showed insufficient variance and a floor effect ($\sigma^2 = .60$, $Md = 1$), this scale was not included in the correlational analyses. Variance of the other scales ranged from 1.4 (Sensitive Responsiveness) to 2.7 (Negative Control and Positive Affect), and scores ranged from 2 to 6 (Sensitive Responsiveness, $Md = 5$) and 1 to 7 (Negative Control, $Md = 4$; Scaffolding, $Md = 5$; Positive Affect, $Md = 4$).

Coding Parenting of Infants and Toddlers

The Coding of Parenting of Infants and Toddlers scheme (CoPIT; Madarevic, 2019) was developed to assess a broad range of parenting behaviours that can be observed during interaction with both infants and toddlers. The CoPIT includes seven parenting behaviours (Warmth, Responsivity, Scaffolding, Proactive Control, Directivity, Reactive Control, Intrusiveness), that are divided in 14 scales, and are scored on a 7-point Likert scale.

Warmth consists of the two scales Affective Behaviour and Supportive Presence. Affective Behaviour assesses the amount of verbal and non-verbal behaviours that convey positive affect, and that are genuine and authentic (e.g., praising, hugging, or kissing), while Supportive Presence assesses a parent's positive regard and emotional support to the child (e.g., warm tone of voice, happy and/or relaxed facial expression, active body orientation).

Responsivity consists of the three scales Sensitivity, Following Child's Lead, and Appropriateness. Sensitivity assesses whether the parent demonstrates that he/she is aware of the child's feelings, actions, needs, intentions, focus of interest (e.g., acknowledging child's behaviours verbally or non-verbally). Following Child's Lead assesses whether the parent recognises and respects the child's

individuality and autonomy, and supports ongoing activities of the child. Appropriateness assesses whether the parent responds in a developmentally and emotionally appropriate manner to the child's bids and/or actions, both verbally and non-verbally.

Scaffolding was taken from the PInTCI, but split into a Technical Scaffolding and a Motivational Scaffolding scale. Technical Scaffolding assesses a parent's focus on scaffolding the cognitive and language skills of the child (e.g., providing demonstrations, labelling objects, pointing out features of an object or task, relating an object to a previous experience). Motivational Scaffolding assesses whether the parent is focused on the perseverance and attention of the child, by attracting attention to an object or helping to refocus the attention of the child if he/she becomes distracted.

Proactive Control consists of the two scales Structure and Limit-setting. Structure assesses both structuring of the physical environment (e.g., moving aside toys that are not currently used, putting the current toy in the focus of attention of the child) and of the play interaction itself (e.g., giving the child clear instructions before and during a task or play activity, preparing the child in advance for a change in activity). Limit-setting assesses whether a parent sets limits and establishes rules to encourage desired child behaviour in a developmentally appropriate manner, and demands compliance with them (e.g., telling the child that you are going to play on the mat and that the child cannot leave the room and/or has to stay close to the mat).

Directivity consists of the two scales Direction of Behaviour and Direction of Interaction. Direction of Behaviour assesses whether a parent directs the immediate behaviour of the child by physically moving the child or moving a part of the child's body, without a clear request from the child (e.g., putting a child from his/her belly onto his/her back, pulling the child close for a hug or pulling the child onto the parent's lap, use the child's arms/legs in a singing game). Direction of Interaction assesses whether a parent directs the focus of the interaction, by initiating activities and/or providing toys to the child (e.g., redirecting the child's attention by pointing somewhere or by offering a new toy while the child is focused on something else or not focused on anything in particular). For both scales, the focus is on *neutral* (i.e., non-intrusive), rather than *intrusive* direction of behaviour or interaction.

Reactive Control is assessed with the Discipline scale. This scale assesses a parent's correction of the child's undesired behaviour in a verbal or non-verbal manner (e.g., speaking up when the child does something undesired, reacting physically to undesired behaviour by pulling the child down in a seated position or taking a toy from the child).

Intrusiveness consists of the two scales Overstimulation and Intrusiveness. Overstimulation refers to an inappropriate activity level, characterised by an inappropriate amount and intensity of actions, commands, requests or interference to direct the child's immediate behaviour (e.g., talking too much, kissing/hugging/praising the child too much, behaving at a pace that is too fast), or to behaviour that may be too intense (e.g., giving very intense kisses or hugs, being restless or extremely playful).

Data-analysis

IBM SPSS Statistics 28 was used for all analyses. First, data were checked for non-normality by using the Kolmogorov-Smirnov test. As all scales but Negative Control ($D(23) = .17$, $p = .10$) and Scaffolding from the PInTCI ($D(23) = .17$, $p = .07$) deviated significantly from a normal distribution, it was decided to use non-parametric tests. Second, descriptive analyses were conducted for the CoPIT. IRR was calculated per scale using percentage agreement, and range, median, and variance were calculated for all subscales to investigate usability. Scales with insufficient IRR (percentage agreement < .70; Stemler, 2004), and a limited range or variance (inspection of our data led to a cut off of ≤ 3 and < 1.00, respectively) were not included in the correlational analyses. Third, Spearman correlations between all CoPIT scales were calculated and then compared using the correlation test of Lee and Preacher (2013), to analyse intercorrelation patterns. Fourth, correlations were calculated between all CoPIT and PInTCI scales to examine (a) whether the CoPIT scales correlated significantly and positively to the PInTCI scales they were based on or that measured similar theoretical constructs, and (b) which CoPIT scales could provide additional information on parenting behaviours during parent-child interaction, being uncorrelated or only weakly correlated to the PInTCI scales.

Results

Descriptive analyses of the CoPIT

IRR of the CoPIT scales ranged from good to excellent, with a percentage agreement within one point of .80 for the scales Sensitivity, Appropriateness, Overstimulation, and Intrusiveness, and 1.00 for all other scales. All cases in which scores differed more than one point between raters concerned one and the same participant.

Out of the 14 scales, four scales (Limit-setting, Discipline, Overstimulation, and Intrusiveness) showed a limited range, floor effects, and insufficient variance, and were therefore not included in the correlational analyses (see Table 2). Although the range of scores was promising for the 10 included scales, the median score of several scales was situated at the lower (Affective Behaviour, Direction of Behaviour) or higher end (Supportive Presence, Appropriateness) of the scale. On average, mothers in this sample thus showed few affective and physically directive behaviours, and many supportive and appropriate behaviours.

Table 2

Minimum, Maximum, Median, Standard Deviation and Variance of the CoPIT Scales

Scale	Min.	Max.	Median	*SD*	Variance (σ^2)
CoPIT					
Affective Behaviour	1	6	2	1.4	2.0
Supportive Presence	2	7	6	1.6	2.5
Sensitivity	1	7	4	1.4	1.9
Following Child's Lead	1	6	3	1.6	2.5
Appropriateness	2	7	6	1.5	2.1
Technical Scaffolding	2	6	4	1.2	1.4
Motivational Scaffolding	1	5	3	1.2	1.4
Structure	1	5	3	1.1	1.3
Limit-setting	1	1	1	< .01	< .01
Direction of Behaviour	1	6	2	1.4	1.9
Direction of Interaction	2	7	5	1.3	1.8
Discipline	1	2	1	0.4	0.2
Overstimulation	1	3	1	0.7	0.5
Intrusiveness	1	3	2	0.6	0.4

Correlational analyses of the CoPIT

Correlations within each parenting behaviour construct (hereafter: intercorrelations) were significant and moderate to strong in most cases (see Table 3), suggesting that the scales measured similar but not exactly the same parenting behaviours. For Warmth, the intercorrelation between Affective Behaviour and Supportive Presence was r_s = .56 (p = .006). For Responsivity, the intercorrelations were r_s = .58 (p = .003) between Sensitivity and Following Child's Lead, r_s = .44 (p = .04) between Sensitivity and Appropriateness, and r_s = .48 (p = .02) between Following Child's Lead and Appropriateness. For Scaffolding, the intercorrelation between Technical and Motivational Scaffolding was r_s = .68 (p < .001). For Directivity, the intercorrelation between Direction of Behaviour and Direction of Interaction was non-significant, r_s = -.01 (p = .97).

Correlations between subscales of different parenting behaviour constructs revealed that most scales were significantly and strongly or moderately correlated to one or more scales belonging to other parenting behaviour constructs (see Table 3). Affective Behaviour was significantly correlated to Appropriateness (r_s = .60, p = .003) and Direction of Behaviour (r_s = .57, p = .005); Supportive Presence to Following Child's Lead (r_s = .60, p = .002) and Appropriateness (r_s = .44, p = .03); Sensitivity to Direction of Interaction (r_s = -.69, p < .001); Following Child's Lead to Motivational Scaffolding (r_s = .56, p = .005) and Direction of Interaction (r_s = -.57, p = .004); Appropriateness to Motivational Scaffolding (r_s = .46, p = .03), Direction of Behaviour (r_s = .43, p = .04), and Direction of Interaction (r_s = -.51, p = .01). Technical Scaffolding and Structure were not significantly correlated to any other CoPIT scale.

Comparison of the *p*-values within and between parenting behaviour constructs demonstrated that the strength and direction of the correlations between the scales of Warmth and Responsivity were similar to the strength and direction of the correlations within the respective constructs (*z*-scores ranged from -0.22 to 0.72, all *p*-values were nonsignificant), suggesting that the five scales measured similar parenting behaviours. For Motivational Scaffolding, the strength and direction of the correlation with Technical Scaffolding did not differ from the correlations with Following Child's Lead ($z = 0.63$, $p = .53$) or Appropriateness ($z = 1.04$, $p = .30$), indicating overlap between Motivational Scaffolding and responsive parenting behaviours.

The non-significant correlation between Direction of Behaviour and Direction of Interaction, the two scales that were developed to measure directive parenting behaviours, suggests that the two scales measure different parenting behaviours. Moreover, the scales showed significant correlations with scales from different parenting behaviour constructs: Direction of Behaviour was positively and significantly associated with Affective Behaviour ($r_s = .57$, $p = .005$), while Direction of Interaction was negatively and significantly correlated to all three Responsivity scales.

Correlational analyses of the CoPIT and the PInTCI

Associations between similar theoretical constructs

As hypothesised, Sensitive Responsiveness of the PInTCI was positively and significantly correlated to Sensitivity ($r_s = .47$, $p = .03$), Following Child's Lead ($r_s = .75$, $p < .001$), and Appropriateness ($r_s = .42$, $p = .05$) from the CoPIT (see Table 3). The association with Affective Behaviour was non-significant ($r_s = .29$, $p = .18$). Scaffolding from the PInTCI was positively and significantly correlated to Technical Scaffolding ($r_s = .50$, $p = .02$) and Motivational Scaffolding ($r_s = .69$, $p < .001$) from the CoPIT. Negative Control from the PInTCI was positively and significantly correlated to Direction of Interaction from the CoPIT ($r_s = .43$, $p = .04$), but non-significantly to Direction of Behaviour ($r_s = .32$, $p = .14$). Discipline, Overstimulation, and Intrusiveness were not included in the correlational analyses.

Additional information provided by the CoPIT scales

Only one CoPIT scale, Direction of Behaviour, showed no significant correlations with any of the PInTCI scales. Four scales from the CoPIT were significantly correlated to only one PInTCI scale: Affective Behaviour was significantly associated with Positive Affect ($r_s = .44$, $p = .04$), Appropriateness with Sensitive Responsiveness ($r_s = .75$, $p < .001$), Structure with Positive Affect ($r_s = .42$, $p = .05$), and Direction of Interaction with Negative Control ($r_s = .43$, $p = .04$).

With regard to the splitting of the Scaffolding scale from the PInTCI, the analyses demonstrated that Technical and Motivational Scaffolding were positively and significantly correlated to one another ($r_s = .68$, $p < .001$) and to the Scaffolding scale ($r_s = .50$, $p = .02$ and $r_s = .69$, $p < .001$, respectively).

Table 3

Spearman's Correlations between the Parental PInTCI Scales and the CoPIT Scales

	PInTCI				CoPIT								
	SR	**NC**	**Sc**	**PA**	**AB**	**SP**	**S**	**FL**	**A**	**TS**	**MS**	**St**	**DB**
PInTCI_NC	-.47*												
PInTCI_Sc	.71**	-.20											
PInTCI_PA	.71**	-.04	.62**										
CoPIT_AB	.29	.05	-.02	.44*									
CoPIT_SP	.61**	-.01	.42*	.56**	.56**								
CoPIT_S	.47*	-.44*	.22	.24	.23	.36							
CoPIT_FL	.75**	-.36	.28	.50*	.41	.60**	.58**						
CoPIT_A	.42*	-.24	.10	.22	.60**	.44*	.44*	.48*					
CoPIT_TS	.45*	-.001	.50*	.37	.20	.34	.11	.20	.13				
CoPIT_MS	.78**	-.28	.69**	.62**	.38	.39	.33	.56**	.46*	.68**			
CoPIT_St	.26	.36	.16	.42*	.38	.29	.14	.35	.14	.31	.36		
CoPIT_DB	-.17	.32	-.38	-.02	.57**	.19	.02	.16	.43*	.13	.06	.28	
CoPIT_DI	-.33	.43*	-.10	-.001	-.30	-.38	-.69**	-.57**	-.51*	.14	-.20	-.03	-.01

Note. SR = Sensitive Responsiveness; NC = Negative Control; Sc = Scaffolding; PA = Positive Affect; AB = Affective Behaviour; SP = Supportive Presence; S = Sensitivity; FL = Following Child's Lead; A = Appropriateness; TS = Technical Scaffolding; MS = Motivational Scaffolding; St = Structuring; DB = Direction of Behaviour; DI = Direction of Interaction. Hypothesised positive significant correlations are marked in grey.

* $p < .05$

** $p < .01$

However, the two scales were differently correlated to the other scales of the CoPIT and the PInTCI. Technical Scaffolding showed only one significant correlation, namely with Sensitive Responsiveness from the PInTCI (r_s = .45, p = .03), while Motivational Scaffolding was positively and significantly correlated to four out of the eight other scales, both from the PInTCI and CoPIT. This suggests that the two scales assess at least partly different parenting behaviours.

The CoPIT scales that were developed to assess intrusive directive behaviours, namely Overstimulation and Intrusiveness, were not included in the analyses. The two scales that were meant to assess neutral directive behaviours, namely Direction of Behaviour and Direction of Interaction, were differently correlated to Negative Control from the PInTCI. Direction of Behaviour was non-significantly correlated to Negative Control from the PInTCI (r_s = .32, p = .14), and the scales thus seemed to measure different behaviours. Direction of Interaction was found to measure directive behaviours that were also captured by Negative Control from the PInTCI (r_s = .43, p = .04), and that are the opposite of responsive behaviours, as measured by the three Responsivity scales (r_s = -.69, p < .001 for Sensitivity, r_s = -.57, p = .004 for Following Child's Lead, and r_s = -.51, p = .01 for Appropriateness).

Discussion

This pilot study was a first exploration of the CoPIT, a newly developed coding scheme. The CoPIT was developed to assess a broad range of parenting behaviours that can be observed during interaction with infants or toddlers. First, we aimed to investigate the applicability and usability of the CoPIT among 10-month-old infants at EL of autism and their mothers, and find out how parenting behaviours as measured with the CoPIT were intercorrelated. Second, we wanted to compare the CoPIT scales to the parent scales of an established coding scheme, the PInTCI, to investigate whether the CoPIT scales correlated significantly and positively to the PInTCI scales that measured similar theoretical constructs, and if they could provide additional information on parenting behaviours during parent-child interaction.

Applicability and usability of the CoPIT

The interrater agreement ranged from good to excellent, indicating that all CoPIT scales could be scored reliably. The fact that all disagreements between the raters concerned only one and the same participant, meaning that raters agreed on all other scores, further strengthens this conclusion. It also indicates that some videoclips were very difficult to score, or that some parenting behaviours during a given parent-child interaction were difficult to interpret. However, only five videos were double-coded, and the possibility of chance agreement cannot be ruled out.

As hypothesised, four out of 14 scales showed a limited range, floor effects, and insufficient variance. For Limit-setting, Discipline, Overstimulation and Intrusiveness, mothers received scores that were almost exclusively situated at the lower end of the scale, indicating that the behaviours assessed with these scales were not or only little demonstrated during the play interactions. The fact that so few limit-setting and disciplinary behaviours were observed could be due to the participants' age, as 10-month-old infants may not test their parents' limits yet (e.g., they may not yet crawl away or understand the concepts of right and wrong) and therefore do not need to be disciplined. In a study with both autistic and non-autistic toddlers of 2.5 years old (Oosterling et al., 2010), structuring and limit-setting behaviours were observed during parent-child interaction, suggesting that this parenting behaviour will become more important when children grow older. Moreover, the free play task may not have prompted limit-setting, disciplinary or intrusive behaviours, as mothers and children were free to play with whatever they liked and however they liked. A more structured and difficult task could have elicited these behaviours, such as providing a shape sorter and requesting the child to sort the shapes correctly while the mother assists as she would do at home. However, parents and children participating in the study of Oosterling and colleagues (2010) could also play freely, and mothers still demonstrated structuring and limit-setting behaviours. Mothers in our pilot study did also not display many overstimulatory or intrusive behaviours during interaction with their child, reflected by the low scores for Overstimulation and Intrusiveness. This could be due to the design of the scales, that may include behaviours at the higher end of the scale that will not be demonstrated readily during play interaction with an infant, but it could also be due to characteristics of the sample (e.g., age, educational level, mental health, and temperament of the mother, age, temperament, and behavioural problems of the child) that we have not included in our analyses.

Although the range of scores was promising for the 10 other scales, the scores for several scales were situated at the lower (Affective Behaviour, Direction of Behaviour) or higher end (Supportive Presence, Appropriateness) of the scale. On average, mothers in this sample were highly supportive, and showed few affective and directive physical behaviours during interaction with their child. The high scores for Supportive Presence could indicate that this scale does not differentiate well between a neutral but warm presence and more overt expressions of support. The low scores for Direction of Behaviour were rather surprising, as we had expected mothers to move their infants and manipulate their limbs (e.g., grabbing their hands to clap while singing a song) quite often. It may be possible that the descriptions of directive behaviours were unclear or not representative for the actual behaviours that mothers demonstrate during a play interaction. Affective behaviours also occurred less often in our sample than expected. One possible explanation lies in the cultural background of the participants, that were almost exclusively Flemish, as cultural differences in the expression of affection exist (see for example Lin and Fu (1990) for a comparison between Chinese, Chinese immigrant, and Caucasian-American parents).

Significant correlations between similar theoretical constructs

Supportive Presence, Sensitivity, Following Child's Lead, and Appropriateness from the CoPIT were positively and significantly correlated to Sensitive Responsiveness of the PInTCI, confirming our hypotheses. Affective Behaviour from the CoPIT was not significantly associated with Sensitive Responsiveness, but with Positive Affect from the PInTCI. This suggests that Affective Behaviour should not be grouped under the same construct as Supportive Presence, i.e., Warmth, but that it assesses parental affect, similar to the PInTCI scale Positive Affect.

Technical Scaffolding and Motivational Scaffolding from the CoPIT were positively and significantly correlated to Scaffolding from the PInTCI, as hypothesised. The correlation between Technical Scaffolding from the CoPIT and Scaffolding from the PInTCI was only moderate, however. All three scales that assessed scaffolding behaviours were moderately to strongly associated with Sensitive Responsiveness from the PInTCI, indicating that mothers who were adequately responding to their child's needs were also scaffolding their child's development by labelling objects and encouraging them during play.

Direction of Interaction from the CoPIT was positively and significantly correlated to Negative Control from the PInTCI, indicating that the two scales measured similar behaviour, namely directing the play interaction instead of following the child's lead. The association between Direction of Behaviour and Negative Control was non-significant, which could suggest that Direction of Behaviour does not assess intrusive directive behaviour, as does Negative Control. Discipline, Overstimulation, and Intrusiveness were not included in the correlational analyses, and it could thus not be investigated whether they were significantly correlated to Negative Control or not.

Insights from the correlations within the CoPIT and between the CoPIT and the PInTCI

The aim of the PInTCI is to predict children's developmental outcomes, including an autism diagnosis, and parental behaviours were thus selected based on their predictive value in previous studies within the context of emergent autism (Pijl et al., 2016). Moreover, as the PInTCI includes scales that assess infant, parent, as well as dyadic behaviours, it could not include all parenting behaviours that may be observed during parent-child interaction, due to feasibility issues. The CoPIT, on the other hand, aims to describe parenting behaviours, rather than study their predictive value. It therefore includes a broad range of specific parenting behaviour scales that were assessed individually, instead of a few overarching scales.

An overarching 'warmth/support' dimension seems to exist

First of all, the positive and significant intercorrelations between the CoPIT scales Supportive Presence, Sensitivity, Following Child's Lead, Appropriateness, and the PInTCI scale Sensitive

Responsiveness suggest that an overarching 'warmth/support' dimension, as proposed by Ku and colleagues (2019), exists. Moreover, the Responsivity scales from the CoPIT were significantly correlated to Motivational Scaffolding and – negatively – to Direction of Interaction from the CoPIT, which suggests that mothers who adequately responded to their child's cues and followed their child's interests, were also motivating their child during play and did not lead the interaction. Researchers could thus save time by assessing these parenting behaviours with an overarching scale such as Sensitive Responsiveness from the PInTCI. However, not all intercorrelations were equally strong, and the correlational patterns differed per scale. More research is needed to confirm the intercorrelations in larger and more diverse samples, and to explore correlations with parent and child characteristics, such as temperament or autism characteristics.

No evidence for an overarching 'control/directivity' dimension

We were unable to confirm the existence of a 'control/directivity' dimension, as the range and variance of the CoPIT scales Discipline, Overstimulation, and Intrusiveness were insufficient, and associations between scales that were hypothesised to assess neutral or intrusive directive behaviours could not be calculated. Moreover, the Negative Control scale from the PInTCI was not very reliably coded, and our results thus need to be confirmed in future research. Nonetheless, we found that Negative Control was positively and significantly correlated – albeit moderately – to Direction of Interaction, but not to Direction of Behaviour from the CoPIT. This suggests that when mothers in our study actively led the play interaction, by offering toys or intervening during the child's play, this was scored as 'low intensive negative control' with the PInTCI, and as directing the interaction with the CoPIT. In this study, the lower end of the Negative Control scale namely represents a parent directing the interaction non-intrusively, while the higher end of the scale represents intrusive directive behaviours. Both Negative Control and Direction of Interaction were negatively and moderately associated with the scales that assessed sensitive parenting behaviours. Hence, parent-led interaction, with the parent directing the play interaction by offering toys or physically manipulating the child without being prompted, seemed to be regarded as mildly intrusive, rather than neutral, in our sample. However, in a different population, with older children or children who develop atypically (e.g., autistic children, children with developmental delay), directive parenting behaviours could be positively associated with sensitive parenting behaviours. In a study including children with significant cognitive and motor developmental delay, Van keer and colleagues (2017) namely found that more demonstration of directive behaviours during play interaction was associated with more observed encouragement of sensorimotor and cognitive achievement and more self-reported autonomy support. Apart from the characteristics of the study sample, these results could be related to the scale that was used. The Directivity scale, which was taken from the Maternal Behavior Rating Scale Revised (Mahoney et al., 2008), assesses parenting behaviours that could be categorised as scaffolding, proactive, or intrusive (Madarevic et al., 2021), and thus differs from the scales used in our study.

The non-significant correlations between Negative Control and Direction of Behaviour, and between Direction of Interaction and Direction of Behaviour indicate that Direction of Behaviour measures different behaviours than the other two scales. As Direction of Behaviour was positively associated with Affective Behaviour and Appropriateness, it seems to evaluate non-intrusive physical manipulation, which may be quite common during interaction with 10-month-old infants. Mothers namely received a higher score when they picked up or moved their child, which can be highly appropriate when a child is uncomfortable in its position and needs help.

Technical Scaffolding and Motivational Scaffolding are different but interdependent

Regarding scaffolding of the child's development, our results indicate that Technical Scaffolding and Motivational Scaffolding from the CoPIT measure different behaviours, but that they are interdependent. The two scales were positively and strongly correlated to one another, and strongly (Motivational Scaffolding) and moderately (Technical Scaffolding) to Scaffolding from the PInTCI, but they showed different correlational patterns. Motivational Scaffolding, comprising behaviours that stimulate and encourage a child, was positively associated with all scales that assessed sensitive and responsive behaviours, while Technical Scaffolding, comprising teaching behaviours such as labelling objects, was only moderately associated with Sensitive Responsiveness from the PInTCI. As Scaffolding, the overarching scale from the PInTCI that was split in two for the CoPIT, was strongly associated with Sensitive Responsiveness, but the correlation between Scaffolding and Technical Scaffolding was only moderate, this was not surprising.

The interdependence of the two scaffolding scales can be explained as follows: In order to teach a child how to perform a task, you should first obtain its attention, and then stimulate and encourage it to complete the task. Vice versa, there is no need to motivate a child for a task if it is not actively involved in the task. Motivational behaviours thus seem to complement teaching behaviours, but our results suggest that they would better be assessed separately, at least in this age group of 10-month-old infants.

Structure seems a promising scale with added value

Structuring of the play environment or the play interaction is already included in other coding schemes, like the Emotional Availability Scales (EAS; Biringen et al., 1998), the Erickson scales (Erickson et al., 1985), and the coding scheme of Karreman (Karreman et al., 2008), but it was not yet assessed among mothers of infants.

Our findings suggest that it is possible to assess structuring behaviours among mothers interacting with 10-month-old infants, although the scale may need to be further adapted for use among very young children. Most mothers namely received scores at the lower end of the scale, which is likely related to the children's young age, as children aged 10 months may not yet understand structuring cues, and to the play task, as free play does not need to be structured. This could also explain the lack of

significant associations with other CoPIT and PInTCI scales than Positive Affect. The moderate association between Structure and Positive Affect may be explained by the aspect of extraversion that both scales share. Structuring the play interaction by telling your child what you are going to do next, even though your child will not respond, may be easier for extravert and verbally strong mothers, which is what Positive Affect assesses, namely a parent's overt enthusiasm, smiling, and expressiveness. However, the lack of significant correlations between Structure and other scales that measured similar behaviours and were associated with Positive Affect, namely Motivational Scaffolding and Affective Behaviour, contradicts this hypothesis.

In conclusion, Structure could be a useful scale in longitudinal follow-up studies of parenting behaviours, as it was already observed in this pilot study (although at this young age only significantly related to maternal positive affect), and would likely be observed more often as children grow older. Indeed, mothers of older (autistic) children demonstrated more proactive behaviours during interaction with their older (autistic) children (Madarevic et al., 2022; Oosterling et al., 2010).

Strengths and limitations

The strength of this study is that we assessed mother-infant interactions with two different coding schemes. In this way, we could compare a newly developed coding scheme to one that already existed to explore associations between similar theoretical constructs and learn more about how parenting behaviours are related.

First, we found that raters could be trained up to good to excellent interrater agreement for most scales, except for Negative Control and Positive Affect from the PIntCI. As those scales were coded reliably in a different study (Pijl et al., 2021), the lower interrater agreement in this pilot study could be a result of the training by the first author instead of one of the developers from the PInTCI. Due to feasibility and timing issues, only five videoclips were double-coded. This pilot study would have been stronger if all 23 videoclips would have been double-coded, as more information would have been available regarding the interrater reliability.

Second, most scales showed a sufficient range and variance, indicating that descriptions of the assessed parenting behaviours represented actual behaviours that were demonstrated during mother-infant interaction. However, five scales could not be included in the correlational analyses due to insufficient range and variance, and as a consequence, not all hypotheses could be tested fully. Moreover, for several scales, the median score was situated near the lower or higher end of the scale. Descriptions of these scales may thus need to be adjusted in order to obtain a more balanced distribution of the scores.

Third, this pilot study was unique in its inclusion of three groups of infants at EL of autism, instead of focusing exclusively on prematurely born infants or infant siblings of children with autism. However, parenting behaviours could not be compared between groups due to the small sample size,

nor could they be compared to children at typical likelihood of autism (i.e., infants born full-term with no close relative diagnosed with autism). Consequently, our results cannot be generalised to the whole target population of infants at EL of autism, nor to the general population.

All in all, this pilot study provided some answers, but even more suggestions for further study. Both the CoPIT itself and its applicability should be the focus of further study, to investigate whether the limitations of this pilot study can be addressed by adjusting the descriptions of the scales, by including older children and their parents, or by using a more structured or difficult task. Moreover, investigation among different samples, for example of typically developing children, autistic children, or children with developmental delay, could shed light on the specificity of the parenting behaviours as observed in this pilot study. However, our findings also indicate that structuring behaviours can already be assessed among mothers of 10-month-old infants, and hence, that it may be useful to add this scale when investigating parent-child interactions in longitudinal studies.

Conclusion

This pilot study contributes to a deeper understanding of parenting behaviours among mothers of infants at EL of autism, by coding the same mother-child interactions with two coding schemes – one existing coding scheme and one developed to characterise parenting behaviours in even more detail. Our results suggest that an overarching 'warmth/support' dimension exists, which includes parenting behaviours that are supportive and responsive. We found no evidence for an overarching 'control/directivity' dimension, but we could not investigate this hypothesis fully, due to the limited range and variance of the scales that measured limit-setting, disciplinary, intrusive, and overstimulatory parenting behaviours.

Structure could be a useful scale in longitudinal follow-up studies of parenting behaviours, as it was already observed in this pilot study (although at this young age only significantly related to maternal positive affect), and would be observed more often as children grow older. However, the description of the scale may need to be further adapted for use among infants.

Finally, further inspection of directive and controlling behaviours is needed to investigate when these behaviours are neutral, intrusive, or supportive for young children with or at EL of autism. A first step would be to elicit these behaviours during the assessment. This could be done by choosing a different task for the observation, for example asking parent and child to perform a task that is too difficult for a child of a given age (e.g., shape sorter, making a puzzle). It may also be useful to include a slightly older sample, as toddlers and pre-schoolers have more fine and gross motor skills and may thus crawl or wander away from the task. In a second step, associations could be investigated between directive and controlling parenting behaviours on the one hand, and child developmental outcomes on the other hand.

Chapter 3

Child temperament changes during the first year of life but does not predict mother-child interactions among infants at elevated likelihood of autism

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Abstract

Child temperament could be a relevant transdiagnostic construct for understanding heterogeneity in emerging autism, as temperament is not specific to autism but rather varies among all individuals. The present study investigated changes in and associations between child temperament and mother-child interactions among infants at elevated likelihood (EL) of autism. Random intercept (generalised) linear mixed models were fit to investigate mother-reported temperament and observed mother-child interactions among 147 infants (89 siblings, 68 preterms) at 5 and 10 months. Surgency and Negative Affectivity increased, while Orienting/Regulation decreased. Mothers of preterms reported more Surgency at 5 months, but no other group differences were found. Some mother-child interactions changed during the first year of life, both confirming and contrasting with previous studies. Child temperament was not associated with mother-child interactions. Our findings provide some evidence for the value of temperament as transdiagnostic construct, but future studies should investigate temperament and parent-child interactions across infancy and toddlerhood, and explore associations with autism characteristics to increase our understanding of heterogeneity in autism.

Introduction

Child temperament could be a relevant transdiagnostic construct for understanding heterogeneity in emerging autism, as temperament is not specific to autism but rather varies among all individuals. Moreover, temperament has been found to predict challenging behaviours in autistic preschoolers (Korbut et al., 2020). In their Editorial Perspective, Chetcuti and colleagues (2019) recommended further investigation of associations between temperament and autism, taking individual differences into account, and considering the role of the child's parenting environment. Research in the general population has namely shown that child temperament and parenting behaviours may influence one another over time and may interact in the prediction of developmental outcomes (Bates et al., 2019; Bates et al., 2012).

Child temperament

Although there is no consensus regarding the precise definition of temperament, it is generally believed that it manifests itself from infancy onward, has a strong genetic or neurobiological basis, and is relatively consistent across situations and time (Rothbart, 2012). From the five temperament models that are most widespread (for a detailed description and discussion, see Mervielde & De Pauw, 2012), the psychobiological model of Rothbart and colleagues (e.g., Rothbart, 1981, 2012) is most commonly used in scientific studies. It describes temperament as individual differences in reactivity and self-regulation, shaped throughout development by complex interactions between genetic, biological, and environmental factors. These individual differences can be described with three broad temperament dimensions: (a) Surgency, referring to social orientation, (b) Negative Affectivity, referring to a general tendency to experience negative emotions and recovery from distress, and (c) Orienting/Regulation (or Effortful Control for older children), referring to attentional focusing and soothability. Although this three-factor structure has most commonly been found (e.g., Enlow et al., 2016; Gartstein & Rothbart, 2003; Montirosso et al., 2011), several German population studies revealed a two-factor structure, with the Orienting/Regulation factor not being replicated (Mink et al., 2013; Sieber & Zmyj, 2022; Vonderlin et al., 2012).

Child temperament among siblings

The relationship between temperament and autism has been the focus of two systematic reviews (Mallise et al., 2020; Chetcuti et al., 2021) and two recent empirical studies (e.g., Sacrey et al., 2022; Sung et al., 2022). These studies included infant siblings of a child with an established autism diagnosis, who have a 7-19.5% chance of developing autism themselves (Messinger et al., 2015; Szatmari et al., 2016), compared to 1% in the general population (Zeidan et al., 2022). In the following, these siblings

will be described as being at elevated likelihood (EL) of autism, and younger siblings of a non-autistic child as being at typical likelihood (TL) of autism.

Compared to non-autistic and TL samples, children and adolescents with or at EL of autism could be characterised by a profile of higher affectivity/emotionality, lower sociability, and lower self-regulation (Chetcuti et al., 2021). However, differences between EL and TL siblings have not consistently been found in the first year of life (Mallise et al., 2020; Sacrey et al., 2022; Sung et al., 2022). Some studies found that EL siblings who developed autism received lower Surgency scores compared to EL siblings who did not develop autism (Paterson et al., 2019; Sung et al., 2022), while others found no differences (Pijl et al., 2019; Sacrey et al., 2022). Negative Affectivity and Orienting/Regulation only started to differ around the end of the first year of life, with EL siblings who developed autism receiving higher scores for Negative Affectivity and lower scores for Orienting/Regulation than those who did not develop autism (Paterson et al., 2019; Pijl et al., 2019), although these differences were not found in other studies (Sacrey et al., 2022; Sung et al., 2022).

Comparisons of temperament trajectories showed both similarities and differences with non-autistic children. Parents of EL siblings who later developed autism reported a decrease in Surgency (Paterson et al., 2019; Pijl et al., 2019) and Orienting/Regulation (Pijl et al., 2019) between 6-8 and 12-14 months, while EL siblings who did not develop autism received similar Surgency and Orienting/Regulation scores at both time-points. Parents of TL siblings reported an increase in Surgency (Paterson et al., 2019) or no change (Pijl et al., 2019), and no change in Orienting/Regulation (Paterson et al., 2019; Pijl et al., 2019). No differences in Negative Affectivity were observed in any group (Paterson et al., 2019; Pijl et al., 2019). In turn, general population studies found that, at the group level, Dutch and US mothers reported more child Negative Affectivity at 12 months compared to six months of age but similar levels of Surgency and Orienting/Regulation (Sung et al., 2015), while Flemish mothers reported higher scores for child Surgency and Negative Affectivity, and lower scores for Orienting/Regulation at 12 months compared to two months of age (Van Cauwenberge et al., 2012).

Child temperament among preterms

More recently, very and extremely prematurely born infants (i.e., infants born at a gestational age of less than 32 and 28 weeks, respectively) have been identified as another EL group, having a chance of 7-13% to develop autism (Agrawal et al., 2018; Laverty et al., 2021; Vermeirsch et al., 2021). Their EL is related to the "preterm behavioural phenotype", a combination of biological and environmental factors associated with very or extremely preterm birth (Montagna et al., 2016). To our knowledge, only one study has explored the associations between temperament and autism among preterms. Vlaeminck and colleagues (2020) studied associations between parent reports of temperament and sensory processing on the one hand, and observed cognitive development and autism characteristics on the other, and found that better cognitive development could be predicted by lower scores for Activity

(Surgency subscale), and that lower scores for Soothability and Perceptual Sensitivity (Negative Affectivity subscales) were associated with more reported and observed autism characteristics.

Outside the autism context, the meta-analysis of Cassiano and colleagues (2020) showed that preterms received higher scores for Activity (Surgency subscale) and lower scores for Attentional Focusing (Orienting/Regulation or Effortful Control subscale) and Attention Span/Persistence from their parents, compared to full-term born infants. Moreover, extremely prematurely born infants received the highest Activity scores of all preterm born infants. No differences in Negative Affectivity were found. This is in contrast to a recent study by Navalón and colleagues (2022), who compared different groups of infants (not) born after a threatened preterm labour (TPL), and found that very preterm-TPL infants received the lowest Surgency scores.

Cross-cultural research found that mean-level change in temperament differed per country (Spinelli et al., 2020). Chilean mothers of preterms reported more Smiling and Laughter (Surgency subscale) and a higher Activity level (Surgency subscale) at 12 months compared to six months, while UK mothers reported a decrease in Smiling and Laughter and no change in Activity, and US mothers reported no change in any of the temperament subscales. No change in any of the Negative Affectivity or Orienting/Regulation subscales was observed.

Parent-child interactions and emerging autism

As mentioned above, Chetcuti and colleagues (2019) stressed the importance of considering a child's parenting environment when investigating the associations between child temperament and autism characteristics. Similar to temperament, parent-child interactions have only been investigated among EL siblings and preterms separately to date.

Observational research among EL and TL siblings suggests that parent-child interactions may differ in some aspects during the first year of life, although findings vary between studies and different ages. Compared to TL siblings, EL siblings demonstrated less liveliness at 6-10 months (Wan et al., 2012), fewer initiations at 10 months but not five months (Pijl et al., 2021), and less intense engagement at six months (Del Rosario et al., 2023). However, they were equally attentive and responsive (Del Rosario et al., 2023; Kellerman et al., 2020; Pijl et al., 2021; Wan et al., 2012), and showed equal amounts of positive and negative affect (Del Rosario et al., 2023; Pijl et al., 2021; Wan et al., 2012). With regard to parental behaviours, parents of EL siblings were found to be more directive than parents of TL siblings in some studies (Harker et al., 2016; Wan et al., 2012), but not in others (Del Rosario et al., 2023; Pijl et al., 2021). No differences in sensitivity were found (Baker et al., 2010; Del Rosario et al., 2023; Harker et al., 2016; Pijl et al., 2021; Wan et al., 2012).

Compared to full-terms, preterms demonstrated fewer facial expressions and made less (eye)contact during interaction (Bozzette, 2007). In addition, Hall and colleagues (2015) found that very preterm infants showed less positive mood compared to full-term infants (but similar negative mood) at

six months, and demonstrated lower levels of activity and sustained attention. Finally, preterms demonstrated less responsiveness (Stack et al., 2019) and less involvement (Harel-Gadassi et al., 2020; Stack et al., 2019), although Muller-Nix and colleagues (2004) observed no differences in cooperation, compliance, difficult behaviours, or passivity. In her review of parenting preterms, Gattis (2019) concluded that parents of preterms have generally been found to be more attentive and engaged than parents of full-terms, and to stimulate their child more often during interaction. These stimulatory behaviours may at times be intrusive or controlling, although this seems to be related to higher levels of stress and anxiety among parents of preterms compared to full-terms. Most studies found no differences in maternal sensitivity (Bilgin & Wolke, 2015; Stack et al., 2019).

Two studies explored change in parent-child interactions using linear mixed models. Pijl and colleagues (2021) investigated change between five and 10 months among EL and TL siblings. Children from both groups demonstrated more positive and less negative affect at 10 months, while mothers demonstrated more sensitive responsiveness and scaffolding. No change was observed for child initiations, attentiveness, and sharing of affect, or for parental negative control and affect. These findings differ from those of Stack and colleagues (2019), who found that child responsiveness and involvement increased, and maternal sensitivity decreased among preterms and full-terms between six and 57 months, while maternal structuring decreased in the preterm group only. These inconsistencies are most likely due to differences in methodology (e.g., coding scheme, child's age at observation) and sample (EL and TL siblings vs. preterms and full-terms).

Overall, it cannot be concluded that parent-child interactions among EL siblings or preterms *consistently* differ from TL siblings or full-terms in the first year of life. However, *when* differences were found, they indicated less (active) engagement of infants, especially among preterms, and more directive behaviours of parents. Parent-child interactions likely change during the first year of life, although the direction differed between studies. Differences in (change in) parent-child interactions could be related to differences in (change in) child temperament, as correlational and (bi)directional relationships have been found between child temperament and parenting (Bates et al., 2019; Bates et al., 2012).

Child temperament and parent-child interactions

In the general population, most evidence has been found for a relationship between the temperament factor Negative Affectivity and parenting behaviours (Bates et al., 2019; Bates et al., 2012). Findings in the first year of life are however mixed. Perry and colleagues (2018) for example found that children's Negative Affectivity at five months was associated with more maternal intrusiveness at 10 months, which in turn predicted increased Negative Affectivity at 24 months. Moreover, child Negative Affectivity seemed to be associated with maternal sensitivity, with mothers demonstrating lower levels of sensitivity when children displayed more Negative Affectivity (Mills-

Koonce et al., 2007), and higher levels of maternal sensitivity when children's Negative Affectivity decreased between three and nine months of child's age (Feldman et al., 1997). On the contrary, Aktar and colleagues (2017) and Wittig and Rodriguez (2019) found no significant associations between child temperament and parent-child interactions.

In the context of emerging autism, similar studies are scarce. So far, the only empirical evidence comes from Hirschler-Guttenberg and colleagues (2015). They found that an authoritarian parenting style (i.e., low in responsiveness, high in demand) predicted higher self-regulation and lower co-regulation of anger among autistic pre-schoolers, while an authoritative parenting style (i.e., high in responsiveness, high in demand) predicted higher self-regulation of fear. Among a group of preterms and full-terms, Vaccaro (2019) found that children's Negative Affectivity (but not Surgency or Orienting/Regulation) was negatively associated with maternal responsivity to non-distress. Harel-Gadassi and colleagues (2020) however found that none of the three temperament dimensions mediated the associations between preterm status and the quality of mother-child interaction at 18 or 36 months.

Based on previous research, it can be concluded that group differences in temperament and temperament trajectories exist between children with and without (EL of) autism, and between preterms and full-terms, although these differences have not consistently been found in the first year of life. Bates and colleagues (2019) concluded that temperament and parenting play transactional roles in children's social development, and may thus help explain individual differences. However, research on the relationships between child temperament and parenting behaviours in the context of autism is scarce. Although EL siblings and preterms share an elevated likelihood of autism, it is not yet known whether, and, if so, how they differ in terms of temperament and parenting. An investigation of the associations between child temperament and mother-child interactions among EL infants could shed more light on heterogeneity in autism and the role of temperament as transdiagnostic construct.

The present study

The present study contributes to a growing body of research on temperament in the context of autism, by investigating associations between temperament and quality of mother-child interactions among two groups of children at EL of autism.

First, we investigated whether temperament differed between five and 10 months and between EL siblings (hereafter "siblings") and preterms. We expected change, but did not know in which direction. As per the heterogeneity in our sample, our findings could be in line with any of the findings among EL and TL siblings (Paterson et al., 2019; Pijl et al., 2019), preterms (Spinelli et al., 2020), and the general population (Sung et al., 2015; Van Cauwenberghe et al., 2012). We expected no systematic group differences in temperament, as group differences between siblings and preterms and their control groups in the first year of life were not consistently found (Cassiano et al., 2020; Mallise et al., 2020; Navalón et al., 2022; Sacrey et al., 2022; Sung et al., 2022).

Second, we explored differences in mother-child interactions between five and 10 months and between siblings and preterms. In line with Pijl and colleagues (2021), we expected no change in child Initiations, Sharing of Affect, and maternal Positive and Negative Affect, but we expected an increase in child Positive Affect and a decrease in child Negative Affect. Regarding child Attentiveness, maternal Sensitive Responsiveness, and maternal Scaffolding, we expected change but were uncertain about the direction, as per the contrasting findings of previous studies (Pijl et al., 2021; Stack et al., 2019).

Third, we tested for the total sample whether the three temperament factors were associated with mother-child interactions. Here, we expected that higher Negative Affectivity would be negatively associated with maternal Sensitive Responsiveness, in line with previous studies (Feldman et al., 1997; Mills-Koonce et al., 2007; Vaccaro, 2019). Given the lack of significant associations in infancy and toddlerhood (Aktar et al., 2017; Harel-Gadassi et al., 2020; Vaccaro et al., 2019; Wittig & Rodriguez et al., 2019), we expected no significant associations between Surgency or Orienting/Regulation on the one hand, and mother-child interactions on the other hand.

Methods

The study's hypotheses and planned analyses were pre-registered on Open Science Framework (https://osf.io/y4txn) prior to the final analysis of the data. Deviations from the pre-registration are listed below.

Participants and procedure

Our data have been collected within the TIARA study, a multi-site longitudinal study that aims to identify and understand the factors that play a role in the early development of autism. Detailed information about the TIARA study can be found in Chapter 4.

The present study includes all siblings and preterms of whom parent-child interaction videos of either one or both time-points (i.e., at five or 10 months) were coded by November 17th, 2022. No new parent-child interaction observations at five or 10 months were collected after this date. As this sample also included eight twin pairs (all in the preterm group), which violated the independency assumption, one randomly chosen twin of each pair was removed from the analyses.

Table 1

Participant Characteristics

Child characteristics	**Siblings (*n* = 89)**		**Preterms (*n* = 58)**		**Test statistic**	***p***	**Effect size**
Chronological age in months	*Mean (SD)*	*NA*	*Mean (SD)*	*NA*			
Wave 1	5.3 (0.9)	30	5.4 (0.5)	8	$t_{(97)}$ = -0.91	.37	d = .13
Wave 2	10.3 (0.6)	5	10.7 (1.5)	8	$t_{(54)}$ = -1.89	.06	d = .39
Developmental indices	*Mean (SD)*	*NA*	*Mean (SD)*	*NA*			
Cognition Wave 1	111.4 (7.7)	32	109.8 (9.4)	9	$t_{(91)}$ = 0.95	.35	d = -.19
Language Wave 1	100.7 (9.0)	31	99.5 (8.7)	9	$t_{(101)}$ = 0.67	.50	d = -.14
Motor Wave 1	92.3 (11.6)	32	96.1 (14.0)	9	$t_{(91)}$ = -1.50	.13	d = .30
Cognition Wave 2	101.1 (11.5)	5	102.5 (12.2)	11	$t_{(84)}$ = -0.64	.52	d = .12
Language Wave 2	104.8 (11.2)	5	107.3 (10.4)	16	$t_{(80)}$ = -1.23	.22	d = .23
Motor Wave 2	88.1 (11.3)	5	87.4 (13.5)	24	$t_{(47)}$ = 0.25	.80	d = -.06
Sex							
Male	50.6 %		48.3 %		$\chi^2_{(1)}$ = 0.07	.79	ϕ = .01
Female	49.4 %		51.7 %				
Mother characteristics	**Siblings (*n* = 89)**		**Preterms (*n* = 58)**		**Test statistic**	***p***	**Effect size**
Chronological age in years	*Mean (SD)*	*NA*	*Mean (SD)*	*NA*			
Wave 1	34.9 (4.2)	31	31.7 (4.9)	12	$t_{(87)}$ = 3.43	< .001	d = -.71
Wave 2	35.2 (4.1)	5	32.9 (4.6)	12	$t_{(77)}$ = 2.76	< .01	d = -.54
Maternal education		*NA*		*NA*			
Primary education or professional secondary education	10.6 %	4	6.3 %	10	$\chi^2_{(3)}$ = 4.73	.19	V = .23
Technical or general secondary education	28.2 %		16.7 %				
Higher non-university education	40.0 %		41.7 %				
University education	21.2 %		35.4 %				

Note. Effect size of Cohen's d: 0.2 = small, 0.5 = medium, 0.8 = large. Effect size of ϕ with 1 Degree of Freedom: 0.10 = small, 0.30 = medium, 0.50 = large (Kim, 2017). Effect size of Cramer's V with 3 Degrees of Freedom: 0.06 = small, 0.17 = medium, 0.29 = large (Kim, 2017). Wave 1 = 5 months, Wave 2 = 10 months of child's (corrected) age.

The final sample consisted of 89 siblings and 58 preterms (N=147). Due to COVID-19 restrictions, research facilities were temporarily closed and data at some time-points got lost. 67 participants (39 siblings, 28 preterms) had videos at both five and 10 months, 30 (13 siblings, 17 preterms) at five months only, and 50 (37 siblings, 13 preterms) at 10 months only. The sibling and preterm group did not differ in child's (corrected) age at assessment, developmental level, or sex (Table 1). As expected, mothers of siblings were significantly older than those of preterms at both waves, because, by definition, the target child at EL could not be the first-born of the family. Maternal educational level was comparable between groups.

Materials

Child temperament

Mothers rated their child's temperament with the Infant Behaviour Questionnaire-Revised Short Form (IBQ-R Short Form; Putnam et al., 2014). This 91-item questionnaire assesses three broad temperament factors: Surgency, Negative Affectivity, and Orienting/Regulation. Surgency, sometimes described as Positive Affectivity or Extraversion, includes approaching behaviours and positive anticipation of pleasurable activities, vocalisation during daily activities, high intensity pleasure, smiling and laughter, gross motor activity, and sensitivity to slight, low intensity stimuli. Negative Affectivity includes a low mood, distress to limitations, fear (e.g., distress to sudden changes in stimulation, novel physical objects or social stimuli), and slow recovery from distress. The third domain, Orienting/Regulation, consists of low intensity pleasure, cuddliness, attention to an object for extended periods of time, reduction of distress when soothed by a caregiver, and the ability to transfer attentional focus. For each item, parents indicate how often a situation occurs, on a scale from 1 (never) to 7 (always). No numerical score ("NA") was given if "does not apply" was checked. Item scores were averaged to obtain 14 subscales, that were again averaged to yield three temperament factors.

As our sample size was too small for reliability analysis (see pre-registration for more details), we relied on the internal consistency analyses of a large Flemish study including children from the general population. In this study, internal consistency ranged from acceptable to excellent (Cronbach's alphas for Surgency, Negative Affectivity and Orienting/Regulation were .78, .92, and .91 at 2 months, and .93, .94, and .92 at 8 months (Van Cauwenberge et al., 2012)).

We adopted the following guidelines for handling missing data: If > 20% of the items of a subscale were missing, the whole subscale was regarded as missing, and if ≤ 20% of the items were missing, the subscale score was calculated by dividing the total score by the number of available items. Missings at the factor level were imputed using the mice R-package (van Buuren & Groothuis-Oudshoorn, 2011).

Mother-child interactions

Observations of mother-child interactions were coded using the Parent-Infant/Toddler Coding of Interaction (PInTCI; Pijl et al., 2016; Pijl et al., 2021). The PInTCI includes parent, child, and dyadic constructs that were found to be predictive for subsequent child development, and that could be used across early childhood (5 to 36 months) in both typically and atypically developing groups of children. The PInTCI is a global coding scheme that includes five child scales (i.e., Initiations, Attentiveness, Sharing of Affect, Positive Affect, (Absence of) Negative Affect), five parent scales (i.e., Sensitive Responsiveness, Scaffolding, (Absence of) Negative Control, Positive Affect, (Absence of) Negative Affect), and one dyadic scale (Dyadic Reciprocity), that are scored on a 7-point Likert scale. Higher

scores reflect more adaptive behaviours, while lower scores reflect more maladaptive behaviours. For a description of the PInTCI scales, see Supplement 3.1.

Interrater Reliability (IRR) of the PInTCI was established through intensive training under supervision of one of the developers (PW). Mother-child interaction videos were coded in two waves by a team of six Master's Students in Psychology or Educational Sciences, who were blind for EL group membership. IRR for the larger data set was calculated on 15.3% of the videos at five months, and 14.8% of the videos at 10 months, using weighted Cohen's Kappas and percentage agreement (with one point difference allowed). Weighted Kappas were calculated using ComKappa (Robinson & Bakeman, 1998), percentage agreement was calculated using MS Excel. Scales were viewed as coded reliably when $\kappa \geq .60$ (McHugh, 2012), and/or percentage agreement $\geq .70$ (Stemler, 2004). All PInTCI scales except for maternal (Absence of) Negative Control at 10 months were coded reliably. For a detailed overview of all IRR scores, see Supplement 1.

Data analysis

Linear mixed models (LMMs) and, where appropriate, generalised linear mixed models (GLMMs) with logit link function were fitted in RStudio (RStudio Team, 2021). Missing data in the predictor variables were imputed 50 times, by means of multiple imputation using the mice R-package's (van Buuren & Groothuis-Oudshoorn, 2011) default setting. Convergence was checked with chain plots. All subsequent analyses were performed on each of the 50 imputed data sets using the lme4 R-package (Bates et al., 2015), after which the results were pooled. While the imputation process allowed all available information to be included in the analyses, the pooling corrected for the additional uncertainty that was introduced by the imputation.

First, three separate LMMs were fitted with the three temperament factors as dependent variables, and child's age (5 vs. 10 months), EL group (siblings vs. preterms), and the interaction between age and EL group as fixed effects, with a random intercept per subject. Age was centred with -0.5 for the first assessment at five months and 0.5 for the second assessment at 10 months. Group was grand-mean centred, because we did not want to view one EL group as the reference group. Consequently, the intercept could be interpreted as the estimated score for the average participant, across time and EL group (i.e., an infant at EL of autism aged 7.5 months).

To answer the second and third research question, two series of models were built for each mother-child interaction scale: (a) a basic model with age, EL group, and an age by EL group interaction as fixed effects (**Models A**), and (b) an extended model that included the three temperament factors as additional predictors (**Models B**). A random intercept per subject was included in all models. The temperament factors were person-mean centred before being entered at Level 1, while the participant's average temperament score across assessment waves was added at Level 2, after being centred using the grand mean. This allowed us to disaggregate the between-person and within-person effects (Curran &

Bauer, 2011). LMMs were fitted for all scales except for child Initiations, child Negative Affect, and maternal Negative Affect, as the linearity assumption was not met for these models. We recoded these three scales into binary variables and modelled them using GLMMs with logit link function (see Figure 1 for our model selection procedure).

Assumptions were checked using ggResidpanel (Goode & Rey, 2019). Variance inflation factors (VIFs) were inspected to check for multicollinearity using the car R-package (Fox & Weisberg, 2019). Finally, the Benjamini and Hochberg procedure (Benjamini & Hochberg, 1995) was applied for each model in order to control the False Discovery Rate (FDR) at .05. Code for the final models is available on OSF (https://osf.io/jgqk7).

Deviations from pre-registration

We fitted random intercept models, instead of the registered random coefficients models. As the linearity assumption was not met for all our planned LMMs, we first tried to transform these outcome variables and run our models again. In line with Pijl and colleagues (2021), we applied a Van der Waerden transformation, which transforms raw scores into z-scores corresponding to the estimated cumulative proportion of the distribution analogous to a particular rank. This however resulted in a variance of 0 for the intercept that we could not explain. We then recoded Initiations and (Absence of) Negative Affect into binary outcome variables, with 0 = no initiations/no negative affect, and 1 = any initiations/any negative affect, and analysed them using GLMMs with logit link function.

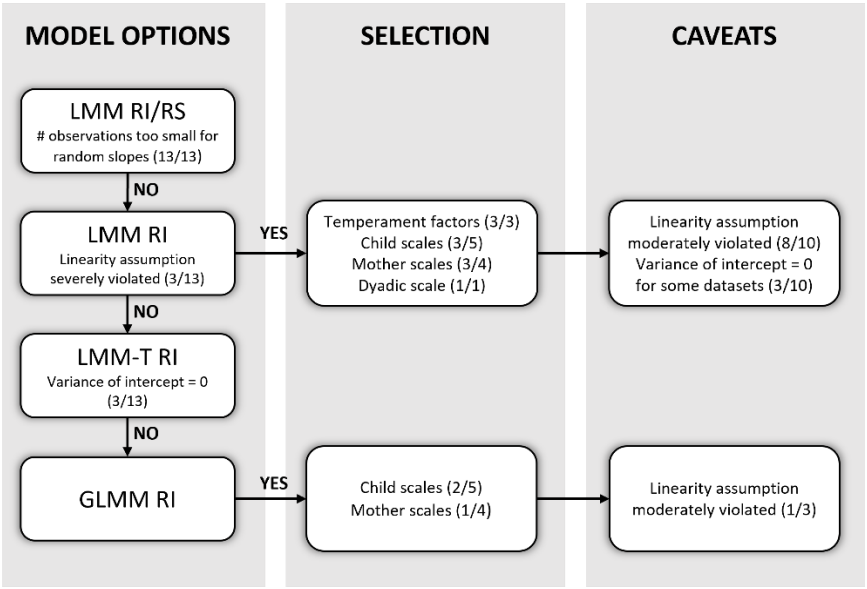
Results

Assumptions

Assumptions were checked for all models using multiple randomly chosen datasets. The linearity assumption was violated for **Models A**, and hence, these findings need to be interpreted with caution. **Models B** showed a better fit to the data, although the linearity assumption was still moderately violated for the majority of the models. The linearity assumption was met for the three GLMMs, as the predictors showed (more or less) linear relationships between the (continuous) predictors and the logit of the outcome. VIFs were below 5 for all models, indicating at most a moderate degree of multicollinearity.

Figure 1

Decision Tree Reflecting a Stepwise Model Selection Procedure Including Caveats



Note. LMM = linear mixed models. LMM-T = linear mixed models with Van der Waerden transformation. GLMM = generalised linear mixed models. RI = random intercept. RS = random slopes.

Age and group differences in child temperament

A main effect of age was found for Surgency (b = 0.601, p < .001), Negative Affectivity (b = 0.506, p < .001), and Orienting/Regulation (b = -0.234, p = .004). Across EL groups, mothers reported more Surgency and Negative Affectivity, and less Orienting/Regulation at 10 months compared to five months (see Table 2). We also observed a main effect of EL group for Surgency (b = 0.278, p = .046), with mothers of preterms reporting more Surgency than mothers of siblings across assessment waves. The age by EL group interaction was not significant (b = -0.421, p = .059). Closer inspection however revealed that there was a group difference in Surgency at five months (*Mean* = 3.954 for siblings, *Mean* = 4.442 for preterms) but not at 10 months (*Mean* = 4.720 for siblings, *Mean* = 4.788 for preterms). Scores seemed to increase rather steeply between five and 10 months for siblings (b = 0.767, p < .001) and less so for preterms (b = 0.346, p = .041), although this difference was not significant. Temperament scores per EL group and per time-point can be found in Supplement 3.2.

Table 2

Age and Group Differences in Child Temperament

	Surgency	Negative Affectivity	Orienting/Regulation
Fixed effects			
Intercept	4.447*** (0.066)	3.284*** (0.069)	5.083*** (0.056)
Age	0.601*** (0.102)	0.506*** (0.102)	-0.234** (0.070)
Group	0.278* (0.128)	-0.199 (0.137)	0.225 (0.113)
Age x Group	-0.421 (0.219)	-0.336 (0.207)	-0.205 (0.158)
Random effects			
Residual	0.615 (0.052)	0.597 (0.051)	0.441 (0.030)
Intercept	0.416 (0.068)	0.554 (0.052)	0.489 (0.035)
ICC	.16	.33	.51

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. Standard deviations between brackets. Random effects are standard deviations. All *p*-values are FDR corrected.

Age and group differences in mother-child interactions

Regarding children's behaviours, a main effect of age was observed for Negative Affect only (*OR* = 1.473, $p = .004$), with the odds of observing Negative Affect at 10 months being 1.473 times higher than at five months (see Table 3). However, the effect of age was not significant in the extended model. No differences were found between siblings and preterms for any of the child interactive behaviours.

A main effect of age was found for the maternal scales Sensitive Responsiveness ($b = -0.663$, $p < .001$) and Scaffolding ($b = 0.520$, $p = .001$), with mothers from both EL groups demonstrating less Sensitive Responsiveness and more Scaffolding at 10 months compared to five months (see Table 4). Only the age effect of Sensitive Responsiveness remained significant in the extended model ($b = -0.935$, $p = .001$). No group differences were found between mothers of siblings and preterms.

Dyadic behaviours did not differ between assessment waves or EL groups (see Table 4).

Child temperament as predictor of mother-child interactions

No significant associations were found between any temperament factor and any mother-child interaction scale (see Tables 3 and 4).

Table 3

Age and Group Differences in Mother-Child Interaction – Child Scales

	Initiations[a]	Attentiveness	Sharing of Affect	Positive Affect	Negative Affect[a]
Model A					
Fixed effects					
Intercept	8.085*** (1.471)	4.006*** (0.076)	1.939*** (0.085)	2.973*** (0.083)	2.773 (0.391)
Age	3.421 (0.996)	0.164 (0.152)	-0.030 (0.167)	0.161 (0.171)	1.473** (0.424)
Group	2.370 (0.754)	-0.018 (0.163)	-0.159 (0.177)	-0.065 (0.178)	2.396 (0.704)
Age x Group	7.463 (4.485)	0.160 (0.306)	0.248 (0.313)	0.141 (0.340)	2.460 (1.422)
Random effects					
Residual	/	1.080 (0.038)	1.149 (0.059)	1.224 (0.032)	/
Intercept	0.335 (0.262)	0.155 (0.153)	0.267 (0.167)	0.077 (0.141)	0.033 (0.090)
Model B					
Fixed effects					
Intercept	8.499*** (1.589)	4.006*** (0.076)	1.939*** (0.085)	2.973*** (0.082)	2.801 (0.406)
Age	2.452 (1.162)	0.208 (0.262)	-0.167 (0.264)	-0.239 (0.312)	1.383 (0.653)
Group	2.433 (0.817)	-0.012 (0.172)	-0.219 (0.187)	-0.070 (0.194)	2.286 (0.761)
Age x Group	11.023 (7.672)	-0.015 (0.354)	0.320 (0.351)	0.304 (0.375)	2.354 (1.593)
Surgency (WP)	3.421 (1.984)	-0.173 (0.299)	0.164 (0.325)	0.512 (0.372)	4.055 (2.145)
Surgency (BP)	2.716 (0.997)	0.056 (0.179)	0.162 (0.208)	-0.043 (0.243)	3.096 (1.084)
Negative Affectivity (WP)	4.221 (2.292)	-0.082 (0.297)	0.112 (0.304)	0.195 (0.321)	2.452 (1.417)
Negative Affectivity (BP)	2.612 (0.823)	-0.007 (0.155)	-0.223 (0.175)	-0.187 (0.188)	1.898 (0.624)
Regulation (WP)	2.746 (2.000)	-0.446 (0.413)	0.041 (0.411)	-0.023 (0.394)	2.773 (2.130)
Regulation (BP)	2.252 (0.883)	-0.093 (0.198)	-0.143 (0.226)	-0.074 (0.231)	1.982 (0.805)
Random effects					
Residual	/	1.056 (0.044)	1.131 (0.060)	1.196 (0.036)	/
Intercept	0.379 (0.267)	0.212 (0.158)	0.279 (0.171)	0.104 (0.151)	0.041 (0.112)
ICC	.06	.06	.09	.06	.02

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person. Standard deviations between brackets. Random effects are standard deviations. All *p*-values are FDR corrected.

[a] Generalised linear mixed models (GLMMs) instead of linear mixed models (LMMs). Results reflect the Odds Ratios of showing initiations or negative affect. Standard deviations were calculated using the delta method.

Table 4

Time and Group Differences in Mother-Child Interaction – Mother and Dyadic Scales

	Sensitive Responsiveness	Scaffolding	Positive Affect	Negative Affect[a]	Dyadic Reciprocity
Model A					
Fixed effects					
Intercept	4.131*** (0.087)	3.511*** (0.077)	4.308*** (0.096)	1.141 (1.267)	3.080*** (0.083)
Time	-0.663*** (0.136)	0.520** (0.143)	-0.372 (0.197)	42.098 (26.901)	-0.239 (0.167)
Group	-0.166 (0.174)	-0.172 (0.159)	-0.267 (0.202)	2.801 (1.333)	-0.353 (0.185)
Time x Group	0.339 (0.300)	0.276 (0.273)	0.316 (0.386)	3.353 (2.947)	0.144 (0.338)
Random effects					
Residual	0.973 (0.064)	1.033 (0.044)	1.409 (0.046)	/	1.236 (0.029)
Intercept	0.599 (0.116)	0.401 (0.114)	0.190 (0.203)	0.848 (1.336)	0.083 (0.125)
Model B					
Fixed effects					
Intercept	4.131*** (0.087)	3.511*** (0.076)	4.308*** (0.095)	1.121° (1.211)	3.080*** (0.081)
Time	-0.935** (0.238)	0.217 (0.251)	-0.299 (0.384)	112.168 (101.849)	-0.154 (0.281)
Group	-0.173 (0.186)	-0.149 (0.173)	-0.309 (0.214)	2.691 (1.418)	-0.463 (0.199)
Time x Group	0.322 (0.327)	0.413 (0.315)	0.289 (0.453)	5.104 (4.992)	0.148 (0.379)
Surgency (WP)	0.135 (0.284)	0.257 (0.287)	-0.018 (0.461)	1.927 (2.023)	-0.271 (0.335)
Surgency (BP)	-0.066 (0.219)	-0.235 (0.203)	0.256 (0.250)	3.633 (2.078)	0.394 (0.221)
Negative Affectivity (WP)	0.172 (0.279)	0.201 (0.297)	-0.029 (0.386)	3.935 (3.368)	0.170 (0.342)
Negative Affectivity (BP)	-0.078 (0.186)	0.138 (0.157)	-0.177 (0.227)	3.633 (1.827)	-0.220 (0.190)
Regulation (WP)	0.059 (0.384)	-0.204 (0.457)	0.149 (0.505)	4.437 (5.812)	0.027 (0.450)
Regulation (BP)	0.070 (0.249)	0.288 (0.201)	-0.303 (0.284)	3.353 (2.082)	-0.164 (0.218)
Random effects					
Residual	0.951 (0.059)	1.002 (0.049)	1.392 (0.048)	/	1.220 (0.033)
Intercept	0.614 (0.105)	0.415 (0.128)	0.191 (0.198)	0.924 (1.284)	0.036 (0.083)
ICC	.18	.10	.06	.13	.04

*** $p < .001$, ** $p < .01$, * $p < .05$, ° $p = .054$

Note. WP = within-person, BP = between-person. Standard deviations between brackets. Random effects are standard deviations. All *p*-values are FDR corrected.

[a] Generalised linear mixed models (GLMMs) instead of linear mixed models (LMMs). Results reflect the Odds Ratios of showing negative affect. Standard deviations were calculated using the delta method.

Discussion

The present study investigated child temperament and mother-child interactions in a group of infants at EL of autism, as they have been shown to influence one another over time and may interact in the prediction of developmental outcomes. Using random-intercept (G)LMMs, we explored whether differences between five and 10 months of child's age and between EL siblings and preterms, and whether child temperament was associated with mother-child interactions.

Temperament changes during the first year of life in both EL groups

As hypothesised, we observed change in child temperament during the first year of life for both EL groups. Mothers of siblings and preterms reported more Surgency and Negative Affectivity, and less Orienting/Regulation at 10 months, compared to five months.

An increase in Surgency was previously found among the general Flemish population (Van Cauwenberghe et al., 2012) and TL siblings (Paterson et al., 2019), suggesting that children in our sample followed a typical trajectory regarding Surgency. Interestingly, our findings suggest that Surgency increased even more steeply among siblings than preterms, different from previous studies that found no change among EL siblings that did not develop autism and a decrease among EL siblings that later developed autism (Paterson et al., 2019; Pijl et al., 2019). Similarly, an increase in Negative Affectivity was found in two general population studies only (Sung et al., 2015; Van Cauwenberghe et al., 2012), while studies among EL and TL siblings observed no change in any group (Paterson et al., 2019; Pijl et al., 2019). The decrease in Orienting/Regulation that we observed was in line with findings among EL siblings that later developed autism (Paterson et al., 2019; Pijl et al., 2019) and the general Flemish population (Van Cauwenberghe et al., 2012).

Overall, it seems that children in our EL sample follow temperament trajectories that are most similar to those found in the general Flemish population, except for Orienting/Regulation. However, methodological differences between studies make it difficult to compare findings, as studies differed in child's age at assessment waves and analytical approach (e.g., model choice and inclusion of covariates, such as child sex or cognitive ability and maternal age or educational level). Moreover, change in temperament may go in a different direction during the second year of life. Paterson and colleagues namely found that Surgency increased among EL siblings that later developed autism, and decreased among TL siblings between 12 and 24 months, while Pijl and colleagues (2019) found that Negative Affectivity increased between 14 and 24 months among EL siblings that later developed autism. Follow-up of our sample is necessary to confirm the directions of change through toddlerhood.

More Surgency in the preterm group at five months

We found a difference in Surgency between siblings and preterms, showing that variation in temperament exists between groups of EL infants. Preterms received higher scores than siblings at five months, but scores no longer differed at 10 months due to the steep increase in the sibling group. This difference could be related to the fact that we used children's corrected age for the preterm group (i.e., age was calculated using expected instead of actual birthdate), meaning preterms were more than two months "older" at each assessment wave. If an increase in Surgency is part of a developmental trajectory seen in the general population, then this increase may have already taken off in the preterm group before the first assessment wave at five months. Alternatively, their higher Surgency scores may reflect higher Activity levels (one of the Surgency subscales) compared to siblings. Preterms were namely found to be more active than full-terms in their first year of life, with the highest scores for extremely preterm infants (Cassiano et al., 2020), while EL siblings showed lower or similar Activity levels and were more withdrawn compared to TL siblings (Mallise et al., 2020).

Given the fact that temperament varies among all individuals, as it is shaped by complex interactions between genetic, biological, and environmental factors, we could however expect that temperament may not only differ *between* EL groups, but also *within* a group of siblings or preterms. An investigation of within-group temperament clusters, such as was done by Chetcuti and colleagues (2020, 2022) among infants demonstrating early autism signs, could complement our findings.

Changes in child negative affect and maternal sensitive responsiveness only

In line with our hypotheses, we found no changes in child initiations and sharing of affect. We found no change in child positive affect and attentiveness either, contrary to our expectations. The odds of a child demonstrating negative affect were higher at 10 months compared to five months, while we expected a decrease. Our findings regarding child affect contrast with those of Pijl and colleagues (2021), who observed an increase in child positive affect and a decrease in child negative affect. The authors concluded that these changes imply that emotional regulation improves during the first year of life. In our sample, mothers however reported a *decrease* in Orienting/Regulation and an *increase* in Negative Affectivity, which could explain the contrasting findings. In addition, the different findings may be related to the included EL groups and their cultural background, as Pijl and colleagues (2021) included an international group of EL and TL siblings while our sample consisted of Flemish siblings and preterms. We could not confirm the increase in child attentiveness that was found by Stack and colleagues (2019). It is possible that attentiveness only started to change around the first birthday, yielding an overall increase between six and 57 months that we could not detect in the first year of life.

Regarding maternal behaviours, we found that mothers used fewer sensitive and responsive parenting behaviours at 10 months compared to five months, in line with Stack and colleagues (2019)

but in contrast to Pijl and colleagues (2021). On the contrary, we observed an increase in scaffolding, in line with Pijl and colleagues (2021) but contradicting Stack and colleagues (2019), although this change was not significant in the extended model. Stack and colleagues (2019) investigated change in interactive behaviours among preterms and full-terms and their mothers, while Pijl and colleagues (2021) did the same among EL and TL siblings in their mothers. As our sample overlapped with both, this may explain the similarities and differences between findings. In line with our hypotheses, we found no changes in maternal positive and negative affect, nor in dyadic reciprocity.

Child temperament was not associated with mother-child interactions

No significant associations were found between child temperament and mother-child interactions, even if they showed conceptual overlap. Despite the increase in Surgency behaviours, we found no change in child positive affect during the play interaction. Moreover, reported Negative Affectivity increased over time, but was not related to the odds of a child showing negative affect during interaction with its mother. These disparities may be related to the difference in assessment methods, as temperament was reported by mothers and interactive behaviours were observed and coded by independent raters, and concordance between multimodal/multirater reports (maternal report vs. examiner observation) was found to be low in a previous study on temperament among preterms (Spinelli et al., 2022).

Contrary to our hypotheses, higher levels of child Negative Affectivity were not associated with lower levels of observed maternal sensitive and responsive behaviours. This could be related to the generally high educational level of mothers in our sample, as associations between child Negative Affect and supportive parenting behaviours seem more apparent for lower socio-economic status (SES) than higher SES samples (Paulussen-Hoogeboom et al., 2007). Although several studies have investigated relationships between child temperament and parenting among infants (e.g., Aktar et al., 2017; Feldman et al., 1997; Mills-Koonce et al., 2007; Perry et al., 2018; Vaccaro, 2019; Wittig & Rodriguez et al., 2019), we are not aware of similar published research in the context of emerging autism. More longitudinal research is needed to assess (bi)directional relationships between child temperament and parenting in the context of (emerging) autism, and to investigate whether these differ between different EL groups.

Strengths and limitations

The present study has made a unique contribution to the autism field by investigating associations between temperament and mother-child interactions in the context of emerging autism, extending findings from the general population. Moreover, comparisons between siblings and preterms, two EL groups that had never been compared before, provided insights into variation in temperament

and mother-child interactions among infants at EL of autism. Although we included random intercepts for each participant, we could not include random slopes in our models. Hence, we could not capture individual differences in change in temperament or mother-child interactions. A larger sample may be needed for full random effects models. Alternatively, a person-centred approach (e.g., clustering) could be used to investigate individual differences within EL groups. Another strength of this study is the transparency with which we have reported on our decisions regarding research methods and data-analysis. This information is often lacking in (observational) studies, hindering the comparison of findings and the advancement of theory and practice in parenting research (Uzonyi et al., 2023).

A first limitation of our study is that we did not include maternal temperament as covariate, while several studies found significant relationships between maternal temperament and negative and controlling parenting behaviours (Atzaba-Poria et al., 2014; Bridgett et al., 2013; Gölcük & Berument, 2021). However, as the PInTCI scale that assessed this kind of behaviours was not coded reliably, it would not have been possible to confirm these findings. Second, our focus on *mother*-child interactions excluded fathers and co-mothers[1], limiting the generalisability of our findings. Fathers have increasingly been included in parenting research, and both similarities and differences have been found at the group level (Taraban & Shaw, 2018). Although our approach is in line with the majority of parent-child interaction studies in the context of emerging autism (all cited studies included mothers, except for Pijl et al., 2021), more research is needed to explore whether associations between child temperament and parent-child interactions differ between mothers and fathers.

Conclusions and recommendations

Taken together, the present study demonstrated some variation in temperament between two groups of children at EL of autism in the first year of life. Moreover, we observed changes in child temperament that were largely similar to those found in the general population. Mother-child interactions changed for both groups alike, both confirming and contrasting with previous studies. Child temperament was not associated with mother-child interactions, possibly due to the high educational level of mothers in our sample. We found variation in temperament among EL infants, supporting the claim that it could be a relevant transdiagnostic construct. However, future studies should investigate temperament and parent-child interactions across infancy and toddlerhood, and explore associations with autism characteristics to increase our understanding of heterogeneity in autism. Moreover, between-group comparisons should be complemented by more person-centred approaches, such as the identification of temperament or parent-child interactions clusters. Our study exposed the complexity of research on temperament and parent-child interactions, by demonstrating how comparisons between studies are complicated due to methodological differences. Transparent reports on methodology and

[1] We included biological mothers, regardless of their partner's gender or sex.

data-analyses are necessary to advance research in general and on temperament and parenting specifically.

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Supplement 3.1

Description of the Parent-Infant/Toddler Coding of Interaction (PInTCI) scales

Child scales	
Initiations	The amount and quality of the infant's social initiations directed to the parent, either verbal (e.g. vocalizing, babbling) or non-verbal (e.g. showing, giving)
Attentiveness	The infant's spontaneous orientation to the parent and the infant's responsiveness to parental behaviour.
Sharing of Affect	The infant's sharing and directing affective states with/to the parent.
Positive Affect	The infant's positive affect (e.g., relaxed body language, smiles, excitement, positive vocalisations)
(Absence of) Negative Affect	Negative affect refers to tense and restless body language, showing anger, dislike, or hostility, negative facial expressions, negative vocalisations, and negative bodily gestures (e.g., distress, rejection).
Parent scales	
Sensitive Responsiveness	The accuracy of identification and interpretation of the child's cues (i.e., is the parent aware of the child's needs, based on observation of the child's behaviour) and the extent and appropriateness of the parent's responses to these cues (i.e., are the responses in line with the child's developmental level, affective state, behaviour, etc.).
(Absence of) Negative Control	The extent to which a parent determines the course of the play interaction in a directive, controlling, and/or intrusive way. Controlling the interaction may take the form of suggestions or commands (e.g., the parent offers a new toy while the child is still playing with his/her own toy), but also the form of intrusions or physical manipulations (e.g., the parent pulls a toy out of the child's hand, or grabs the child by the arm to move it).
Scaffolding	The extent to which the parent adequately facilitates the child's development, by providing opportunities for the child to achieve things he or she would likely not achieve without guidance. Two types of scaffolding are included, namely Technical Scaffolding (e.g., parent demonstrates a task, labels objects, or describes sub steps that are too difficult for a child to conceptualise on its own) and Motivational Scaffolding (e.g., the parent focuses on the perseverance of the child, by helping it to become engaged and remain focused).
Positive Affect	Parental positive affect can be defined in terms of positive and relaxed body language, physical affection, enthusiasm and the demonstration of smiles or laughter.
(Absence of) Negative Affect	Negative affect refers to tense body language, negative tone of voice, tightened or angry facial expressions, or hostile acts.
Dyadic scale	
Dyadic Reciprocity	The amount and quality of engagement, mutuality, cooperation, reciprocity, and sharedness between parent and child.

Interrater reliability of the PInTCI scales at 5 and 10 months of child's (corrected) age

Scales were viewed as coded reliably when $\kappa \geq .60$ and/or percentage agreement $\geq .70$.

	Weighted Kappa	Percentage agreement within 1 point	Included (yes/no)
Infant scales at 5 months			
Initiations	.16	.95	yes
Attentiveness	.54	.91	yes
Sharing of Affect	.89	.96	yes
Positive Affect	.80	.92	yes
(Absence of) Negative Affect	.65	.90	yes
Parent scales at 5 months			
Sensitive Responsiveness	.29	.78	yes
(Absence of) Negative Control	.10	.76	yes*
Scaffolding	.38	.84	yes
Positive Affect	.57	.82	yes
(Absence of) Negative Affect	.23	.97	yes
Dyadic scale at 5 months			
Dyadic Reciprocity	.59	.85	yes
Infant scales at 10 months			
Initiations	.39	.94	yes
Attentiveness	.72	.86	yes
Sharing of Affect	.81	.97	yes
Positive Affect	.72	.86	yes
(Absence of) Negative Affect	.85	.98	yes
Parent scales at 10 months			
Sensitive Responsiveness	.68	.92	yes
(Absence of) Negative Control	.36	.60	no
Scaffolding	.59	.82	yes
Positive Affect	.88	.96	yes
(Absence of) Negative Affect	.43	.97	yes
Dyadic scale at 10 months			
Dyadic Reciprocity	.65	.92	yes

* As (Absence of) Negative Control was not reliably coded at 10 months, this scale was not included in the further analyses.

Supplement 3.2

Table S3.2

Mean and (Standard Deviations) of IBQ-R and PInTCI Scales for Both EL Groups Separately

	Siblings		Preterms	
	5 months	10 months	5 months	10 months
Child temperament				
Surgency	3.85 (0.88)	4.70 (0.66)	4.59 (0.50)	4.80 (0.71)
Negative Affectivity	3.03 (0.87)	3.69 (0.77)	2.99 (0.74)	3.36 (0.88)
Orienting/Regulation	5.08 (0.62)	4.92 (0.70)	5.44 (0.62)	5.05 (0.62)
Child scales				
Initiations[a]	2.02 (0.85)	2.01 (1.00)	1.77 (0.88)	1.85 (0.74)
Attentiveness	4.02 (0.98)	4.08 (1.10)	3.77 (1.26)	4.10 (1.12)
Sharing of Affect	2.12 (1.22)	1.91 (1.19)	1.71 (1.16)	1.81 (1.12)
Positive Affect	3.04 (1.34)	3.05 (1.22)	2.75 (1.27)	3.04 (1.15)
(Absence of) Negative Affect[a]	5.46 (1.73)	6.33 (1.14)	5.69 (1.46)	6.48 (1.05)
Maternal scales				
Sensitive Responsiveness	4.65 (1.12)	3.83 (1.20)	4.38 (1.21)	3.81 (0.98)
Scaffolding	3.40 (1.09)	3.78 (1.23)	3.15 (0.96)	3.77 (1.12)
Positive Affect	4.71 (1.55)	4.20 (1.46)	4.31 (1.45)	4.02 (1.19)
(Absence of) Negative Affect[a]	6.90 (0.36)	6.63 (0.80)	6.92 (0.27)	6.67 (0.63)
Dyadic scales				
Dyadic Reciprocity	3.40 (1.27)	3.11 (1.17)	2.94 (1.39)	2.81 (1.12)

Note. Analyses were run on the data set containing missing items for the temperament subscales. Parametric statistics were used in line with previous published findings (Pijl et al., 2021).

[a] These scales were recoded into binary variables before being entered in the models. Mean and Standard Deviations in this table were however calculated on the original variables.

Chapter 4

Well-being does not predict change in parenting behaviours among mothers of young children at elevated likelihood of autism

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Abstract

Well-being and parenting behaviours were studied longitudinally among mothers of younger siblings of children on the autism spectrum ('siblings'; n = 81) and prematurely born children ('preterms'; n = 40). Growth curves were modelled to investigate whether well-being and group (mothers of siblings vs. preterms) were associated with (change in) reported parenting behaviours between 10 and 24 months of child's age. As expected, we found more stability than change in parenting behaviours, and more similarities than group differences in parenting behaviours and well-being. Both mothers of siblings and preterms reported more disciplinary behaviours when their child grew older, in line with general population findings. Initial levels of supportive behaviours were equally high among mothers of siblings and preterms, but mothers of preterms reported a further increase between 10 and 24 months while mothers of siblings reported stability. Contrary to our hypotheses, well-being was not associated with any of the parenting behaviours. Despite well-being levels below the general population mean (primarily in the sibling group), mothers in our sample reported that they often used supportive behaviours. This is encouraging, as all children, but in particular a subgroup of children at elevated likelihood of autism who may be especially susceptible to their environment, benefit from supportive and responsive behaviours.

Introduction

Parenting and autism

Parenting has been investigated in the context of autism from different angles and in several stages, reflecting the prevailing theories at the time. While parenting was once believed to play a primary role in the aetiology of autism, the notion of a biological neurodevelopmental origin became more dominant after the 1970s (McCauley et al., 2019). More recently, both pre- and perinatal environmental factors, including the parent-child relationship, and genetic factors associated with autism are viewed as important components in the development of autism. The hypothesis was formulated that genetic factors associated with autism, present at birth, may alter a child's interaction with its social environment, and that this gene-environment interaction may amplify early susceptibilities and contribute to a later autism phenotype (Dawson, 2008; Mandy & Lai, 2016).

Several research findings provided preliminary support for this hypothesis (e.g., Green et al., 2015; Harker et al., 2016; Landry et al., 2003; Wan et al., 2013, but see also Pijl et al., 2021), but the interaction between genetic factors associated with autism and parenting behaviours has only recently been studied empirically. In a sample of autistic children aged four to seven, Caplan and colleagues (2021) tested the theory of differential susceptibility, which states that children who seem most vulnerable to adverse environments, may also benefit the most from enriched environments (Belsky et al., 2007). They found that children with 'susceptibility markers' (dopamine and serotonin-related gene polymorphisms) were more strongly influenced by parenting behaviours, indicated by a significant moderation of the association between responsive parenting behaviours and children's social skills (Caplan et al., 2021). Although these 'susceptibility markers' were the same as in non-autistic populations (e.g., Bakermans-Kranenburg & van IJzendoorn, 2011; van IJzendoorn et al., 2012), they have also been associated with autism and environmental susceptibility within autism (e.g., Reiersen & Todorov, 2011; Wiggins et al., 2014). As the sample included children who were already diagnosed with autism, the findings of Caplan and colleagues (2021) cannot be viewed as empirical evidence for the hypotheses of Dawson (2008) and Mandy and Lai (2016). However, they suggest a great potential for responsive parenting behaviours in enhancing a child's social development, especially for those children who are highly susceptible to their environment.

Parental well-being and autism

Given the importance of responsive parenting behaviours, it is crucial to understand the factors that could increase a parent's ability to carry out the parenting role in a sensitive and responsive manner, especially for those parents whose well-being is challenged. In the present study, well-being is defined as a subjective concept in itself, distinguishing it from mental health, in line with recent studies among

parents of autistic pre-schoolers and school-aged children (Cai et al, 2020; Green et al., 2021; Salomone et al., 2018). Subjective psychological well-being includes a positive mood, vitality, and general interest (Topp et al., 2015). As such, it also differs from parenting stress, which indicates stress regarding the parenting role. Previous studies found that, at the group level, parents of autistic children reported lower psychological well-being (Likhitweerawong et al., 2020), lower family well-being (Tint & Weiss, 2016), more parenting stress (i.e., stress related to the parenting role; Boonen et al., 2015; Estes et al., 2013; Hayes & Watson, 2013), higher levels of depression, anxiety, and stress (e.g., Padden & James, 2017; Teague et al., 2018), and a lower quality of life (e.g., Eapen et al., 2014; Pisula & Porębowicz-Dörsmann, 2017) than parents of non-autistic children. Lower parental well-being was associated with less authoritative (i.e., high in responsiveness, high in demand), and more authoritarian (i.e., low in responsiveness, high in demand) and permissive (i.e., high in responsiveness, low in demand) parenting behaviours among parents of school-aged children with and without autism (Likhitweerawong et al., 2020). Higher levels of parenting stress have been shown to be associated with less reported involvement, communication, and limit-setting (Osborne & Reed, 2010), and less reported support of the child's autonomy (Madarevic et al., 2022) among mothers of pre-schoolers on the autism spectrum, and with more use of material rewarding and (harsh) punishment, and more negative and criticising behaviours during interaction among mothers of autistic school-aged children (Boonen et al., 2015). Together, these findings suggest that well-being and parenting stress may influence parenting behaviours among parents of autistic children, and that autistic children are more likely to experience less optimal parenting behaviours due to lower levels of parental well-being and higher levels of parenting stress.

Parenting and well-being among parents of children at elevated likelihood of autism

To our knowledge, associations between well-being, mental health, quality of life, and parenting stress on the one hand, and parenting behaviours on the other hand, have only been studied in the context of autism among parents of young children with an autism diagnosis. However, as early environmental factors, including parenting behaviours, can have a large impact on a child's physical and psychosocial development on the long term (Hochberg et al., 2011; Vaiserman, 2014), it seems essential to investigate these associations during the first two years of life, before an autism diagnosis is generally given (van 't Hof et al., 2020). This can be done by prospectively following up young children at elevated likelihood (EL) of autism. Among this group of children at EL of autism, infant siblings of a child with an established autism diagnosis ('siblings') have received the most research attention. Given the heritability of autism, siblings have a 7-19.5% chance of developing autism themselves (Messinger et al., 2015; Szatmari et al., 2016), compared to a 0.62-1.7% chance in the general population (Elsabbagh et al., 2012; Maenner et al., 2021). More recently, a second group of prematurely born infants (i.e., infants born at a gestational age of less than 32 weeks; 'preterms'), has been identified as being at EL of autism,

having a chance of 7-13% to develop autism (Agrawal et al., 2018; Laverty et al., 2021; Vermeirsch et al., 2021). Their EL is thought to be the result of interactions between a biological vulnerability and exposure to environmental stressors that would initiate a foetal immune response, leading to both preterm birth and altered neurodevelopment (Erdei & Dammann, 2014; Limperopoulos, 2009).

As described above, higher levels of well-being and lower levels of parenting stress were associated with more responsive parenting behaviours among parents of young children on the autism spectrum (Boonen et al., 2015; Likhitweerawong et al., 2020; Madarevic et al., 2022; Osborne & Reed, 2010). Similar results were found among parents of prematurely born children (Korja et al., 2008; Neri et al., 2015; Zengin-Akkus et al., 2020), although these studies were not conducted in the context of autism. In turn, sensitive and responsive parenting behaviours were associated with a child's social and cognitive functioning (e.g., Baker et al., 2010; Harker et al., 2016; Landry et al., 2003). Given the expected lower levels of well-being among parents of children at EL of autism and the possible associations with less optimal parenting behaviours, an investigation of the role that well-being plays in the course of early parenting behaviours seems vital. Moreover, as some children at EL of autism may be especially susceptible to parenting behaviours (e.g., Caplan et al., 2021, van IJzendoorn & Bakermans-Kranenburg, 2015), this investigation could provide a better understanding of the individual strengths and vulnerabilities in this specific population and open windows for tailored intervention.

The present study

The present three-wave longitudinal study investigated change in reported parenting behaviours among mothers of two groups of infants at EL of autism (i.e., siblings and preterms) and whether this change was predicted by their well-being. The participating mothers had one thing in common, namely having a young child at EL of autism. However, they may differ in other ways. For example, mothers of siblings and preterms had different pregnancies and deliveries (mostly term vs. preterm), a different family situation (no vs. one or more autistic children), and possibly a different number of children in the household (one or more vs. two or more), which could all affect their well-being and parenting behaviours. Our study aims to investigate possible group differences to gain a better understanding of family functioning in the context of emergent autism, and to find out whether we could treat the two groups as one group of mothers having a child at EL of autism, or whether they needed to be viewed as two separate groups in studies regarding well-being and parenting behaviours.

First, we explored individual change in reported parenting behaviours from 10 to 24 months. To our knowledge, there is no existing literature investigating change in reported parenting behaviours among mothers of infants at EL of autism. We therefore relied on general population studies for our hypotheses, which seems reasonable given that more similarities than differences have been found in parenting behaviours between mothers of preterms and full-terms (e.g., Bilgin & Wolke, 2015; Korja et

al., 2012; Neel et al., 2019), mothers of infants with and without a sibling diagnosed with autism (e.g., Baker et al., 2010; Harker et al., 2016; Pijl et al., 2021, Wan et al., 2012; Wan et al., 2013), and mothers of autistic and non-autistic pre-schoolers (Lambrechts et al., 2015; Madarevic et al., 2022). In line with the findings of Verhoeven and colleagues (2007) and the secondary analysis of the data from Van Leeuwen and colleagues (2015), two general population studies that investigated change and stability in reported parenting behaviours among parents of children aged 12 to 36 months, we expected no change in supportive behaviours, supervisory behaviours, autonomy supporting behaviours, provision of daily structure, social rewarding, or indulging behaviours from 10 to 24 months, and we expected an increase in disciplinary behaviours from 10 to 24 months.

As a second step, we investigated whether well-being was associated with parenting behaviours. For our hypotheses, we relied on previous findings regarding parenting and well-being among parents of autistic children (Likhitweerawong et al., 2020), and parenting and parenting stress among parents of autistic pre-schoolers and school-aged children (Boonen et al., 2015; Madarevic et al., 2022; Ojo et al., 2021; Osborne & Reed, 2010). We expected that lower well-being would be associated with less 'responsive demandingness' (cfr. Likhitweerawong et al., 2020), which we translated into less provision of daily structure but more disciplinary behaviours, and with less social rewarding but more indulging in the present study. Moreover, we expected that a lower level of well-being would be associated with less support of the child's autonomy (cfr. Madarevic et al., 2022), less provision of daily structure (cfr. less clear communication and less limit-setting in Osborne & Reed, 2010), and less social rewarding and more indulging behaviours (cfr. more material rewarding in Boonen et al., 2015) in both groups. In addition, we investigated possible group differences in initial parenting behaviours, as mothers of siblings and preterms may share some vulnerabilities but may differ in other aspects. As both groups have never been directly compared, we had no hypotheses regarding the influence of EL group.

In addition to our primary analyses, we performed several secondary analyses. Our pre-registered secondary analyses aimed to investigate individual change in well-being from 10 to 24 months, and whether initial well-being (i.e., independent of child's age) differed between EL groups. We further explored whether change in parenting behaviours and well-being differed between mothers of siblings and preterms, by adding a group by age interaction to the final models. As only large effects could be detected due to our relatively small sample, and we did not expect any, we had not included this interaction term in our pre-registered models. Since these two groups were never compared before, the detection of group differences could generate new hypotheses for future research.

Methods

The study's hypotheses and planned analyses were pre-registered on Open Science Framework (https://osf.io/5quyw) prior to the analysis of the data. Any deviations from the pre-registration are listed below.

Participants and procedure

Our data have been collected within the Tracking Infants At Risk[2] for Autism (TIARA) study, a multi-site longitudinal study that aims to identify and understand the factors that play a role in the early development of autism. TIARA is a collaboration between KU Leuven, Ghent University, and societal partners, that is conducted in Flanders, Belgium (www.tiara-onderzoek.be). Children participating in TIARA belong to one of three groups, each with an elevated likelihood of developing autism, namely (a) infant siblings of children with an established autism diagnosis (Messinger et al., 2015; Ozonoff et al., 2011), (b) infants born prematurely, at a gestational age of less than 30 weeks (Agrawal et al., 2018; Laverty et al., 2021, Vermeirsch et al., 2021), c) children with persistent idiopathic feeding difficulties (Field, 2003). Siblings were recruited through centres for developmental disorders, rehabilitation centres, well-baby clinics, home guidance centres, centres for child and adolescent psychiatry, and paediatricians in Flanders, Belgium. Furthermore, parent support groups, Facebook, and the website of the TIARA study were used. Preterms were recruited through multiple Flemish hospitals before leaving the Neonatal Intensive Care Unit or at the first follow-up visit at the corrected age of 4 months. All parents were aware of the fact that their child was at EL of autism before entering the study (e.g., through flyers of the study, conversation with study nurse or TIARA researcher). Study data were collected and/or managed using REDCap electronic data capture tools hosted at Ghent University (Harris et al., 2009; Harris et al., 2019).

As part of the TIARA study, participants and their parent(s) visited one of the labs in Leuven or Ghent at five assessment waves (i.e., at the (corrected) age of 5, 10, 14, 24 and 36 months). The study is still ongoing. Following the assessment at 36 months, a best-estimate categorical research diagnosis of AUTISM will be given, based on established diagnostic assessments, multiple questionnaires, and expert judgement. The study protocol of the TIARA study was approved by the Medical Ethical Committees of Ghent University Hospital (2017/1057) and Leuven University Hospital/KU Leuven (S60646) as conforming to the Declaration of Helsinki, 2000, and GDPR regulation (2016/679) was strictly followed. Parents provided written informed consent prior to participating in the TIARA study. During each lab visit, several assessments took place, among which developmental (BSID-III-NL;

[2] Although the phrase 'at-risk for autism' is widely used in research settings, we understand that the use of the word 'risk' when referring to autism is controversial. Following the recommendations of Fletcher-Watson and colleagues (2017), we opted for the replacement of 'risk' by 'likelihood' in our scientific work.

Bayley, 2006; Dutch version by van Baar et al., 2014), behavioural (e.g., ADOS-2; Lord et al., 2012; Dutch version by de Bildt et al., 2013;), and neurophysiological (e.g., EEG) tests, and observation of mother-child interaction. Parents filled in multiple questionnaires prior to or following each visit, reporting on their child's functioning as well as their own.

Table 1

Participant and Child Characteristics

Mother characteristics	**Siblings (*n* = 81)**		**Preterms (*n* = 40)**		**Test statistic**	***p***	**Effect size**
Chronological age in years	*Mean (SD)*	*NA*	*Mean (SD)*	*NA*			
Wave 1	35.2 (4.9)	11	32.7 (3.9)	3	$t_{(90)} = 2.91$	< .001	$d = .56$
Wave 2	35.4 (5.0)	10	32.8 (4.1)	4	$t_{(83)} = 2.87$	< .01	$d = .57$
Wave 3	36.2 (6.6)	14	32.9 (4.0)	12	$t_{(81)} = 2.99$	< .01	$d = .60$
Maternal education		*NA*		*NA*			
Primary education or professional secondary education	19.5%	4	15.4%	1	$\chi^2_{(3)} = 2.23$	.53	$V = .14$
Technical or general secondary education	18.2%		10.3%				
Higher non-university education	42.9%		46.2%				
University education	19.5%		28.2%				
Child characteristics	**Siblings (*n* = 81)**		**Preterms (*n* = 40)**		**Test statistic**	***p***	**Effect size**
Chronological age in months	*Mean (SD)*	*NA*	*Mean (SD)*	*NA*			
Wave 1	10.4 (0.6)	7	10.7 (1.0)	2	$t_{(49)} = -1.90$	.06	$d = .36$
Wave 2	14.6 (1.2)	6	14.7 (1.1)	2	$t_{(78)} = -0.56$	.58	$d = .09$
Wave 3	24.5 (0.8)	10	24.6 (0.6)	5	$t_{(83)} = -0.83$	.41	$d = .14$
Developmental indices	*Mean (SD)*	*NA*	*Mean (SD)*	*NA*			
Cognition Wave 1	101.4 (10.2)	9	102.1 (17.4)	11	$t_{(36)} = -0.19$	.85	$d = .05$
Language Wave 1	103.9 (10.8)	9	108.4 (10.7)	13	$t_{(47)} = -1.87$	.07	$d = .42$
Motor Wave 1	87.4 (11.8)	10	83.2 (22.9)	16	$t_{(26)} = 0.84$	.41	$d = .23$
Cognition Wave 2	94.9 (16.3)	11	93.8 (14.2)	2	$t_{(85)} = 0.35$	.73	$d = .07$
Language Wave 2	95.8 (12.7)	12	93.5 (13.0)	2	$t_{(75)} = 0.89$	.38	$d = .18$
Motor Wave 2	94.5 (18.7)	12	84.8 (18.3)	2	$t_{(78)} = 2.62$	.01	$d = .52$
Cognition Wave 3	91.5 (15.5)	21	99.4 (15.7)	23	$t_{(26)} = -1.84$	.08	$d = .51$
Language Wave 3	86.3 (18.8)	21	92.3 (15.6)	24	$t_{(28)} = -1.30$	.20	$d = .35$
Motor Wave 3	95.6 (17.9)	23	91.4 (16.1)	24	$t_{(26)} = 0.90$	.38	$d = .25$
Sex							
Male	53.1%		57.5%		$\chi^2_{(1)} = 0.21$	.65	$\phi = .04$
Female	46.9%		42.5%				

Note. Effect size of Cohen's d: 0.2 = small, 0.5 = medium, 0.8 = large. Effect size of ϕ with 1 Degree of Freedom: 0.10 = small, 0.30 = medium, 0.50 = large (Kim, 2017). Effect size of Cramer's *V* with 3 Degrees of Freedom: 0.06 = small, 0.17 = medium, 0.29 = large (Kim, 2017). Wave 1 = 10 months, Wave 2 = 14 months, Wave 3 = 24 months of child's (corrected) age.

The present study includes all mothers of siblings and preterms of whom reported parenting behaviours of two out of three assessment waves (i.e., at 10, 14, 24 months of (corrected) age) were available by December 1st, 2021. The group of children with feeding difficulties was too small to be included in group comparisons. The sample ($N = 127$) included a limited number of twin pairs (six twin pairs (9.4%), all in the preterm group), which violated the independency assumption (i.e., six mothers were counted twice). Therefore, one randomly chosen twin of each pair was removed from the analyses,

yielding a final sample of 121 participants (81 mothers of siblings, 40 of preterms[3]). Mothers of siblings and preterms did not differ in terms of educational level, but mothers of siblings were generally older. Siblings and preterms did not differ regarding age at assessment wave or sex (see Table 1). Developmental level was comparable between siblings and preterms at all three assessment waves, except for motor skills at wave 2, with siblings demonstrating better motor skills than preterms ($t_{(78)}$ = 2.62, p = .01, d = .52). Reports of parenting behaviours were available for 112 participants at the first wave, 112 at the second wave, and 106 at the third wave[4].

Materials

Parenting behaviours

The Parental Behavior Scale for Toddlers (PBS-T; Van Leeuwen et al., 2011; Van Leeuwen & Vermulst, 2004) was used to assess parenting behaviours. Previous psychometric analyses yielded 7 subscales and 38 items for the ages of 12, 30 and 36 months, in a general population sample (Van Leeuwen et al., 2015): Warmth/Support (n = 11; e.g., I imitate the sounds that my child makes), Autonomy Support (n = 4; e.g., I give my child the opportunity to try new things), Supervision and Safety (n = 7; e.g., I provide a safe environment for my child), Discipline (n = 7; e.g., When my child does something I do not like, I raise my voice), Rules and Structure (n = 3; e.g., I make sure my child's daily routine is the same day in, day out), Social Rewarding (n = 3; e.g., When my child masters doing something new, I applaud or say "well done!") and Indulging (n = 3; e.g., When my child wants something, I give in so he or she won't get cross or start to cry). Mothers rated the frequency of their parenting behaviour towards the child that was participating in the study using a 5-point Likert scale (1 = (almost) never, 2 = little, 3 = sometimes, 4 = often, and 5 = (almost) always), and scores were averaged to yield a final score for each parenting behaviour subscale. Internal consistency in our study ranged from α = .72 to α = .79 at 10 months, from α = .65 to α = .83 at 14 months, and from α = .71 to α = .84 at 24 months. As the internal consistency of the Indulging subscale was low (α = .55, .61, .67), we removed one item (i.e., When my child is not succeeding instantly, I take over). Spearman's Rho for the two remaining Indulging items was ρ = .53, ρ = .53, and ρ = .58, respectively.

Well-being

The 5-item World Health Organization Well-Being Index (WHO-5; Topp et al., 2015; World Health Organization, 1998) is a short and generic global rating scale measuring subjective psychological well-being. The five questions assess positive mood (good spirits, being relaxed), vitality (being active

[3] In the pre-registration of this study, the number of participants was incorrectly described as 82 siblings and 39 pre-terms.
[4] Further inspection of the datafiles showed that one participant was wrongly entered at the first wave, yielding a final sample of 112 participants. In the meantime, 7 additional questionnaires had become available at the third wave, yielding a total of 106 participants.

and waking up fresh and rested), and general interest (being interested in things). On a 5-point Likert scale, mothers rated their well-being over the last two weeks, with higher scores indicating a higher level of well-being (5 = all of the time, 4 = most of the time, 3 = more than half of the time, 2 = less than half of the time, 1 = some of the time, 0 = at no time). A total score is calculated by summing up the five item scores and multiplying this by four (range 0 – 100). In our study, the Dutch version of the WHO-5 was administered, and total scores at each time-point were used in the analyses. Internal consistency of the WHO-5 ranged from $\alpha = .79$ (10 months) to $\alpha = .83$ (14 and 24 months).

Data-analysis

To describe and predict patterns of change in maternal parenting behaviours over time, growth curves were fitted in RStudio (RStudio Team, 2021) using a multi-level modelling framework. All analyses were performed using the lme4 package (Bates et al., 2015), and *p*-values were obtained using lmerTest (Kuznetsova et al., 2017). RStudio (RStudio Team, 2021) and the Statistical Package for the Social Science Software version 28 (IBM Corp., 2021) were used for the descriptive analyses.

Change in parenting behaviours over time

Growth trajectories were modelled for each parenting behaviour, taking into account that scores for each parenting behaviour at the three assessment waves (Level 1) were nested within persons (Level 2). Random intercepts and slopes were added to allow participants to vary independently. If a model did not converge, the slope was fixed and the model was run again. Two unconditional models were computed per parenting behaviour scale: 1) the unconditional mean model (**Model A**), which yielded an Intraclass Correlation Coefficient (ICC), to investigate the proportion of within-person and between-person variation in the outcome variable; and 2) the unconditional growth model (**Model B**), which included child's exact age in months as a predictor, to investigate within-person and between-person variation over time. Age was person-mean centred (i.e., for each participant at each assessment wave, their child's mean age in months over the three assessment waves was subtracted from their child's age in months for the respective assessment wave), to facilitate the interpretation of the intercept. The intercept then represented the estimated parenting behaviour score at the child's average age in months, instead of at month 0. Child's average age was added as a Level 2 variable for each participant, after being grand-mean centred (i.e., the mean age of all children was subtracted from each child's mean age), to disaggregate within-person and between-person effects of child's age on parenting behaviours (Curran & Bauer, 2011). A quadratic age term was added to the second model to explore possible non-linear trajectories of change (**Model C**). If the quadratic term was non-significant, it was not included in the consecutive models. The models were fitted using restricted maximum likelihood estimation, which can handle missing data.

Well-being and EL group as predictors of (change in) parenting behaviours

Time-invariant (EL group; mothers of siblings vs. preterms) and time-varying (well-being) predictors were included in the models (**Model D**) to investigate their effect on the intercept and the rate of change. Group was centred using the grand mean (i.e., for each participant, the grand mean was subtracted from the binary value that represented the participant's group) before being entered at Level 2. By doing so, the intercept could be interpreted as the estimated parenting behaviour score for the average participant, instead of a participant from the sibling group (since group was coded as 0 for siblings, 1 for preterms). Well-being was person-mean centred (i.e., for each participant at each assessment wave, their mean well-being score over the three assessment waves was subtracted from their well-being score for the respective assessment wave) before being entered at Level 1, while the participant's average well-being level across assessment waves was added at Level 2, after being centred using the grand mean. Again, this allowed us to disaggregate the between-person and within-person effects (Curran & Bauer, 2011). Lastly, we included a possible confounding variable, namely the number of children under 18 in the household (grand-mean centred). Assumptions of linearity, homogeneity of variance, and a normal distribution of the residuals were checked for the final models. Finally, a correction for multiple comparisons was applied to each model, using the false discovery rate (FDR) controlling procedure with a *q*-value of .05 (Benjamini & Hochberg, 1995).

Secondary analyses

Our secondary analyses investigated change in well-being, and whether initial well-being was predicted by group. In addition, we explored whether group predicted change in parenting behaviours and well-being, by adding an interaction term (i.e., group by age) to the final models. We included two interaction variables in the final models, namely the interaction between group and person-mean centred child's age, and the interaction between group and average child's age, to disaggregate within-person from between-person effects (**Model E**). We also included a possibly confounding variable, namely the number of children under 18 in the household (grand-mean centred). Following the same steps as described above, these models were fitted in RStudio, assumptions were checked, and the FDR controlling procedure was applied (Benjamini & Hochberg, 1995).

Deviations from pre-registration

To facilitate a better interpretation of the age coefficient, we used age in months instead of days, by dividing age in days by 30.4167. Moreover, we needed to impute child's age at a specific wave for several participants (n = 6 at wave 1, n = 1 at wave 2, n = 16 at wave 3), in order to calculate a child's personal mean and three person-centred age variables. Waves were namely not equally spaced in time, so we could not simply average the ages of the other waves. If a child's age was missing at one of the three waves, we filled in the children's general mean age of that respective wave. We then calculated the child's mean age by averaging the ages at the three waves, and calculated the three person-mean

centred ages by subtracting the child's mean age from the age at the respective waves. Finally, we deleted the imputed age, as the absence of age at that time-point meant that no data were available for that participant at that assessment wave so age was not needed. We also applied the FDR controlling procedure separately on all individual models, and not only on each final model. Lastly, we added a possible confounding variable to Models D and E, namely the number of children under 18 in the household.

Results

Descriptive statistics

As the scores for most parenting behaviour scales and the WHO-5 were not normally distributed, as indicated by significant results on the Shapiro-Wilk test, we opted for non-parametric tests. Table 2 presents the median, range, and correlations between assessment waves for all parenting behaviours per participant group.

Table 2

Descriptive Statistics and Correlations Across Child's Age (Rank-Order Stability) for All Parenting Behaviour Scales

		Siblings				Preterms			
				Spearman correlations				Spearman correlations	
Parenting behaviour	**Wave**	**Median**	**Range**	**Wave 2**	**Wave 3**	**Median**	**Range**	**Wave 2**	**Wave 3**
Warmth/Support	1	4.0	3.3-5.0	.72***	.69***	4.0	3.2-4.9	.60***	.36*
	2	4.0	2.9-5.0	-	.55***	4.0	3.0-4.7	-	.46**
	3	4.0	3.4-4.8	-	-	4.0	3.6-5.0	-	-
Autonomy Support	1	4.0	2.8-5.0	.24	.19	4.0	1.0-5.0	.43*	.38*
	2	4.0	3.3-5.0	-	.38**	4.0	1.0-5.0	-	.48**
	3	4.0	3.3-5.0	-	-	4.0	3.0-5.0	-	-
Supervision & Safety	1	4.9	3.6-5.0	.70***	.73***	4.7	3.7-5.0	.52**	.70***
	2	4.7	3.9-5.0	-	.68***	4.7	3.6-5.0	-	.53**
	3	4.6	3.6-5.0	-	-	4.7	3.9-5.0	-	-
Discipline	1	1.7	1.0-3.7	.46***	.70***	1.9	1.0-3.3	.64***	.54**
	2	2.1	1.0-3.6	-	.71***	2.1	1.3-3.4	-	.47**
	3	2.6	1.3-4.4	-	-	3.0	1.4-3.6	-	-
Rules & Structure	1	4.0	2.0-5.0	.55***	.47***	4.3	3.0-5.0	.61***	.47**
	2	4.0	2.0-5.0	-	.54***	4.3	2.7-5.0	-	.65***
	3	4.0	2.3-5.0	-	-	4.2	3.0-5.0	-	-
Rewarding	1	5.0	3.7-5.0	.40***	.36**	5.0	2.0-5.0	.63***	.46**
	2	5.0	3.3-5.0	-	.48***	5.0	3.3-5.0	-	.48**
	3	5.0	3.7-5.0	-	-	4.8	3.3-5.0	-	-
Indulging	1	2.5	1.0-4.5	.56***	.36**	2.5	1.0-4.0	.36*	.46**
	2	2.5	1.0-4.5	-	.52***	2.5	1.5-4.0	-	.54**
	3	2.5	1.0-4.0	-	-	2.0	1.0-4.0	-	-

*** $p < .001$, ** $p < .01$, * $p < .05$

Note.
Wave 1 = 10 months, Wave 2 = 14 months, Wave 3 = 24 months of child's (corrected) age.

At the group level, mothers reported high levels of Warmth/Support, Supervision & Safety, Rules & Structure, and Rewarding, indicated by median scores ranging from 4 to 5, while they reported lower levels of Discipline and Indulging. Significant and positive Spearman correlations indicated moderate to strong rank-order stability between 10 and 14 months and between 14 and 24 months for Warmth/Support, Supervision & Safety, Rules & Structure, and Indulging in the sibling group, and for Supervision & Safety and Rules & Structure in the preterm group.

Table 3 shows the median and range of well-being scores for the two EL groups at each assessment wave, followed by a comparison between EL groups and between each EL group and Flemish women from the general population (European Quality of Life Survey, 2016). Well-being only differed significantly between the two EL groups at the second wave. However, well-being in the sibling group was consistently lower than that of women from the general population, while well-being in the preterm group was lower at the first wave only. For the screening of depression, a cut-off score of ≤ 50 is generally used in clinical samples (Topp et al., 2015), while ≤ 10 seems optimal for general population samples (i.e., Carrozzino et al., 2021). Using a cut-off score of ≤ 50, 35.8-37.8% of the mothers in the sibling group would have screened positive for depression, against 19.2-29.7% in the preterm group and 18.4% in the general population. With a cut-off score of ≤ 10, these percentages dropped to ≤ 1.5%, ≤ 3.8%, and ≤ 0.7%, respectively.

Table 3

Comparison of Well-being between EL Groups and with the General Population

			Siblings vs. Preterms			**Siblings vs. GP**		**Preterms vs. GP**	
	Siblings ***Median (range)***	**Preterms** ***Median (range)***	**Test statistic *U***	***p***	**GP** ***Median (range)***	**Test statistic *U***	***p***	**Test statistic *U***	***p***
Wave 1	56 (12-92)	60 (20-76)	1245.5	.438	68 (8-100)	6780.0	< .001	3554.0	< .001
Wave 2	56 (12-84)	64 (16-92)	1020.5	.046	68 (8-100)	7218.0	< .001	4608.5	.204
Wave 3	60 (8-88)	64 (4-88)	772.0	.395	68 (8-100)	7435.0	.002	3178.5	.153

Note. GP = Women from the general Flemish population (European Quality of Life Survey, 2016). Wave 1 = 10 months, Wave 2 = 14 months, Wave 3 = 24 months of child's (corrected) age.

Growth curves

Assumptions

The assumptions of linearity, homogeneity of variance, and normal distribution of the residuals were visually inspected for all final models (**Models D**) and interaction models (**Models E**). Linearity was explored by comparing the model-estimated values to the observed values. Homogeneity of variance was explored with scatter plots of the model residuals on the y-axis and fitted values on the x-

axis, which should be evenly spread around the centred line. Finally, distribution of the residuals was checked using Q-Q plots. Linearity and homogeneity of variance assumptions seemed to be mostly met for all variables. The Q-Q plots showed normal distributions for most variables, although Rewarding was somewhat negatively skewed and most variables had so-called 'heavy tails' in varying degrees (see Supplement 4.1). These heavy tails indicated that the chance of an extreme value in this model was higher than expected in a normal distribution. The mean can thus be misleading, and the sample mean may underestimate the population mean. However, applying a log-transformation did not improve the normality of the residuals.

Change in parenting behaviours over time

First, ICCs were calculated for the unconditional mean models (see **Models A** in Tables 4 to 11). ICCs represent the proportion of the overall variation in parenting behaviour that is explained by variation across mothers. In this study, ICCs ranged from .35 for Discipline to .69 for Supervision & Safety.

The unconditional growth models investigated within-person and between-person linear change (**Models B**) and within-person quadratic change (**Models C**) in parenting behaviours over time. All models had random intercepts, and slopes were fixed for all parenting behaviour models except Warmth/Support, as models did not converge with random slopes. Note that in the remainder of the Results section, all *p*-values are FDR corrected (Benjamini & Hochberg, 1995). Within-person linear change was significant for Autonomy Support ($b = 0.010$, $p = .047$), Discipline ($b = 0.051$, $p < .001$), and Supervision & Safety ($b = -0.005$, $p = .031$), indicating that mothers reported more autonomy supporting and disciplinary behaviours over time, while their supervisory behaviours decreased. However, the rates of change were near zero, meaning that changes were very small (i.e., the score for Autonomy Support increased with 0.01 every month). Between-person effects of age were non-significant for all parenting behaviours. The quadratic effect of age was only significant for Discipline ($b = -0.002$, $p = .030$). The addition of the quadratic age term did not alter the significance of the linear term for Autonomy Support and Discipline, but it rendered the linear term for Supervision & Safety non-significant ($b = -0.004$, $p = .396$). For the subsequent analyses, quadratic age terms were trimmed from the models, except for Discipline.

Well-being and EL group as predictors of (change in) parenting behaviours

Well-being and EL group were then entered as predictors of parenting behaviours (**Models D**). EL group was not associated with any initial parenting behaviour, and well-being was not significantly associated with change in parenting behaviours over time. However, adding these predictors to the model rendered the linear effect of age for Autonomy Support and Supervision & Safety (as the quadratic term was already trimmed) non-significant ($b = 0.010$, $p = .174$ and $b = -0.004$, $p = .198$, respectively).

Table 4

Growth Models of Warmth/Support

ICC = .58	Model A	Model B	Model C	Model D	Model E
Fixed effects					
Intercept	4.026*** (0.031)	4.026*** (0.031)	4.066*** (0.040)	4.023*** (0.036)	4.022*** (0.036)
Age (WP)		0.002 (0.003)	0.006 (0.003)	0.004 (0.003)	0.004 (0.003)
Age (BP)		0.068 (0.054)	0.038 (0.057)	0.031 (0.060)	0.036 (0.061)
Age (Q)			-0.001 (0.001)		
Well-being (WP)				0.003 (0.002)	0.003 (0.002)
Well-being (BP)				0.004 (0.002)	0.003 (0.002)
Group				-0.086 (0.084)	-0.083 (0.086)
Children under 18				0.012 (0.033)	0.010 (0.033)
Age (WP) x Group					0.017* (0.006)
Age (BP) x Group					0.072 (0.135)
Random effects					
Residual	0.067 (0.260)	0.060 (0.244)	0.067 (0.259)	0.070 (0.264)	0.067 (0.259)
Intercept	0.093 (0.305)	0.095 (0.308)	0.093 (0.305)	0.091 (0.301)	0.093 (0.305)
Age (WP)		0.0001 (0.012)			

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person, Q = quadratic term. Standard errors between brackets. All *p*-values are FDR controlled.

Table 5

Growth Models of Autonomy Support

ICC = .40	Model A	Model B	Model C	Model D	Model E
Fixed effects					
Intercept	4.059*** (0.041)	4.060*** (0.041)	4.119*** (0.059)	4.072*** (0.047)	4.070*** (0.048)
Age (WP)		0.010* (0.004)	0.014* (0.005)	0.010 (0.005)	0.010 (0.005)
Age (BP)		0.050 (0.075)	0.049 (0.075)	0.051 (0.080)	0.055 (0.081)
Age (Q)			-0.002 (0.001)		
Well-being (WP)				0.0003 (0.003)	0.001 (0.003)
Well-being (BP)				0.004 (0.003)	0.003 (0.003)
Group				-0.029 (0.112)	-0.085 (0.093)
Children under 18				0.061 (0.044)	0.061 (0.045)
Age (WP) x Group					0.011 (0.010)
Age (BP) x Group					0.067 (0.178)
Random effects					
Residual	0.198 (0.445)	0.194 (0.441)	0.194 (0.440)	0.205 (0.453)	0.206 (0.454)
Intercept	0.129 (0.360)	0.132 (0.363)	0.131 (0.362)	0.128 (0.357)	0.128 (0.358)

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person, Q = quadratic term. Standard errors between brackets. All *p*-values are FDR controlled.

Table 6

Growth Models of Supervision & Safety

ICC = .69	Model A	Model B	Model C	Model D	Model E
Fixed effects					
Intercept	4.637*** (0.029)	4.636*** (0.029)	4.650*** (0.035)	4.623*** (0.034)	4.619*** (0.034)
Age (WP)		-0.005* (0.002)	-0.004 (0.002)	-0.004 (0.002)	-0.004 (0.002)
Age (BP)		0.049 (0.053)	0.049 (0.053)	0.060 (0.057)	0.065 (0.058)
Age (Q)			-0.0004 (0.001)		
Well-being (WP)				0.0001 (0.001)	0.0005 (0.001)
Well-being (BP)				0.001 (0.002)	0.001 (0.002)
Group				-0.100 (0.080)	-0.100 (0.081)
Children under 18				-0.016 (0.031)	-0.017 (0.031)
Age (WP) x Group					0.010 (0.004)
Age (BP) x Group					0.083 (0.128)
Random effects					
Residual	0.039 (0.197)	0.038 (0.195)	0.038 (0.196)	0.039 (0.197)	0.038 (0.195)
Intercept	0.087 (0.295)	0.087 (0.294)	0.087 (0.294)	0.092 (0.304)	0.093 (0.305)

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person, Q = quadratic term. Standard errors between brackets. All *p*-values are FDR controlled.

Table 7

Growth Models of Discipline

ICC = .35	Model A	Model B	Model C	Model D	Model E
Fixed effects					
Intercept	2.247*** (0.046)	2.257*** (0.046)	2.344*** (0.059)	2.289*** (0.053)	2.287*** (0.053)
Age (WP)		0.051*** (0.004)	0.058*** (0.005)	0.052*** (0.004)	0.053*** (0.004)
Age (BP)		0.067 (0.083)	0.066 (0.083)	0.041 (0.089)	0.046 (0.090)
Age (Q)			-0.002* (0.001)		
Well-being (WP)				-0.001 (0.003)	-0.001 (0.003)
Well-being (BP)				-0.003 (0.003)	-0.004 (0.003)
Group				0.116 (0.125)	-0.115 (0.126)
Children under 18				0.051 (0.049)	0.051 (0.049)
Age (WP) x Group					0.012 (0.010)
Age (BP) x Group					0.086 (0.200)
Random effects					
Residual	0.281 (0.530)	0.146 (0.382)	0.143 (0.378)	0.148 (0.384)	0.147 (0.383)
Intercept	0.151 (0.389)	0.196 (0.442)	0.195 (0.442)	0.200 (0.447)	0.202 (0.450)

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person, Q = quadratic term. Standard errors between brackets. All *p*-values are FDR controlled.

Table 8

Growth Models of Rules & Structure

ICC = .61	Model A	Model B	Model C	Model D	Model E
Fixed effects					
Intercept	4.114*** (0.05)	4.115*** (0.050)	4.156*** (0.062)	4.136*** (0.057)	4.140*** (0.058)
Age (WP)		0.004 (0.004)	0.007 (0.005)	0.005 (0.004)	0.004 (0.004)
Age (BP)		0.045 (0.091)	0.044 (0.091)	0.010 (0.096)	0.003 (0.097)
Age (Q)			-0.001 (0.001)		
Well-being (WP)				0.002 (0.003)	0.002 (0.003)
Well-being (BP)				-0.002 (0.003)	-0.001 (0.004)
Group				0.147 (0.135)	0.151 (0.137)
Children under 18				0.029 (0.053)	0.029 (0.053)
Age (WP) x Group					-0.012 (0.009)
Age (BP) x Group					-0.119 (0.215)
Random effects					
Residual	0.153 (0.391)	0.134 (0.367)	0.133 (0.365)	0.159 (0.399)	0.158 (0.398)
Intercept	0.242 (0.492)	0.249 (0.499)	0.251 (0.501)	0.240 (0.490)	0.243 (0.493)
Age (WP)		0.0003 (0.019)	0.0003 (0.020)		

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person, Q = quadratic term. Standard errors between brackets. All *p*-values are FDR controlled.

Table 9

Growth Models of Rewarding

ICC = .40	Model A	Model B	Model C	Model D	Model E
Fixed effects					
Intercept	4.658*** (0.033)	4.658*** (0.033)	4.663*** (0.049)	4.638*** (0.040)	4.630*** (0.041)
Age (WP)		0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)
Age (BP)		0.043 (0.060)	0.047 (0.061)	0.069 (0.068)	0.079 (0.068)
Age (Q)			-0.0001 (0.001)		
Well-being (WP)				0.003 (0.003)	0.003 (0.003)
Well-being (BP)				0.002 (0.002)	0.002 (0.002)
Group				-0.050 (0.096)	-0.063 (0.096)
Children under 18				-0.006 (0.038)	-0.004 (0.038)
Age (WP) x Group					0.007 (0.008)
Age (BP) x Group					0.194 (0.151)
Random effects					
Residual	0.130 (0.360)	0.115 (0.339)	0.131 (0.361)	0.129 (0.359)	0.129 (0.359)
Intercept	0.087 (0.295)	0.092 (0.303)	0.087 (0.296)	0.101 (0.317)	0.100 (0.316)
Age (WP)		0.0003 (0.017)			

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person, Q = quadratic term. Standard errors between brackets. All *p*-values are FDR controlled.

Table 10

Growth Models of Indulging

ICC = .52	Model A	Model B	Model C	Model D	Model E
Fixed effects					
Intercept	2.481*** (0.057)	2.482*** (0.057)	2.537*** (0.076)	2.503*** (0.064)	2.510*** (0.065)
Age (WP)		-0.0001 (0.005)	0.004 (0.006)	-0.0001 (0.005)	-0.0001 (0.005)
Age (BP)		0.112 (0.102)	0.110 (0.102)	0.193 (0.109)	0.184 (0.110)
Age (Q)			-0.002 (0.001)		
Well-being (WP)				-0.003 (0.004)	-0.003 (0.004)
Well-being (BP)				-0.001 (0.004)	-0.001 (0.004)
Group				-0.196 (0.153)	-0.184 (0.155)
Children under 18				0.021 (0.060)	0.019 (0.061)
Age (WP) x Group					-0.002 (0.012)
Age (BP) x Group					-0.160 (0.243)
Random effects					
Residual	0.273 (0.522)	0.255 (0.505)	0.255 (0.505)	0.276 (0.526)	0.278 (0.527)
Intercept	0.292 (0.540)	0.294 (0.542)	0.294 (0.542)	0.279 (0.529)	0.280 (0.529)
Age (WP)		0.0004 (0.019)	0.0004 (0.019)		

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person, Q = quadratic term. Standard errors between brackets. All *p*-values are FDR controlled.

Table 11

Growth Models of Well-being

ICC = .57	Model A	Model B	Model C	Model D	Model E
Fixed effects					
Intercept	56.497*** (1.333)	56.666*** (1.335)	57.345*** (1.720)	56.239*** (1.535)	55.921*** (1.555)
Age (WP)		0.299* (0.110)	0.347* (0.135)	0.286* (0.108)	0.277 (0.108)
Age (BP)		2.401 (2.432)	2.415 (2.431)	2.537 (2.589)	2.848 (2.603)
Age (Q)			-0.020 (0.031)		
Group				1.846 (3.639)	1.123 (3.677)
Children under 18				-0.574 (1.434)	-0.444 (1.437)
Age (WP) x Group					-0.229 (0.238)
Age (BP) x Group					6.895 (5.762)
Random effects					
Residual	122.700 (11.080)	188.700 (10.900)	119.200 (10.920)	111.300 (10.550)	111.100 (10.540)
Intercept	165.300 (12.860)	167.200 (12.930)	166.800 (12.920)	177.300 (13.320)	177.400 (13.320)

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. WP = within-person, BP = between-person, Q = quadratic term. Standard errors between brackets. All *p*-values are FDR controlled.

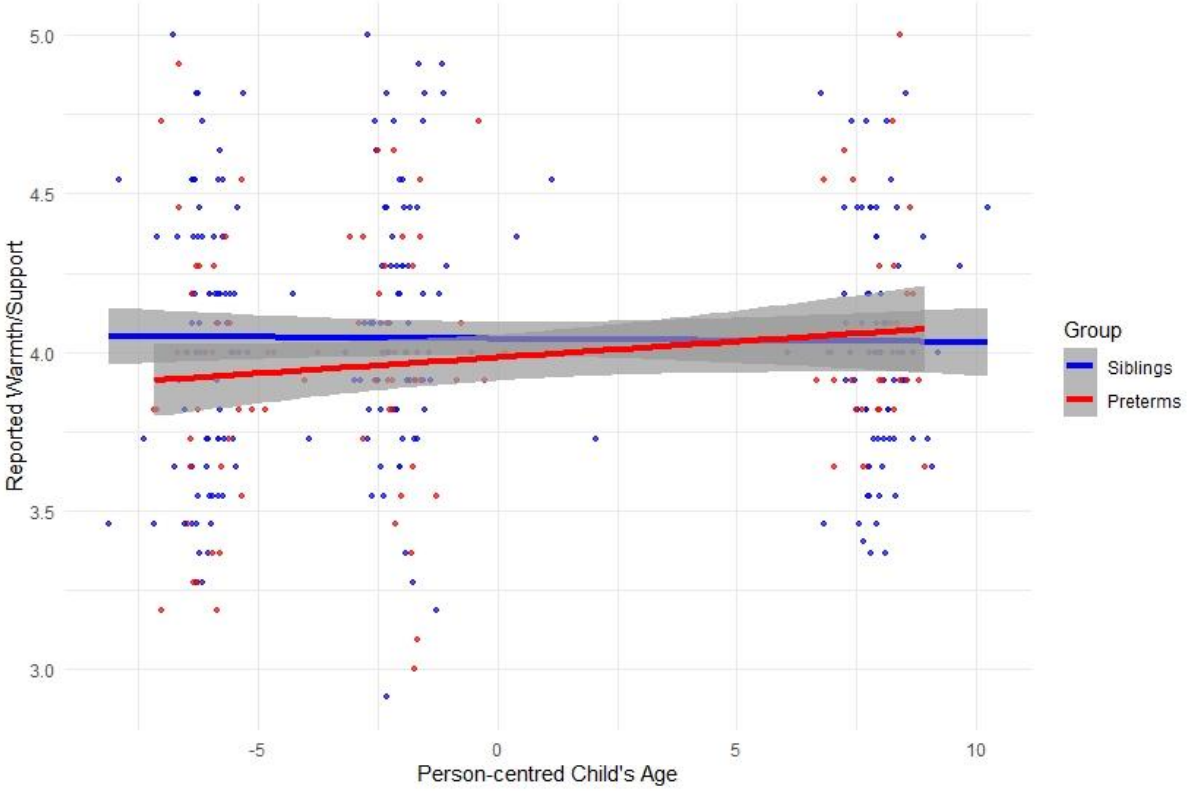
Secondary analyses

Following the same steps as described above for the parenting behaviours, growth curves were modelled to explore change in well-being, and group was added as a predictor of initial well-being. The ICC of .57 indicated that variation in well-being across waves was for 57% explained by variation across mothers, and for 43% by variation within mothers on different occasions (see Table 11, **Model A**). The unconditional growth models explored linear (**Model B**) and quadratic (**Model C**) change in well-being. Within-person linear change was significant in the linear and quadratic models (b = 0.299, p = .015; b = 0.347, p = .033), indicating that well-being increased over time. Quadratic change was non-significant (b = -0.020, p = .532). There were no group differences in initial well-being (b = 1.846, p = .613, see **Model D**). Within-person linear change remained significant when the variables Group and Children were entered (b = 0.286, p = .026, see **Model D**).

Next, we explored whether a group by age interaction predicted change in parenting behaviours and well-being (see Tables 4 to 11, **Models E**). We found a significant interaction effect for Warmth/Support (b = 0.017, p = .034), with mothers of preterms reporting an increase in supportive behaviours over time (b = 0.016, p < .001) while mothers of siblings reported no change (b = -0.001, p = .67) (Figure 1). No significant interaction effects were found for well-being or other parenting behaviours. The inclusion of the interaction term rendered the change in well-being over time non-significant (b = 0.277, p = 0.056).

Figure 1

Linear relationship between child's age and self-reported Warmth/Support per group (mothers of siblings vs. preterms)



Discussion

The present study contributed to the existing body of parenting research by using a growth curve modelling approach in a sample of mothers of very young children at EL of autism, investigating whether well-being was associated with change in reported parenting behaviours between 10 and 24 months of child's age.

More stability than change in reported parenting behaviours

Confirming our hypotheses, provision of daily structure, social rewarding, and indulging behaviours were stable over time for both EL groups alike. On average, mothers of young children at EL of autism reported that they often provided daily structure, almost always rewarded their child with an applause or a hug when they achieved something new or otherwise positive, and little to sometimes indulged their child between 10 and 24 months of child's age. Mothers in both groups also reported a small increase in autonomy supporting behaviours and a very subtle decrease in supervisory behaviours over time. These latter findings could reflect an increasing confidence in their children's abilities, as mothers may have been very careful during the first months of life because of their child's prematurity, additional medical issues, or suspected developmental problems. It could also indicate a typical developmental change, since secondary analysis of the data from Van Leeuwen and colleagues (2015) showed a decrease in supervisory behaviours between 12 and 30 months as well. However, the changes in the present study were not robust, as they became non-significant when other predictors were added to the models.

As expected, mothers in our sample reported more disciplinary behaviours when their child grew older, in line with findings from the general population (Van Leeuwen et al., 2015; Verhoeven et al., 2007; Vittrup et al., 2006). During toddlerhood, children become more independent, autonomous individuals, and they are expected to learn to comply with social rules and expectations (Verhoeven et al., 2019). In their development towards more autonomy, toddlers may thus prompt more disciplinary behaviours, and mothers may feel that sanctions (i.e., giving a time-out, making the child clean up) become more useful as their child's self-regulation increases. As the items of the Discipline subscale include responses to challenging behaviour (e.g., When my child does something I do not like, I raise my voice), the increase in disciplinary behaviours reflects this developmental change. The fact that disciplinary behaviours increased in the two EL groups alike suggests that both siblings and preterms follow this typical developmental path.

Interestingly, our exploratory analyses indicated a group difference regarding change in supportive parenting behaviours (e.g., doing play activities, showing affection, being responsive to their child's needs). Initial levels were equally high among mothers of preterms and siblings, but mothers of

preterms reported a further increase between 10 and 24 months while mothers of siblings reported stability. This group difference may be related to the specific developmental trajectory of preterms. Parents may have had fewer opportunities to interact with their child beyond the necessary (motor) stimulation during the first months of life, due to their hospitalisation and the occurrence of medical problems. It could therefore be the case that they want to make up for the missed 'care free' play time in the second year of life. Moreover, parents are regularly invited for a follow-up consultation, where they receive advice on how to stimulate their child, in line with items of the Warmth/Support scale. Finally, motor skills of preterms in our sample lagged behind those of siblings at 14 months but not at 24 months anymore, so these motor advances may have had a cascading effect on the social interaction with their environment, prompting more interactive behaviours from their mothers (Iverson, 2021). Stability of supportive behaviours among mothers of siblings, on the other hand, would be in line with most previous observational and questionnaire studies among parents from the general population and of siblings (Bornstein et al., 2008; Hallers-Haalboom et al., 2017; Harker et al., 2016; Pijl et al., 2021; (secondary analysis of) Van Leeuwen et al., 2015; Verhoeven et al., 2007). However, a decrease in observed sensitive behaviours was found among mothers of preterms (Hall et al., 2015; Stack et al., 2019). An alternative hypothesis could be that an increase in reported supportive behaviours is the norm, and stability in the sibling group the exception. Gutman and Feinstein (2010) namely found an increase in reported supportive and interactive parenting behaviours between 6 and 42 months of child's age using growth curve modelling. Stability, or the absence of an increase, among mothers of siblings could then be explained by the family situation. As these families include one or more children diagnosed with autism that may require time and energy, mothers may have less time to always read a book or sing songs to the participating child. Moreover, early autism symptoms may emerge in the second year of life (Estes et al., 2015; Landa et al., 2013), which could challenge mother-child interaction. Following this hypothesis, an increase in reported supportive behaviours could have remained undetected in the two other questionnaire studies (Van Leeuwen et al., 2015, and Verhoeven et al., 2007), due to the different analytical approach based on the sample mean or rank. In either case, the stability or decrease in supportive behaviours that was found in most observational studies should be viewed as complementary to findings from questionnaire studies, since correlations between observed and reported parenting behaviours are generally weak (Gardner, 2000). It is also important to note that the increase in the preterm group was significant but small, and that it may reflect nuances that are not relevant in day-to-day life.

Finally, we found significant within-person effects of child's age (described above), but no significant between-person effects of child's age. This means that, at each assessment wave, differences in parenting behaviours could not be explained by age differences between children. The lack of between-person effects could be due to only minimal differences in children's ages at each assessment wave, but could also result from the fact that only few data-points were available and that the effect had to be large to be detected.

Well-being was not associated with change in parenting behaviours

Based on previous findings, we expected that lower levels of well-being would be associated with less social rewarding, less provision of daily structure, less support of the child's autonomy, and with more disciplinary and indulging behaviours. However, none of the associations were significant. The non-significant findings could be explained by several differences between our study and previous research.

First, children in our study were below two years of age, while other studies included pre-schoolers and school-aged children aged two and above. It is possible that well-being and parenting behaviours become (differently) associated when children grow older and challenge their parents in different ways, although this seems the case for parents of autistic children only. Higher levels of parenting stress were namely associated with less support of the child's autonomy among parents of autistic and non-autistic pre-schoolers (Madarevic et al., 2022), but with more material rewarding and harsh punishment among parents of school-aged children in the autism group while with none of the parenting behaviours in the non-autism group (Boonen et al., 2015). Higher levels of parenting stress were however consistently correlated to less involvement and less optimal communication among parents of pre-schoolers and school-aged children on the autism spectrum (Osborne & Reed, 2010).

Second, the significant associations found in previous studies could be explained by additional behaviour problems. Externalising behaviour problems are more common among children diagnosed with autism, and may be perceived as particularly stressful for parents (e.g., Boonen et al., 2014; Estes et al., 2013; Hastings et al., 2005). Repeating our analyses once all our study's participants will have been assessed at the age of three, when a best-estimate research diagnosis of autism is possibly given, could test these two hypotheses. This way, a comparison could be made between those children who have received an autism diagnosis and those who have not. Alternatively, children could be grouped based on the amount of externalising behaviour problems that mothers reported at the age of two or three, to explore whether behaviour problems could be a key variable in predicting associations between well-being and parenting behaviours.

A third explanation for the non-significant associations could be that well-being is not associated with parenting behaviours in the same way as parenting stress or measures of depression, anxiety and stress. Although studies including parents of school-aged children on the autism spectrum found moderate to strong associations between parental well-being on the one hand, and mental health (Salomone et al., 2018) and parenting stress (Likhitweerawong et al., 2020) on the other, these findings need to be replicated among parents of young children at EL of autism. In addition, as mental health or parenting stress measures may be more sensitive than our current well-being questionnaire, associations with (change in) parenting behaviours need to be explored as well. This was not possible in the present study, as parental mental health was exclusively assessed at 10 months of child's age, while parenting stress was assessed from 14 months of child's age onwards only. Moreover, the relationship between

well-being and observed mother-child interaction needs to be explored to confirm the lack of associations between well-being and parenting behaviours.

Well-being increased over time in both EL groups

Exploration of the well-being trajectories indicated no group differences in initial well-being or change over time. Compared to women from the general Flemish population, mothers of siblings reported lower well-being at all assessment waves, but mothers of preterms at the first wave only. However, mothers from both EL groups reported an increase in well-being between 10 and 24 months, indicating change toward the mean well-being score of women from the general population (European Quality of Life Survey, 2003-2016). This is encouraging, as Topp and colleagues (2015) concluded that the ideal goal should be to reach the general population mean score when using well-being as an outcome measure. As previous studies found that maternal well-being decreases after giving birth (e.g., Giesselmann et al., 2018), except when having a first child (Kohler et al., 2005), the increase in our sample seems surprising. However, a recent review describes how parental well-being is related to having a life partner, social-economic status, and importantly, policy and institutional support for parents (Nomaguchi et al., 2020). In this regard, our findings are less surprising. Most mothers in our study namely had a life partner, the majority had received higher education, and the Flemish government provides parents with child tax allowances, child care subsidy, and the possibility to take parental leave. This may not fully account for the increase in well-being, but it may have prevented a decrease. In addition, preterms are followed up at Neonatology and later at a centre for developmental disorders (around 4, 9, 14, and 24 months of child's (corrected) age), and parental well-being is usually addressed during these consultations. In turn, mothers from the sibling group may have learned ways to cope with challenging situations in intervention regarding their older child(ren) on the autism spectrum. Maternal well-being may thus be followed-up more closely in our sample than in the general population, which could explain the contrasting findings. It is however important to note that the increase in well-being became non-significant in the interaction model. The change in well-being may not be very robust, or the effect could have been too small to be detected given our sample size.

Strengths and limitations

The present study is novel in several aspects, including its sample, methodology, and analytic strategy. First, we gained a better understanding of the differences between mothers of siblings and preterms, who all have a young child at EL of autism but vary in other ways. To our knowledge, only one study included a mixed sample of siblings and preterms, but the sample was too small to allow for group comparisons (Srinivasan & Bhat, 2020). However, we did not include a comparison group of children at typical likelihood of autism (i.e., with no family history of autism and born full-term) and

their mothers. Repeating our analyses once all our study's participants will have been assessed at the age of three, when a best-estimate research diagnosis of autism will be given to a subset of the participating children, could offer additional insights. Alternatively, our data set could be merged with the one of Van Leeuwen and colleagues (2015), although age at assessment differs between studies. Another limitation is that we only investigated the association between well-being and parenting behaviours of biological mothers, excluding fathers and co-mothers. Future research could explore possible differences between parents, as mothers of autistic and non-autistic children generally reported lower well-being levels than fathers (e.g., Ang & Loh, 2019; Davis & Carter, 2008; Nelson-Coffey et al., 2019; Skreden et al., 2012). However, previous questionnaire studies found more similarities than differences in parenting behaviours (Verhoeven et al., 2007, 2010).

Regarding methodology, our findings complement and extend those of observational studies that examined observed interactive behaviours among children at EL of autism and their mothers during the first two years of life (e.g., Hall et al., 2015; Pijl et al., 2021; Srinivasan & Bhat, 2020; Stack et al., 2019; Wan et al., 2013), and questionnaire studies that investigated parenting behaviours in the general population (Gutman & Feinstein, 2010; Van Leeuwen et al., 2015; Verhoeven et al., 2007). Although descriptive statistics of the parenting behaviour subscales in our study were comparable to those in general population studies using the same (Van Leeuwen et al., 2015) or a different questionnaire (Verhoeven et al., 2017), we noticed several floor and ceiling effects that need to be considered in the future. When most scores are clustered around the lower or upper end of the scale, this namely limits the detection of significant effects. In the present study, the non-robustness of the decrease in supervisory behaviours could have been due to a ceiling effect. As a greater differentiation in scores would also allow for a better assessment of the true extent of parenting behaviours, future research should consider the way we currently assess parenting behaviours using self-report. Finally, our findings show that a short and positively worded questionnaire like the WHO-5 can capture change in well-being over time among mothers of children at EL of autism, and may thus be a valid alternative for longer negatively worded mental health questionnaires. However, the lack of norms makes it difficult to interpret the well-being scores and compare them to previous research.

By analysing our data using growth curve modelling, including random intercepts and slopes in our models when possible, we could study inter-individual variability in intra-individual change in parenting behaviours and well-being over time. As we did so within a multi-level modelling framework, missing data could be handled and unequally spaced assessment waves could be accounted for. However, our sample size was relatively small, which meant that only large effects could be detected, and that we could include only a minimum of predictors in our models not to reduce power. We therefore decided to exclude maternal education from our growth curve analyses, although previous findings found significant associations between educational level and parenting behaviours (e.g., Pijl et al., 2021; Van Leeuwen et al., 2015). A follow-up study could replace well-being by educational level as a predictor, and include data from the last assessment wave as well.

Implications

First, the results of our study showed more similarities than differences between mothers of young siblings and preterms in terms of parenting behaviours and well-being. This suggests that, at this young age, they could be treated as one group of mothers with a child at EL of autism. However, our findings also indicated that subtle group differences may exist. We only found one group difference among seven parenting behaviours, but we cannot rule out that other differences have remained undetected due to our sample size and limited variation in parenting behaviour scores. Until future research demonstrates if and when parenting trajectories diverge, group differences should thus be accounted for.

Second, we found consistent high levels of supportive behaviours in both groups, even though mothers of siblings (and mothers of preterms at the first wave) reported well-being levels below the general population mean. As all children, but in particular a subgroup of children at EL of autism who may be especially susceptible to their environment, benefit from supportive and responsive behaviours, this is encouraging. The increase in well-being scores over the course of our study suggests that mothers in our sample generally find ways to deal with life challenges. However, there are still mothers who reported very low well-being throughout the study. Individual differences in well-being may be related to a wide range of child, personal, and environmental factors, as demonstrated by Green and colleagues (2021) and Salomone and colleagues (2018). A personalised assessment of a mother's strengths and needs thus seems crucial to improve well-being for those who need it.

Conclusions

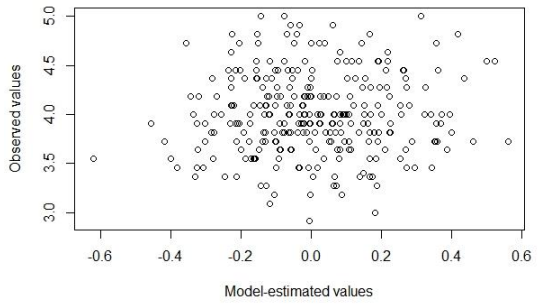
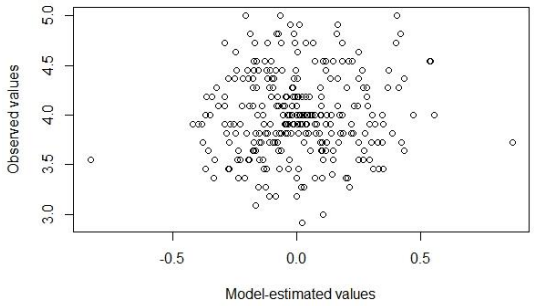
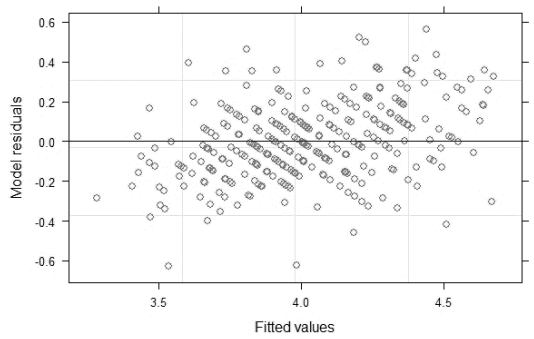
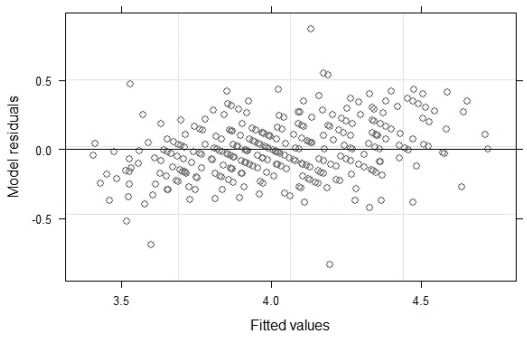
For the first time, mothers of siblings and preterms were studied together in a study on well-being and parenting behaviours in light of emergent autism. As expected, we found more stability than change in parenting behaviours, in line with findings from the general population. In general, both mothers of siblings and preterms reported more disciplinary behaviours when their child grew older. Additionally, mothers of preterms reported an increase in warm and supportive behaviours between 10 and 24 months of child's age, while mothers of siblings reported no change. Contrary to our hypotheses, well-being was not associated with any of the parenting behaviours. No group differences were found in initial well-being or change over time. Mothers from both EL groups reported an increase in well-being between 10 and 24 months, indicating change toward the mean well-being score of women from the general population. Further longitudinal research should investigate if and when differences in parenting behaviours and well-being emerge and what drives them, taking into account that individual trajectories may differ between mothers.

Acknowledgements

We are thankful to all families that have been and still are participating in the TIARA study. We would also like to thank Vera E. Heininga for generously sharing her growth curve modelling and assumption testing syntax.

Supplement 4.1

Figures showing the results of three assumption tests (linearity, homogeneity of variance, distribution of residuals) per parenting behaviour scale/well-being scale

Warmth/Support	**Warmth/Support by group x age**
Linearity	Linearity
	
Homogeneity of variance	Homogeneity of variance
	
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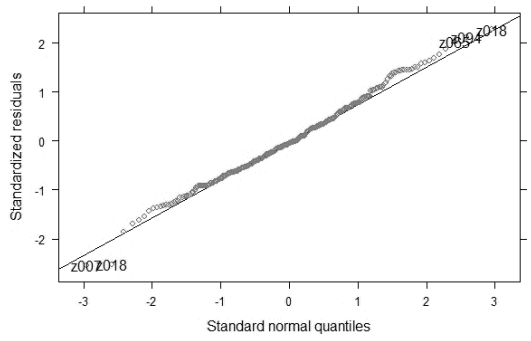
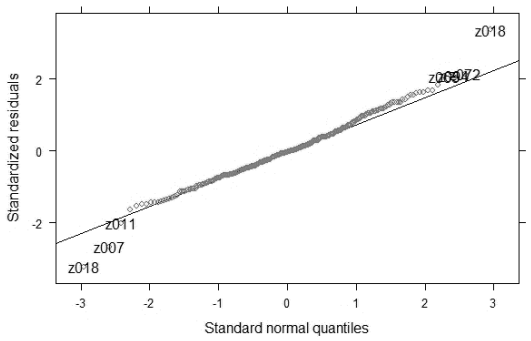
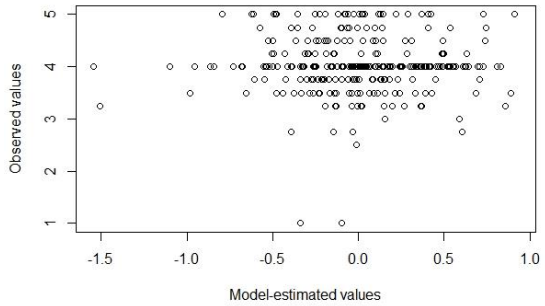
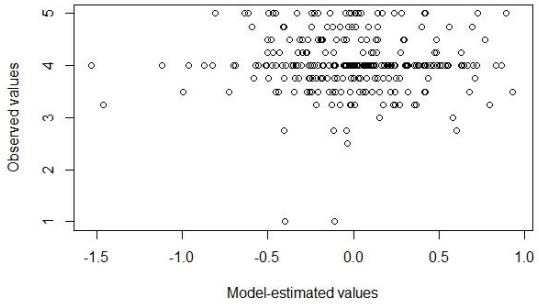
	

Autonomy Support	**Autonomy Support by group x age**
Linearity	Linearity
	
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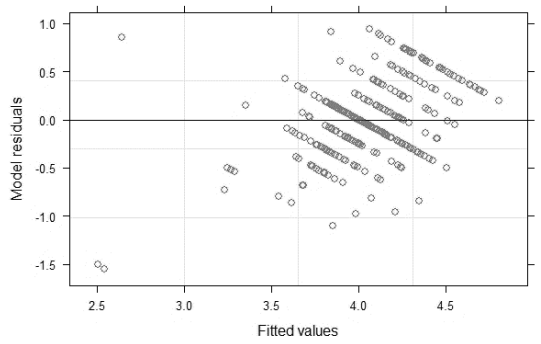
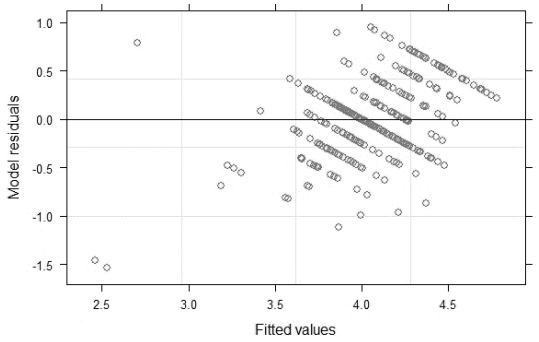
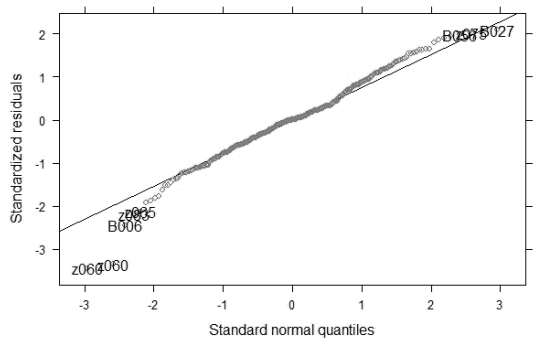
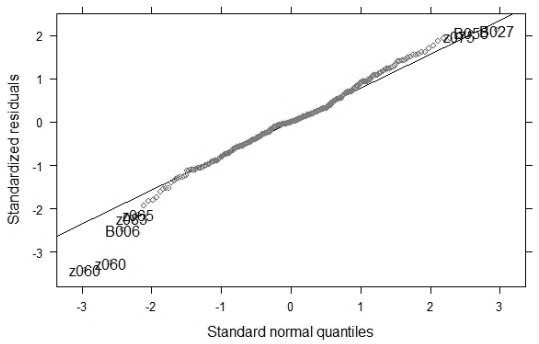
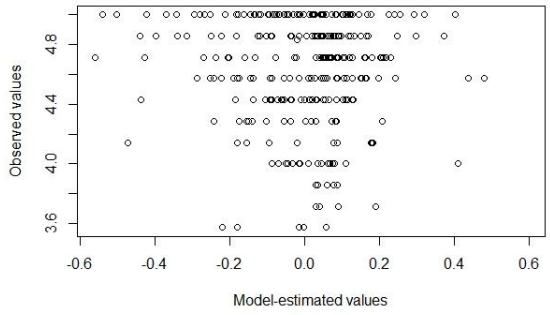
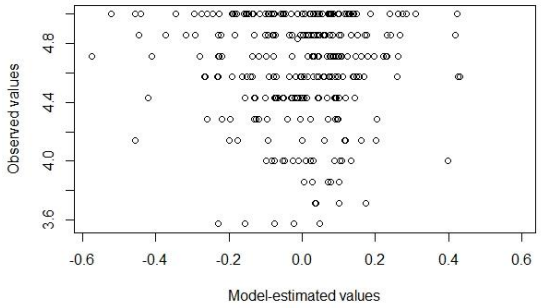
	
Normal distribution of residuals	Normal distribution of residuals
	

Supervision & Safety	**Supervision & Safety by group x age**
Linearity	Linearity
	
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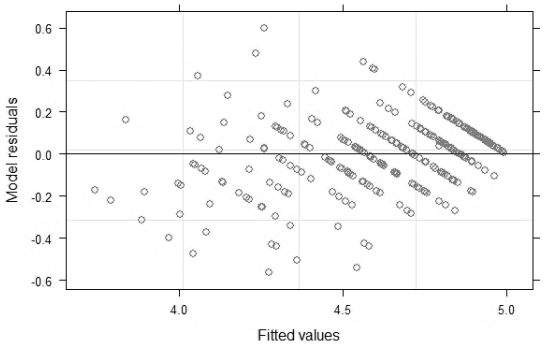	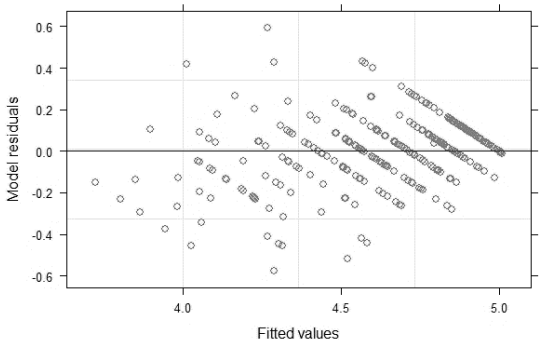
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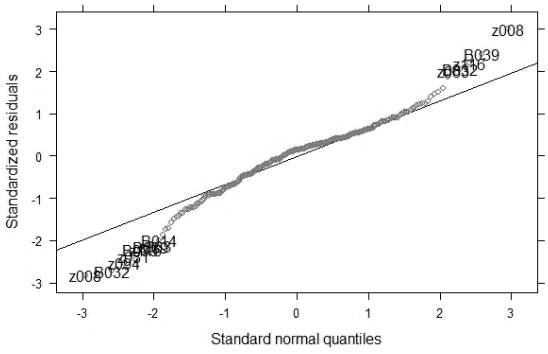
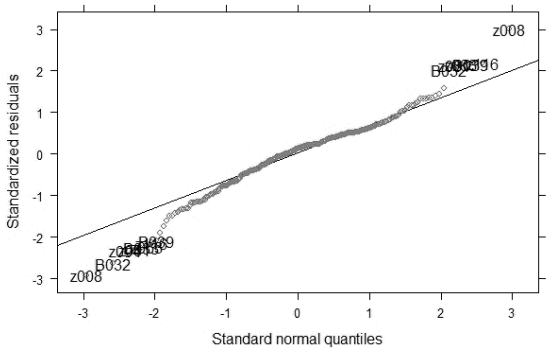
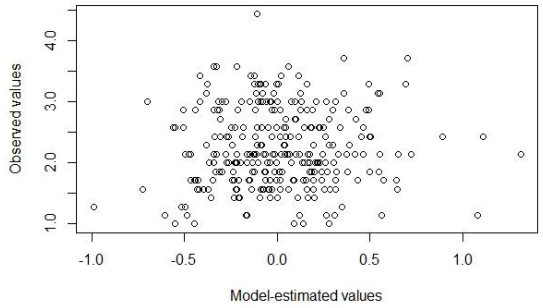
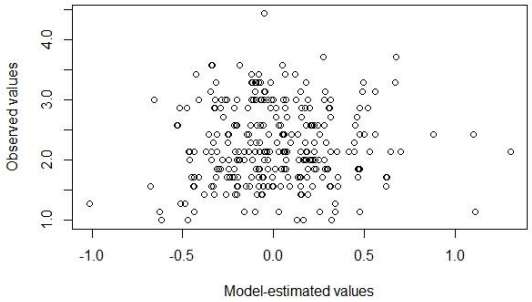
	

Discipline	**Discipline by group x age**
Linearity	Linearity
	
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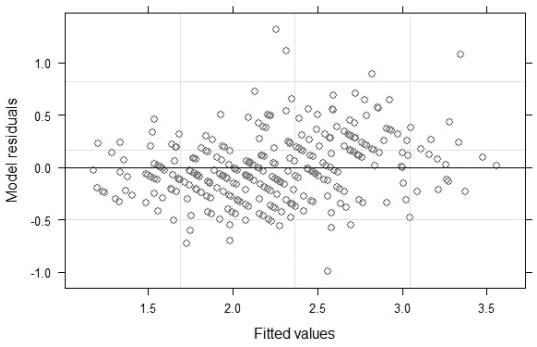
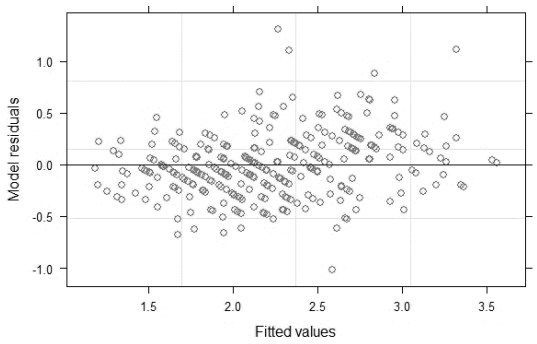
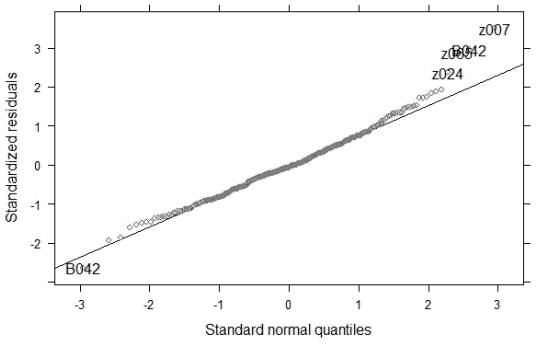
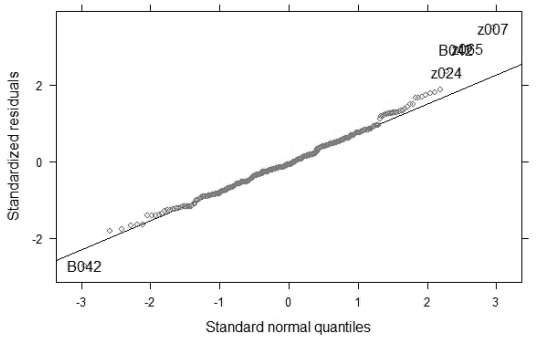
	
Normal distribution of residuals	Normal distribution of residuals
	

Rules & Structure	**Rules & Structure by group x age**
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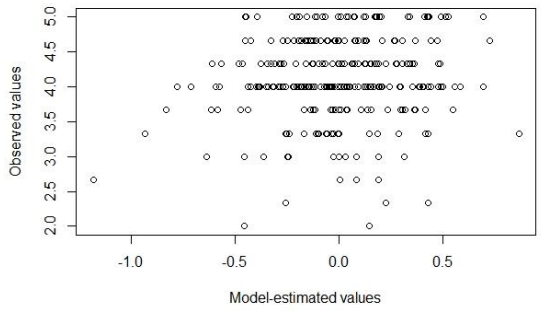	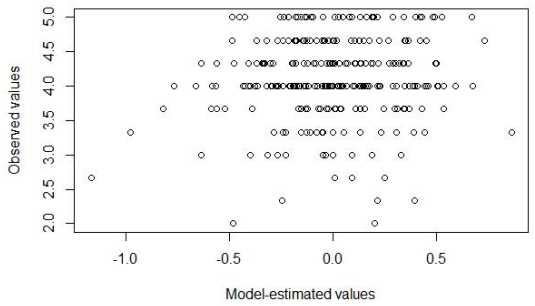
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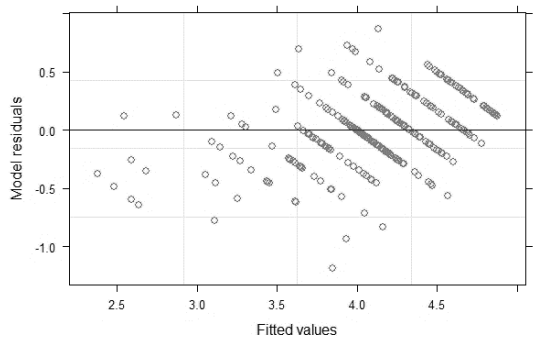
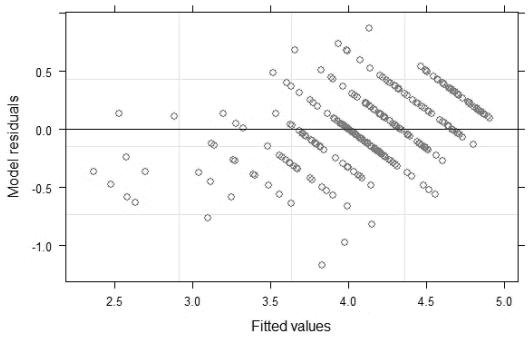
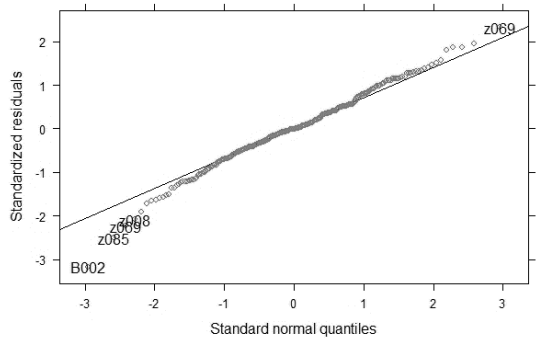
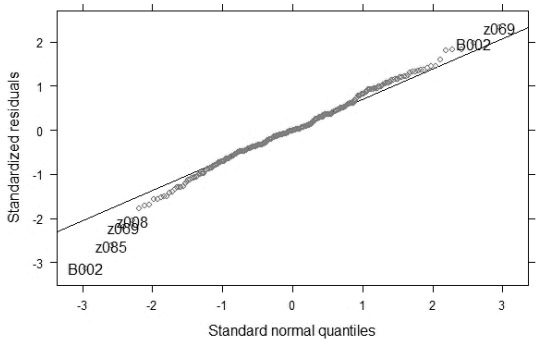
	
Normal distribution of residuals	Normal distribution of residuals
	

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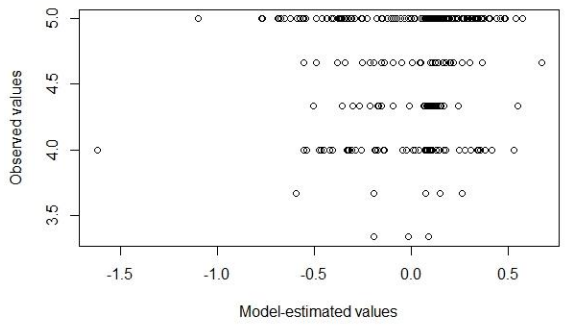
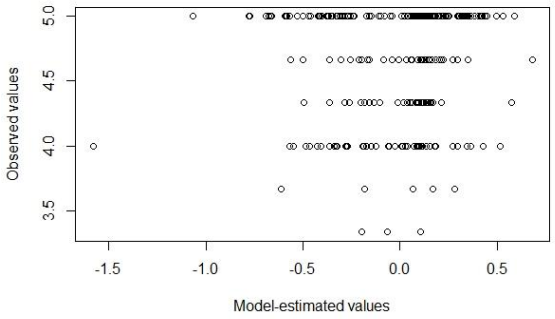
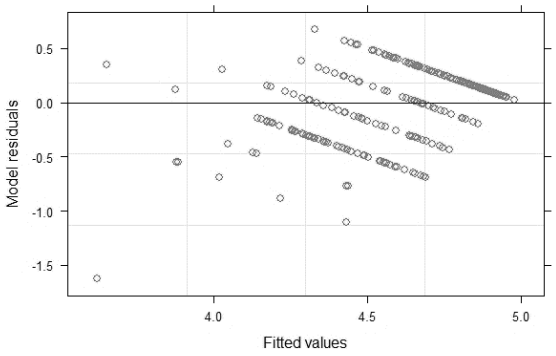
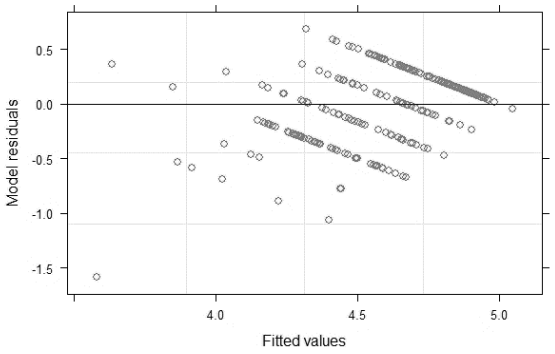
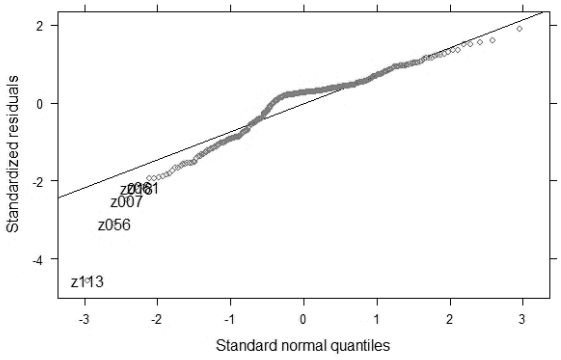
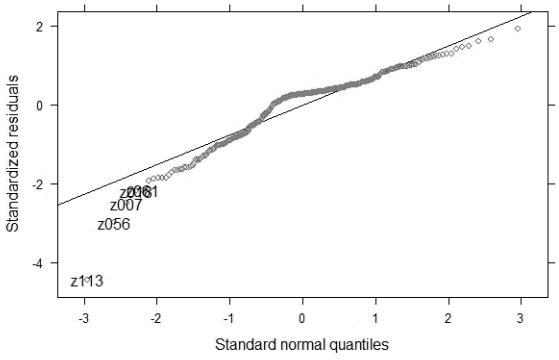
Linearity	Linearity
	
Homogeneity of variance	Homogeneity of variance
	
Normal distribution of residuals	Normal distribution of residuals
	

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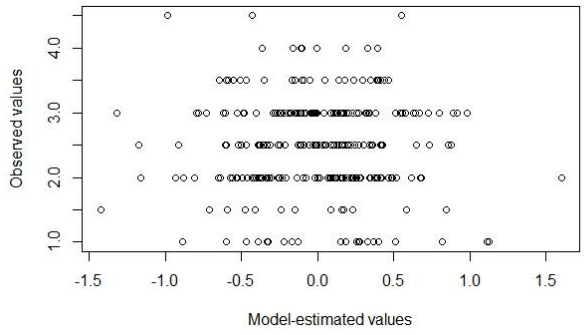	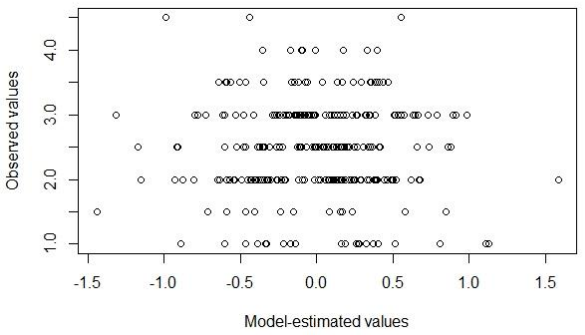
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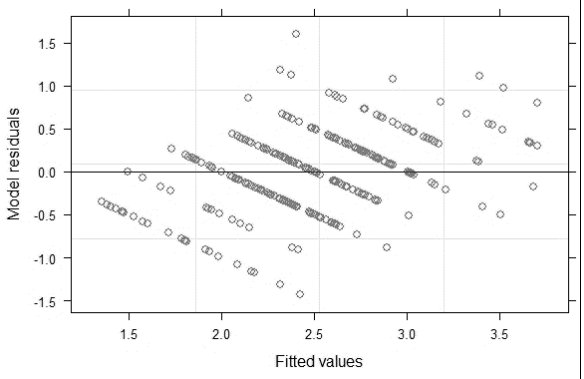	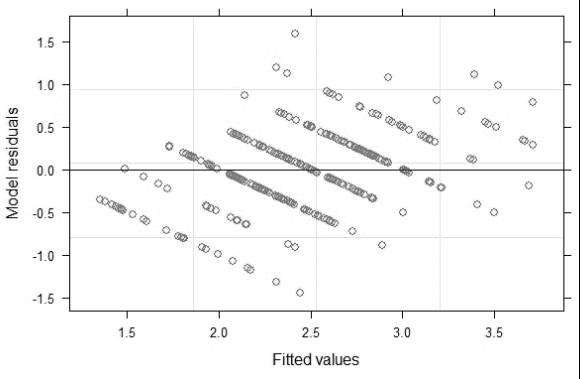
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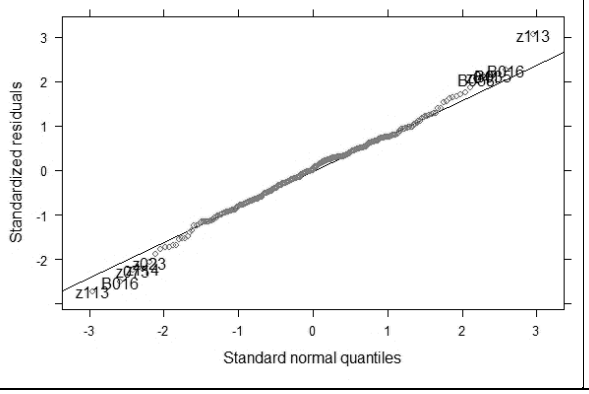	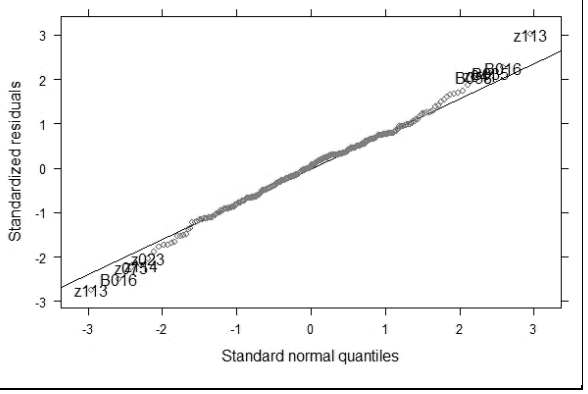

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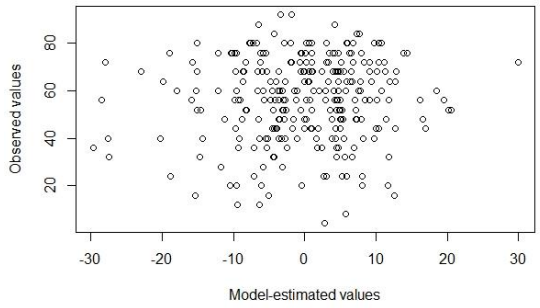
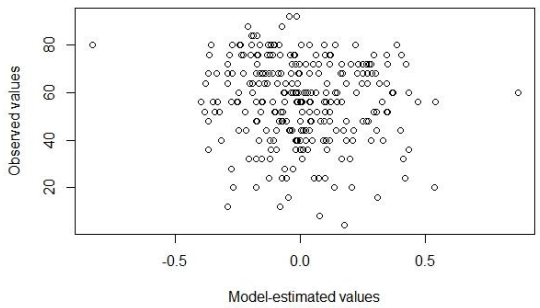
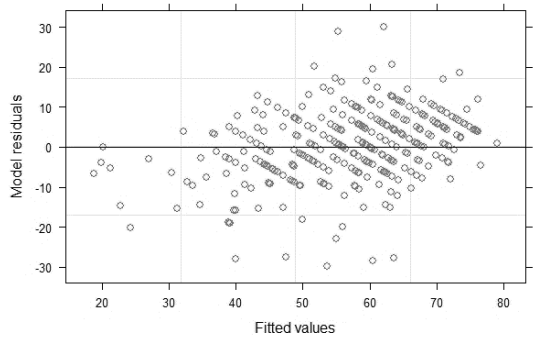
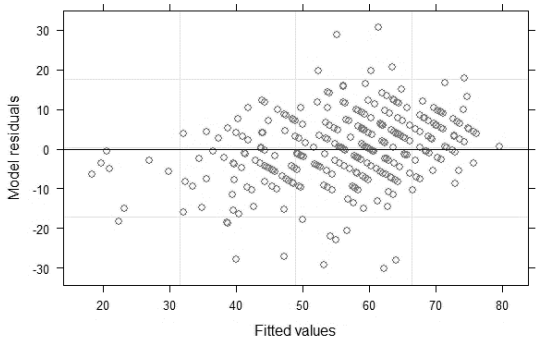
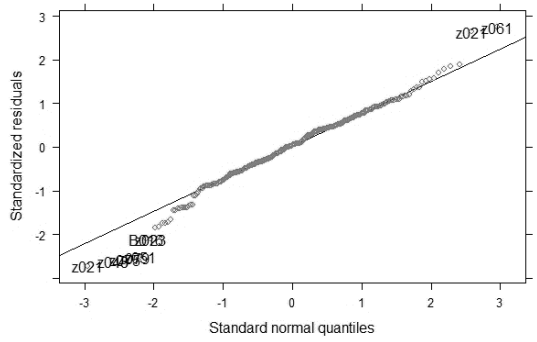
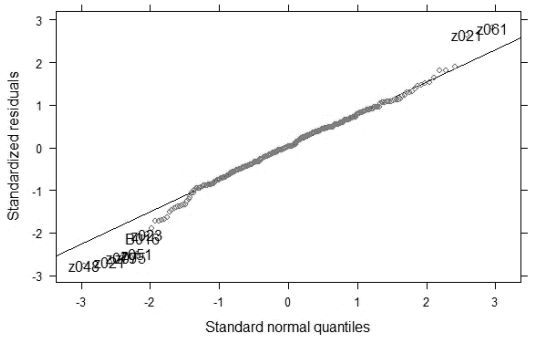
Linearity	Linearity
	
Homogeneity of variance	Homogeneity of variance
	
Normal distribution of residuals	Normal distribution of residuals
	

Chapter 5

Parenting behaviours among mothers of pre-schoolers on the autism spectrum: Associations with parenting stress and children's externalising behaviour problems

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Abstract

Parents of autistic pre-schoolers report increased parenting stress (i.e., stress related to the parent role) and more behaviour problems of the child compared with parents of non-autistic pre-schoolers. Parenting stress and children's behaviour problems are both associated with parenting behaviours, but have not yet been investigated together. 42 mothers of autistic and non-autistic pre-schoolers were observed during mother-child interaction and they reported on parenting behaviours, parenting stress, and children's externalising behaviour problems. Spearman correlations between all variables were calculated for the autism group and the non-autism group separately, and covariance pattern models were built to investigate whether parenting stress and externalising behaviour problems were similarly associated to parenting behaviours in both groups. Mothers in the autism group reported more parenting stress and more externalising behaviour problems than mothers in the non-autism group. In the autism group only, parenting stress was related to externalising behaviour problems but not to the level of autism characteristics. In both groups, more externalising behaviour problems were associated with more observed negative parenting behaviours (i.e., criticising and ignoring the child), and more parenting stress was associated with less reported autonomy support. Our findings indicate that in the case of possibly problematic parenting behaviours, such as negativity and lack of autonomy support, it is important to investigate associated factors like parenting stress and children's behaviour problems. An individualised strengths and needs assessment could then offer a tailored intervention to families with an autistic pre-schooler.

Introduction

Pre-school age can be a stressful time for any parent, but parents of a young child on the autism spectrum may encounter additional challenges. Early autism signs that parents may have observed in their child, such as differences in social responsiveness or the presence of repetitive behaviours, can become more pronounced and may cause further concern. Moreover, parents may have to cope with the recent autism diagnosis and the start of intervention services (Davis & Carter, 2008). Not surprisingly, parents of autistic pre-schoolers experience increased parenting stress (i.e., stress related to the parent role), compared with parents of typically developing (TD) children and those who have a child with another disability (for a review, see Tint & Weiss, 2016). Despite this consistent finding, little research has focused on the relationships between parenting stress and parenting behaviours among parents of pre-schoolers on the autism spectrum. Moreover, children's additional behaviour problems have not consistently been taken into account when investigating parenting behaviours.

Parenting behaviours

Although parents of pre-schoolers on the autism spectrum report elevated stress levels compared with parents of non-autistic pre-schoolers, research suggests that parenting behaviours are largely comparable between parents of autistic and non-autistic pre-schoolers. However, some differences exist. Observational studies namely found that parents of autistic pre-schoolers were similarly sensitive and responsive (i.e., being child-centred; responding timely and appropriately to the child's needs and following the child's needs) as parents of non-autistic pre-schoolers (Blacher et al., 2013; Campbell et al., 2018), but demonstrated more behaviours deemed controlling and intrusive (i.e., being parent-centred; following their own agenda, being overly stimulating, or unable or unwilling to relinquish control) (Blacher et al., 2013). Blacher and colleagues (2013) suggest that these differences in parent-centred and controlling behaviours may be related to children's behaviour problems, which were more common in the autism group compared to the non-autism group. They also suggest that early intervention could have played a role, as behavioural techniques that parents may have learned can appear intrusive or directive, and are thus coded as such.

In line with these results, a questionnaire study by Lambrechts and colleagues (2015) found no differences between mothers from an autism group and a non-autism group for most parenting behaviours that are viewed as sensitive and responsive (e.g., supporting the child's autonomy or adapting the environment according to the child's needs). Moreover, they found no differences in provision of rules and structure or indulging behaviour (e.g., giving in when the child throws a tantrum). They however found that mothers in the autism group reported lower scores on the subscale Stimulating the Child's Development (e.g., stimulating pretend play, explaining emotions in others, teaching a child to wait its turn) than mothers in the non-autism group. Contrary to the findings of Blacher and colleagues

(2013), mothers of autistic pre-schoolers reported fewer disciplinary behaviours (e.g., raising your voice when your child does not listen, giving a time-out) compared with the non-autism group. However, the Discipline subscale assesses only disciplinary behaviours and not intrusive or controlling behaviours, and results may thus not be comparable between the different studies.

Parenting behaviours and parenting stress

Parenting stress has received considerable attention in autism research, but the nature of parenting stress is still open to debate. Some studies point at children's autism characteristics as strongest factor associated with parenting stress (Davis & Carter, 2008; Eisenhower et al., 2005; Firth & Dryer, 2013; Lyons et al., 2010), while other studies found that parenting stress is related to children's additional externalising behaviour problems (Estes et al., 2013; Hastings et al., 2005; Lecavalier et al., 2006; Lin et al., 2021; Peters-Scheffer et al., 2012). Behaviour problems are more common in autistic than in TD children (Estes et al., 2013; Wilson et al., 2013), and they seem associated with the amount of autism characteristics (Jang et al., 2011; Lindsey et al., 2020).

To the best of our knowledge, the relationships between parenting stress and parenting behaviours have only been investigated specifically among parents of autistic pre-schoolers by Osborne and Reed (2010), who included different age groups (2–3, 4–6, 7–11, 12+ years) in their study. Parents of children aged two to three years reported "extremely elevated levels of parenting stress" at baseline (p. 411), and these high initial levels of parenting stress predicted less involvement and poorer communication at follow-up (9–10 months later). Moreover, less limit-setting at baseline predicted more parenting stress at follow-up. In the age group of four to six years, elevated parenting stress at baseline predicted poorer communication and less limit-setting at follow-up, and vice versa. However, this study relied solely on self-report measures and no control group was included.

In a study on school-aged autistic and non-autistic children and their mothers, Boonen and colleagues (2015) found that parenting stress was related to both self-reported and observed parenting behaviours. In the autism group, higher levels of parenting stress were associated with more self-reported use of material rewarding and (harsh) punishment, and with more negative parenting behaviours (i.e., criticising or ignoring the child) during observation. In the non-autism group, more parenting stress was only associated with less creativity (i.e., using fantasy or humour) during observation. There are several possible explanations for these group differences. First, they might be explained by the higher parenting stress levels in the autism group, which may have diminished the mothers' ability to remain patient towards their autistic child. Second, there may have been additional differences between the groups regarding parental autism characteristics and temperament on the one hand, and children's temperament and behaviour problems on the other hand.

Parenting behaviours and children's behaviour problems

As suggested by Blacher and colleagues (2013), differences in parenting behaviours could be related to differences in children's behaviour problems. The relationships between parenting behaviours and behaviour problems have not yet been investigated among autistic pre-schoolers and their parents specifically, but were explored in three broader age samples.

Boonen and colleagues (2014) found that, in a sample of autistic and non-autistic children aged six to 12 years, significantly more behaviour problems, both externalising and internalising, were reported in the autism group compared to the non-autism group. Externalising (but not internalising) behaviour problems were positively associated with self-reported disciplinary parenting behaviours in both groups. Externalising behaviour problems were also positively associated with self-reported positive parenting behaviours (e.g., showing affection, providing daily structure, rewarding) in the autism group, although the correlation was rather weak.

Shawler and Sullivan (2017) yielded similar results in a sample of autistic children aged three to 11 years, namely that harsh disciplinary parenting behaviours (e.g., displays of parental anger and irritability) were significantly – albeit weakly – related to children's behaviour problems. However, no significant association was found between permissive parenting behaviours (e.g., giving in to a tantrum, failing to enforce rules) and children's behaviour problems. Moreover, they found that the use of harsh disciplinary parenting behaviours, as reported by parents, mediated the link between parenting stress and behaviour problems. No mediation effect was found for permissive parenting behaviours.

A recent questionnaire study by Lindsey and colleagues (2020) among autistic children aged four to 10 years and their parents extends these findings. They found that poorer monitoring/supervision and higher levels of inconsistent discipline (the authors use the term "negative parenting") predicted children's externalising behaviour problems one year later, above parental distress, sex, and child's age. Warmth and involvement ("positive parenting"), on the other hand, did not predict children's behaviour problems one year later. However, the relationship between the "negative" parenting behaviours and children's behaviour problems needs to be interpreted with caution, since the interaction effect between autism characteristics and these "negative" parenting behaviours was also significant in the final model. This means that higher levels of "negative" parenting behaviours predicted more behaviour problems for children with less severe autism characteristics, but predicted fewer behaviour problems for children with more severe autism characteristics.

The present study

Pre-school age is challenging for any parent, and may be even more so for parents of a pre-schooler on the autism spectrum. Research shows that parents of autistic pre-schoolers report elevated parenting stress levels and more behaviour problems of the child compared to parents of non-autistic

pre-schoolers, which are both associated with parenting behaviours. However, parenting behaviours, parenting stress, and children's externalising behaviour problems have not yet been investigated together among autistic pre-schoolers and their mothers, comparing them to non-autistic pre-schoolers and their mothers.

Building on prior research, investigating parenting using a multimethod approach (Boonen et al., 2015, van Esch et al., 2018), the current study aimed to gain insight in parenting pre-schoolers on the autism spectrum. More specifically, we wanted to investigate whether parenting stress and externalising behaviour problems were similarly associated to observed and self-reported parenting behaviours among mothers of autistic and non-autistic pre-schoolers.

First, we explored parenting stress, children's autism characteristics, and children's externalising behaviour problems in our study sample. As a first step, we examined possible differences between a group of pre-schoolers diagnosed with autism and their mothers ("autism group"), and a group of pre-schoolers from a general population control group and their mothers ("non-autism group"). In line with previous findings, we expected higher levels of parenting stress, more autism characteristics, and more externalising behaviours in the autism group, compared with the non-autism group. In the next step, we explored the associations between these three variables. The only study that used a similar measure of parenting stress (i.e., scores on the Parent Domain of the Parenting Stress Index; Abidin, 1983) found that autism characteristics and not behaviour problems predicted parenting stress (Davis & Carter, 2008). However, most studies found stronger associations with children's behaviour problems (Estes et al., 2013; Hastings et al., 2005; Lecavalier et al., 2006; Lin et al., 2021; Peters-Scheffer et al., 2012). We therefore predicted positive associations between children's externalising behaviour problems and parenting stress and between children's autism characteristics and parenting stress. In line with previous findings (Jang et al., 2011; Lindsey et al., 2020), we expected a positive correlation between autism characteristics and behaviour problems.

Second, we compared self-reported and observed parenting behaviours between the autism group and the non-autism group. With regard to parenting behaviours, we hypothesised that mothers in the autism group would demonstrate similar responsive and sensitive parenting behaviours during observation (Blacher et al., 2013; Campbell et al., 2018), and more disciplinary and negative parenting behaviours) than mothers in the non-autism group (Blacher et al., 2013; Boonen et al., 2015). With regard to self-reported parenting behaviours, we expected similar results as Lambrechts and colleagues (2015), namely no differences in sensitive and responsive parenting behaviours, provision of rules and structure or indulging behaviours between the two groups, but fewer disciplinary behaviours and lower scores for Stimulation of the Child's Development in the autism group, compared with the non-autism group.

Third, we investigated how parenting stress and externalising behaviour problems were related to both self-reported and observed parenting behaviours, and whether this association differed between groups. Following Boonen and colleagues (2015), we expected that parenting stress would be associated

with self-reported disciplinary behaviours and observed negative parenting behaviours in the autism group, but not – or less strongly – in the non-autism group. Moreover, we hypothesised that externalising behaviour problems were positively associated with self-reported disciplinary behaviours (Boonen et al., 2015; Shawler & Sullivan, 2017) in both groups, and negatively with supervision behaviours (e.g., creating a safe environment, keeping an eye on my child when he or she is playing) in the autism group (Lindsey et al., 2020).

Methods

Participants

In total, 42 children participated together with their mother. Inclusion criteria were: chronological age between 24 and 60 months, (estimated) developmental age above 15 months, Dutch speaking, no sensory or motor issues that could hinder the testing, no known neurological or genetic problems. Demographic characteristics of the participants are shown in Table 1. The autism group consisted of 21 mothers of children between 32 months and 66 months old (M = 49.76 months, SD = 7.82 months), of which 18 were boys. All children had received a formal Autism Spectrum Disorder (ASD) diagnosis according to DSM-IV-TR criteria (American Psychiatric Association, 2000) by a multidisciplinary team, including a child psychiatrist or child neurologist, prior to the study. To confirm this diagnosis, the Autism Observation Schedule (ADOS; Lord et al., 2000) and the Diagnostic Interview for Social and Communication Disorders – version 11 (DISCO-11; Wing, 2006) were used. All children received a score above the classification threshold on at least one of the two instruments. Fifteen children received both an algorithm score above the cut-off for ASD on the ADOS (Module 1 or 2) and a classification of ASD on the ICD-10 algorithm of the DISCO-11. Four children only received a classification of ASD on the ICD-10 algorithm of the DISCO-11 and two children only on the ADOS.

The non-autism group consisted of 21 mothers of children without ASD. Children were between 26 and 47 months old (M = 39.57 months, SD = 6.68 months) and 18 were boys. They all had algorithm scores below the cut-off for ASD on the ADOS (Module 1 or 2) and no classification of ASD on the ICD-10 algorithm. The children in the non-autism group (n = 21) were selected from a larger control group (N = 47) of a previous study in our research group (Jansen et al., 2013), matched on developmental age and sex.

Procedure

The mothers of the autism group were contacted via the Autism Expertise Centre and the Centre for Developmental Disorders in Leuven, two special needs schools, and a home guidance service for families with a child on the autism spectrum. The mothers of the non-autism group were contacted via

eight regular schools and eight day care services. All parents of a child between two and six years old received a letter with information about the study and were asked if they were interested to participate. All mothers gave informed consent prior to the study. A researcher contacted them by telephone to arrange a date for the home visit and the questionnaires were sent by post. By the time of the home visit, the mothers had filled out the questionnaires. During the home visit, mother and child were observed in three different situations.

Table 1

Demographic and Other Characteristics of the Autism Group and Non-Autism Group

Child characteristics		**Autism (*n* = 21)**	**Non-Autism (*n* = 21)**	**Test statistic (*U*)**	***P***	**Effect size**
Chronological age (in months)	min.-max.	32–66	26–47	62.00	< .001	η^2 = .38
	Median	50	41			
Developmental age (in months)	min.-max.	12–81	24–62	199.50	.60	η^2 = .01
	Median	46	46			
Sex (%)	Female	3 (14.3)	3 (14.3)	220.50	1.00	η^2 < .001
	Male	18 (85.7)	18 (85.7)			
Autism characteristics	min.-max.	2-10	1–3	22.50	< .001	η^2 = .59
	Median	6	2			
Externalising behaviour problems	min.-max.	8–44	0–26	68.00	< .001	η^2 = .35
	Median	23	10			
Maternal characteristics		**Autism (*n* = 21)**	**Non-Autism (*n* = 18) [a]**	**Test statistic (*U*)**	***P***	**Effect size**
Age (in years)	min.-max.	25–45	27–40	198.50	.79	η^2 = .002
	Median	33.3	34.0			
		Autism (*n* = 21)	**Non-Autism (*n* = 21)**			
Parenting stress	min.-max.	19–53	13–36	56.50	< .001	η^2 = .41
	Median	29	17			

Note. Effect size of η^2 = .00 – .01: no effect; η^2 = .01 – .06: small effect; η^2 = .06 – .14: intermediate effect; η^2 = .14 – .20: large effect.

[a] Birth year was not available for three mothers.

The three play tasks were chosen to elicit a wide variety of parenting behaviours, as every play task brings out different parenting behaviours and children may be more comfortable during more or less structured tasks (see also Blacher et al., 2013). The instructions were given before the start of every task. Mothers were told that when the researchers would indicate the end of the task, they had to clean up together with their child. The observation was video recorded. The first situation aimed to elicit free

play, to gain insight in naturalistic parenting behaviours. Mother and child could choose one out of three bags with different play materials: a Duplo pet store; several little cars, a train, a plane and two little puppets; or music instruments. They were asked to play for 4 minutes like they usually do at home. In the second situation, they received a big bag with toys (two telephones, a doll, two plates, two cups, and two spoons, a peg puzzle, a tower with rings, two little trucks and a book) and were again asked to play for 4 minutes like they usually do at home. This situation aimed to elicit free play as well, but provided the mother-child dyad with a wide range of toys. In the third more structured situation, mother and child were asked to build a little house with Duplo similar to the example. This last task ended after 5 minutes or earlier when they were finished. During this situation, we wanted to elicit more directive parenting behaviours. Mothers were interviewed using the DISCO-11 (Wing, 2006), and an individual assessment took place at school, in the day care centre, at a home guidance service or at our research centre. Cognitive abilities of 39 out of 42 children were assessed by using the Snijders-Oomen Nonverbal Intelligence Test (SON-R 2½-7; Tellegen et al., 1998). This test consists of six subtests and provides insight into visual-spatial ability and abstract and concrete reasoning. The result can be expressed as an IQ score and a reference age can be calculated. For three children of the autism group, no SON-R scores were available. Their cognitive level was estimated by the Bayley Scales of Infant Development – Second Edition (BSID-II-NL; van der Meulen et al., 2002) or the Psychoeducational Profile-Revised (PEP-R; Schopler et al., 1990; Steerneman et al., 1997). Communication and social skills were assessed with the ADOS (Lord et al., 2000). This study was reviewed and approved by the Ethical Committee of the Faculty of Psychology and Educational Sciences of KU Leuven and carried out in accordance with the Declaration of Helsinki.

Materials

Observed parenting behaviours

We used the Parenting Rating Scale of Karreman and colleagues (2008, 2010), based upon McHale's Coparenting and Family Rating System (CFRS; McHale, 1995). Seven dimensions of maternal parenting were rated on a 7-point Likert scale: Warmth, Negativity, Investment, Limit-Setting, Sensitivity, Provision of Structure and Creativity. To measure Autonomy Support, the coding system of Whipple and colleagues (2011) was used. For a detailed description of the scales, see Boonen and colleagues (2015).

The first, middle and last minute of the three play situations were rated for each mother-child dyad, resulting in nine minutes of coded observation. All the video observations were rated by two coders and a mean score was calculated based on their ratings. The coders were trained using similar video observations and they had to reach exact agreement of 70% with the primary coder before they could start coding the actual observations. We calculated adjacent inter-agreement reliability between two coders based on the percentage agreement within one scale point, which ranged from .73

(Negativity) to .95 (Warmth) in the autism group, and from .77 (Limit-Setting) to .98 (Warmth) in the non-autism group.

The Negativity subscale is meant to detect subtle indications of negative parenting behaviour. A maximum score of 7 means that a parent is overtly hostile and critical, and is only focused on the shortcomings of the child; a score of 4 stands for a parent that criticises or ignores a child once; a minimum score of 1 means that no hostile or critical behaviours were observed. The maximum score given in this study was a 4 (both in the autism-group and non-autism group).

The dimension Limit-Setting could only be rated if the child showed disobedient behaviour, or behaviour that deviated from the task during the observation. Most children did not show this type of behaviour, so this dimension could only be rated for 11 mother-child dyads in the autism group and for six mothers in the non-autism group. This dimension is mentioned in the descriptive analyses, but excluded from the final analyses.

Self-reported parenting behaviours

The Parental Behavior Scale for Toddlers (PBS-T; Van Leeuwen et al., 2011; Van Leeuwen & Vermulst, 2004) was used to assess parenting behaviours. In line with a prior study (Lambrechts et al., 2015), behaviours specially relevant for parents of pre-schoolers on the autism spectrum were added, leading to a final 50-item questionnaire. Seven subscales refer to general parenting behaviour: Positive Parenting (n = 6; e.g., I play with my child), Autonomy Support (n = 4; e.g., I give my child the opportunity to try new things), Supervision and Safety (n = 6; e.g., I provide a safe environment for my child), Discipline (n = 5; e.g., When my child does something I do not like, I raise my voice), Rules and Structure (n = 3; e.g., I make sure my child's daily routine is the same day in, day out), Rewarding (n = 3; e.g., When my child masters doing something new, I applaud or say good boy/girl) and Indulging (n = 2; e.g. When my child wants something, I give in so he or she won't get cross or start to cry). Two subscales include items specifically relevant for parenting autistic children: Stimulating the Development (n = 13; e.g., When a person is crying, I explain to my child how this person is feeling and why) and Adapting the Environment (n = 8; e.g., When my child is doing an activity (e.g. drawing, reading a book, …), I restrict distraction to a minimum). Using a 5-point Likert scale, parents rate the frequency of their parenting behaviour towards the child that is participating in the study (1 = (almost) never, 2 = little, 3 = sometimes, 4 = often, and 5 = (almost) always). Internal consistency was measured in a larger sample (Lambrechts et al., 2015), and was acceptable or good for five of the subscales (ranging from α = .71 for the subscale Supervision and Safety to α = .81 for the subscale Rewarding; corrected item total correlations >.36). However, internal consistency of the subscale Discipline was rather poor, with Cronbach's alpha value of .57 (corrected item total correlations >.25). Pearson's correlation between the two items of the Indulging subscale was high (r = .48; p < .001).

Parenting stress

The Nijmegen Parental Stress Index – Short (NOSIK; de Brock et al., 1992), a shorter and translated version of the Parenting Stress Index (PSI; Abidin, 1983), was used to measure parenting stress. By means of a 6-point Likert scale ranging from 1 (totally disagree) to 6 (totally agree), parents rate their stress level on 25 items. The subdomain of Parent Related Stress includes 11 items, and 14 items refer to the subdomain of Child Related Stress. The NOSIK has shown good internal reliability with Cronbach's alpha's higher than .90 (de Brock et al., 1992; Boonen et al., 2015; Lambrechts et al., 2015). In the current study, the raw sum scores on the parent domain are used.

Autism characteristics

The Autism Diagnostic Observation Schedule, second edition, module 1 of 2 (ADOS; Gotham et al., 2007) was administered to all participants. The total severity scores were used to estimate autism characteristics.

Externalising behaviour problems

Children's emotional and behaviour problems were assessed with the Child Behaviour Checklist for children aged 1½-5 years (CBCL; Achenbach & Rescorla, 2001). Parents are asked to rate each of the 100 items for how true it is for their child, now or within the past two months, using the following scale: 0 = not true (as far as you know); 1 = somewhat or sometimes true; 2 = very true or often true of the child. The CBCL consists of seven empirically derived syndrome scales (Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn, Sleep Problems, Attention Problems, Aggressive Behaviour), and two broad problem scales (Internalising Behaviours, Externalising Behaviours). The internal consistencies of the Externalising Behaviours scale was $\alpha = .89$, as calculated for a large Flemish study sample (Braet et al., 2011). In the current study, raw sum scores were used.

Data analysis

To answer our first research question, group differences in parenting stress and externalising behaviour problems were investigated with Mann-Whitney *U* tests (Table 1), and Spearman correlations between parenting stress, externalising behaviour problems, and autism characteristics were calculated for the autism group and the non-autism group separately (Table 2), using IBM SPSS version 24. Due to non-normality of the data, non-parametric tests were used. To answer the second and third research questions, covariance pattern models (CPMs) were built in IBM SPSS version 24 (Table 4 and 5). The observed parenting dimensions, minus Limit-Setting, and the subscales of the self-report questionnaire were used as dependent variables. Group was dummy coded (0 for non-autism group, 1 for autism group) and included as a first covariate, to investigate group differences. Parenting stress was included as a second covariate, using within-group centred scores, since the mean maternal parenting stress score

differed significantly between the two groups. Externalising behaviour problems were entered as a third covariate, again using within-group centred scores, since the average scores in the autism group were significantly higher than in the non-autism group. Lastly, we included the interaction between parenting stress and externalising behaviour problems. For the observed parenting behaviours, task situation (3 levels; three different play situations) and minutes (3 levels; first, middle and last minute) were additionally included as fixed within-subject factors. No random effects were fitted in the CPMs.

Results

Parenting stress, children's autism characteristics, and children's externalising behaviour problems

Mann-Whitney *U* tests revealed significant differences in Parenting Stress ($U = 56.5$, $p < .01$, $\eta^2 = 0.42$), Externalising Behaviour Problems ($U = 68.0$, $p < .01$, $\eta^2 = 0.36$) and autism characteristics ($U = 22.5$, $p < .01$, $\eta^2 = 0.63$) between the autism group and the non-autism group (Table 1).

In the non-autism group, no significant associations were found between the variables (Table 2). In the autism group, Parenting Stress was positively and significantly associated with Externalising Behaviour Problems ($r_s = .45$, $p = .04$), but not with autism characteristics ($r_s = .20$, $p = .40$).

Table 2

Spearman Correlations between Parenting Stress, Externalising Behaviour Problems, and Autism Characteristics

	Parenting stress		Externalising behaviour problems	
	r_s	p	r_s	p
Autism group				
Externalising behaviour problems	.45	.04	/	/
Autism characteristics	.20	.40	.02	.95
Non-Autism group				
Externalising behaviour problems	.18	.44	/	/
Autism characteristics	.20	.38	-.24	.29

Observation of parenting behaviours

Mean scores of the observed parenting behaviours are presented in Table 3. To investigate the possible differences between mothers in the autism and the non-autism group, mean scores were compared between the two groups using CPM (Table 4). Mothers in the autism group received significantly lower scores on Sensitivity and higher scores on Negativity. Within-group centred Parenting Stress did not predict any of the observed parenting behaviours, and neither did the interaction

of Parenting Stress and group. Within-group centred Externalising Behaviour Problems significantly predicted Negativity, with more Externalising Behaviour Problems predicting more Negativity. The interaction between within-group centred Externalising Behaviour Problems and group was not significant, meaning that its predictive value was similar for both groups.

Self-reported parenting behaviours

Mean scores of the self-reported parenting behaviours are presented in Table 3. Table 5 presents the results of the CPMs conducted with the subscales of the PBS as dependent variables. Mothers in the autism group reported lower scores on Stimulation of the Development, compared with mothers in the non-autism group. Within-group centred Parenting Stress significantly predicted reported Autonomy Support, with higher levels of Parenting Stress predicting lower scores on Autonomy Support. The interaction between within-group centred Parenting Stress and group did not predict any of the self-reported parenting behaviours, so Parenting Stress predicted Autonomy Support similarly in both groups. Independently, within-group centred Externalising Behaviour Problems did not predict any of the parenting behaviours. However, the interaction with group significantly predicted Indulging, with more Externalising Behaviour Problems predicting less Indulging in the autism group but more Indulging in the non-autism group.

Table 3

Range and Mean Scores of Observed and Self-Reported Parenting Behaviours

	Autism group (*n* = 21)		**Non-Autism group (*n* = 21)**	
	Range	***Mean***	***Range***	***Mean***
Observed parenting behaviours				
Warmth	4.1 – 5.5	4.6 (0.4)	3.9 – 5.1	4.6 (0.3)
Negativity	1.1 – 2.1	1.5 (0.4)	1.0 – 2.2	1.2 (0.3)
Investment	4.2 – 5.3	4.8 (0.3)	3.9 – 5.1	4.7 (0.4)
Limit-Setting	2.0 – 6.0	4.3 (1.2)	2.3 – 6.3 [a]	4.7 (1.8) [a]
Sensitivity	3.8 – 5.8	4.9 (0.5)	4.7 – 5.8	5.3 (0.3)
Provision of Structure	4.3 – 6.0	5.3 (0.6)	4.7 – 6.0	5.6 (0.4)
Creativity	1.6 – 3.0	2.2 (0.4)	1.1 – 2.9	2.1 (0.6)
Autonomy Support	2.9 – 4.8	3.7 (0.5)	3.4 – 4.5	3.9 (0.3)
Self-reported parenting behaviours				
Positive Parenting	3 – 5	3.9 (0.5)	4 – 5	4.1 (0.3)
Autonomy Support	3 – 5	3.9 (0.4)	3 – 5	4.1 (0.4)
Supervision and Safety	3 – 5	4.3 (0.5)	3 – 5	4.2 (0.4)
Discipline	2 – 4	2.9 (0.6)	2 – 4	3.2 (0.4)
Rules and Structure	2 – 5	4.1 (0.8)	3 – 5	4.4 (0.6)
Rewarding	4 – 5	4.7 (0.4)	4 – 5	4.7 (0.4)
Indulging	2 – 4	2.9 (0.6)	2 – 4	2.6 (0.6)
Stimulating the Development	2 – 5	3.6 (0.6)	3 – 5	3.9 (0.5)
Adapting the Environment	3 – 5	3.5 (0.5)	3 – 5	3.7 (0.4)

[a] Only 6 out of 21 children from the control group received a score for Limit-Setting, and this subscale has thus been removed from further analyses.

Table 4

Unstandardised Parametres Estimates from Covariance Pattern Models for Predictors of Observed Parenting Behaviours

	Warmth	Negativity	Investment	Sensitivity	Provision of Structure	Creativity	Autonomy Support
Intercept	4.63**	1.15**	4.71**	5.27**	5.57**	2.03**	3.86**
Group	0.07	0.29**	0.12	-0.34**	-0.24	0.14	-0.11
Within-group centred Parenting stress	0.00	-0.01	-0.01	0.01	-0.01	-0.03	-0.00
Within-group centred Externalising behaviour problems	0.01	0.02**	0.01	-0.00	-0.00	0.02	-0.00
Group * Within-group centred Parenting stress	-0.02	-0.00	0.01	-0.02	-0.02	0.03	-0.02
Group * Within-group centred Externalising behaviour problems	-0.00	0.00	-0.01	0.01	0.00	-0.02	0.02

* $p < .05$, ** $p < .01$

Table 5

Unstandardised Parametres Estimates from Covariance Pattern Models for Predictors of Self-Reported Parenting Behaviours

	POS	AUT	SUP	DIS	RULES	REW	IND	STIM	ADAPT
Intercept	4.06**	4.10**	4.17**	3.18**	4.40**	4.67**	2.62**	3.90**	3.70**
Group	-0.20	-0.15	0.15	-0.28	-0.27	0.03	0.31°	-0.32*	-0.18
Within-group centred Parenting stress	-0.00	-0.03*	-0.01	-0.00	-0.00	-0.02	0.02	-0.03	-0.01
Within-group centred Externalising behaviour problems	0.01	-0.02	-0.00	0.00	-0.02	0.01	0.03	-0.02	0.01
Group * Within-group centred Parenting stress	0.01	0.03	0.01	0.02	-0.01	0.02	-0.02	0.02	0.01
Group * Within-group centred Externalising behaviour problems	-0.03	0.01	-0.00	0.01	0.01	-0.02	-0.08**	0.03	-0.00

* $p < .05$, ** $p < .01$, ° $p = 0.054$

Note. POS = Positive Parenting, AUT = Autonomy Support, SUP = Supervision and Safety, DIS = Discipline, RUL = Rules and Structure, REW = Rewarding, IND = Indulging, STIM = Stimulating the Development, ADAPT = Adapting the Environment

Discussion

Although pre-school age is thought to be challenging for parents in general and even more so for parents of a pre-schooler on the autism spectrum, very little research has focused on the relationships between parenting behaviours, parenting stress, and children's behaviour problems. This study aimed to fill this gap by investigating whether parenting stress and externalising behaviour problems were similarly associated to observed and self-reported parenting behaviours among mothers of autistic and non-autistic pre-schoolers.

Parenting stress, children's autism characteristics, and children's externalising behaviour problems

In line with previous findings, we found that mothers in the autism group reported significantly more parenting stress than mothers in the non-autism group (Tint & Weiss, 2016), and that pre-schoolers on the autism spectrum were reported to demonstrate more externalising behaviour problems than non-autistic pre-schoolers (Estes et al., 2013; Wilson et al., 2013). Moreover, our findings indicate that parenting stress is not significantly associated with children's autism characteristics, but rather with children's externalising behaviour problems, confirming previous studies (Estes et al., 2013; Hastings et al., 2005; Lecavalier et al., 2006; Lin et al., 2021; Peters-Scheffer et al., 2012) but contradicting others (Davis & Carter, 2008; Firth & Dryer, 2013; Lyons et al., 2010). Contrary to our hypothesis however, parenting stress was related to children's externalising behaviour problems only in the autism group and not in the non-autism group. One possible explanation could be that mothers in the non-autism group reported both low levels of parenting stress and externalising behaviour problems, and it might be that variations within the normal range are not experienced as very stressful by these mothers. In contrast with Jang and colleagues (2011) and Lindsey and colleagues (2020), we found no significant association between children's autism characteristics and externalising behaviour problems, suggesting that they are independent from one another.

Observed parenting behaviours

We found that mothers in the autism group received lower scores on the subscale Sensitivity and higher scores on the subscale Negativity over the three tasks, compared with mothers in the non-autism group. In the coding scheme of Karreman (2008, 2010), Sensitivity assesses the timing and quality of the mother's interventions with the child, and Negativity assesses the degree of the mother criticising or ignoring the child, and being annoyed during the session.

The lower scores on the Sensitivity subscale suggest that mothers of autistic pre-schoolers are more likely to have difficulties with timing and quality of play interventions, compared with mothers of

non-autistic pre-schoolers. This could be explained by the child's cues that may be more challenging to interpret for mothers in the autism group. As the autism diagnosis has been given only recently, mothers may still be figuring out how to read their child and how to respond adequately. Our results are in line with those of Boonen and colleagues (2015), who found that mothers of school-aged children on the autism spectrum received lower scores on Sensitivity, compared with mothers in the non-autism group. However, mothers of adolescents on the autism spectrum received *higher* scores on Sensitivity during interaction with their child than mothers from a general population control group (van Esch et al., 2018). Although these three studies investigated children at consecutive developmental stages (i.e., pre-schoolers, school-aged children, and adolescents), they have not followed the same groups of children and their parents, so no causal conclusions can be drawn from the results. It is possible that mothers' sensitive and responsive parenting behaviours have evolved over time, but longitudinal research is needed to test this hypothesis.

An important note needs to be made concerning the finding regarding the lower Sensitivity scores, that contrasts with previous research including pre-schoolers (Blacher et al., 2013; Campbell et al., 2018). While the coding scheme of Karreman (2008, 2010) includes a single Sensitivity subscale, the other two studies used composite scores: Blacher and colleagues (2013) used the composite Positive Parenting, which exists of Positive Affect, Sensitivity, Stimulation of Cognition, and Detachment-reverse coded, and Campbell and colleagues (2018) used a Sensitivity Composite score that was derived by adding the subscales Warmth and Sensitivity, and subtracting the subscale Intrusiveness. If we would have used a composite score in our study, combining the scores on the subscales Sensitivity and Warmth, we would probably not have found a difference between the two groups either, since mothers in the autism group did not differ from mothers in the non-autism group on the Warmth subscale.

Although the Negativity subscale does not assess reactive behaviours per se, the higher scores on the Negativity subscale could be explained by the child's behaviour during the observation. Externalising behaviour problems were not assessed during the play interaction, but we found that reported externalising behaviour problems were associated with observed Negativity in both groups. Moreover, the subscale Limit-Setting gives an indication of disobedient behaviour, since this scale assesses the extent to which the mother prevents the child from wandering away from an assigned task. As mentioned in the Methods section, this parenting behaviour could only be rated if a child displayed disobedient behaviour. Interestingly, this happened in 11 mother-child dyads in the autism group, compared with 6 dyads in the non-autism group. It could thus be the case that the higher Negativity score for mothers in the autism group reflects a higher number of situations that prompted a negative reaction, compared with the interactions in the non-autism group.

Self-reported parenting behaviours

Regarding the self-report questionnaires, there was only one significant difference between the two groups, namely that mothers in the autism group reported lower scores on Stimulating the Development than mothers in the non-autism group. This is in line with prior results in a larger sample of autistic and non-autistic pre-schoolers (Lambrechts et al., 2015). One possible explanation is that some items of the subscale Stimulating the Development may be less suited to young children on the autism spectrum, such as "When a person is crying, I explain to my child how this person is feeling and why", and "I stimulate pretend play." It could also be the case that mothers of an autistic child stimulate the development of their child in a different way than mothers of non-autistic children, for example stimulating other play forms than pretend play. The scores on this subscale thus reflect only some ways of stimulating the development, leaving others out. Another explanation could be that these mothers are experimenting with different ways to stimulate the development of their child, since the children have received the autism diagnosis only relatively recently.

We could not confirm the significantly lower scores on Discipline that Lambrechts and colleagues (2015) found in the autism group. As our sample existed of 42 children only, the power could have been too low to yield a significant difference.

Associations between parenting stress and parenting behaviours

We did not find consistent associations between parenting stress and parenting behaviours, contrary to our hypotheses. In both the autism and the non-autism group, more parenting stress only predicted less self-reported Autonomy Support. This contradicts the findings of Osborne and Reed (2010), although one could argue that Autonomy Support requires involvement and good communication, which is reflected in the items of the subscale (e.g., "I encourage my child to do or to try something by him/herself", "I encourage my child to make his/her own choices (e.g., to play with something)"). Nonetheless, our findings suggest that parents of pre-schoolers in this sample are able to cope with their elevated stress levels, so that their parenting behaviours remain mostly unaffected. However, we only investigated stress that is related to the parenting role, and should not necessarily expect the same results for general stress, depressive symptoms or anxiety.

Associations between children's externalising behaviour problems and parenting behaviours

Our hypotheses regarding the associations between externalising behaviour problems and observed parenting behaviours were partly confirmed, as we found only one significant association, that was similar for both groups: Mothers who reported more externalising behaviour problems displayed more Negativity during observation. With regard to self-reported parenting behaviours, we only found

that the interaction with group predicted self-reported Indulging. Mothers in the autism group who reported more externalising behaviour problems reported *less* indulging behaviour, whereas mothers in the non-autism group who reported more externalising behaviour problems reported *more* indulging behaviour. The results in the non-autism group are in line with our expectations, but the results in the autism group are less clear. A first explanation could be that mothers of an autistic pre-schooler attribute the behaviour problems to their child's autism, and therefore react with clear and predictable parenting behaviours, rather than giving in to their child. A second explanation could be that mothers of a child on the autism spectrum with co-occurring behaviour problems look for support from child services sooner than parents of children on the autism spectrum without co-occurring behaviour problems. In this way, they may get advice on how to best approach their child's difficulties.

Due to our cross-sectional research design, we could not replicate the findings of Lindsey and colleagues (2020) regarding the predictive value of inconsistent discipline, punishment and poor supervision in the relationship between parenting behaviours and externalising behaviour problems. However, we did find that externalising behaviour problems were associated with observed Negativity (cfr. supra, "the degree of the mother's criticising, ignoring the child, and being annoyed"), in both the autism and the non-autism group. Further longitudinal research could provide more insight into the relationships between parenting behaviours and externalising behaviour problems over time in the context of autism.

Strengths

This study has several strengths. To our knowledge, observational measures and self-report questionnaires were combined to investigate parenting behaviours among mothers of pre-schoolers on the autism spectrum for the first time. The observation of mother-child interaction consisted of three different tasks that varied in the amount of structure that was provided, which allowed for a more nuanced assessment of parenting behaviours. This nuance was reflected in our choice for covariance pattern models to analyse our data, since this method takes the intra-individual differences in parenting behaviours (i.e., all three minutes of all three observational tasks were included in the models) into account by adjusting for the covariance structure. Although we have tried to create natural circumstances during mother-child play by filming at the family's home, more naturalistic observations could add to the understanding of parenting behaviours in families of a child with autism. A second strength of this study is the non-autism group, that was matched on gender and developmental age, instead of chronological age. As a result, differences in parenting behaviours could not be attributed to differences in levels of development. However, this also means that parents of the autism group have more experience being parents. Finally, to advance the understanding of parenting among parents of an autistic child, we included measures of parenting stress and externalising behaviour problems in our analyses to avoid conclusions based solely on a comparison between young autistic and non-autistic children.

Limitations

A first limitation of this study is the small sample size. We are aware of the precautions that should be made when working with a small sample, and have thus chosen our analytic methods accordingly, relying on non-parametric tests for correlational analyses and comparisons between the two groups. However, a larger sample size might have given us more opportunities to observe disobedient child behaviour and parental limit-setting in more mother-child dyads, and the chance to include the scale Limit-Setting in our analyses. Moreover, the inclusion of children that show elevated levels of externalising behaviour problems could have given us additional insight into the relationships between children's behaviour problems and parenting behaviours and parenting stress. Secondly, we included only measures of the mother's behaviours during interaction with their child, which makes it impossible to investigate bidirectional relationships. To investigate bidirectionality, measures of the child's behaviour should be included and behaviours should (additionally) be micro-coded to allow for the analysis of temporal associations. Thirdly, we have not included measures of other parent and child characteristics, such as parental autism characteristics or children's temperament, in our study, although these factors could have influenced parenting stress levels or parenting behaviours. A fourth limitation is that the interrater reliability for Negativity was not very high. This demonstrates the difficulty of the interpretation and assessment of parenting behaviours, especially of critical parenting behaviours. Moreover, the coding scheme was not developed for use with children on the autism spectrum and may thus not be suited to capture "negative" parenting behaviours in this population. This is the case for more coding schemes used in autism research. Blacher and colleagues (2013) namely noted that in their coding scheme, there was no "differentiation between appropriate direction and unnecessary intrusion" (p. 771). Future research should investigate this differentiation further. A fifth, and often mentioned, limitation of our study is the exclusive focus on mothers. Despite all emancipating efforts, mothers are often the primary caregivers and spend more time with their children, work part-time, and fill out questionnaires more often than fathers do. This might be a valid reason not to include fathers in this study, since data collection would most probably require more resources and effort when fathers are required to participate as well, but we, as researchers, should definitely investigate ways in which fathers can be included in parenting studies.

Implications

This study has implications for both research and clinical practice. First, our findings regarding the association between negative parenting behaviours, such as criticising and ignoring the child, and externalising behaviour problems underline the need for concurrent measures of parent and child behaviours to explore how parent and child react to one another during interaction, and suggest that the assessment of parenting behaviours during observation may need further fine-tuning. For example,

parents receive higher scores on the Negativity subscale when they ignore their child, when they criticise their child, or when they are visibly annoyed. These behaviours could be independent of the child's behaviour and be characteristic for the parent, but they are more likely reactions to the child's behaviour. Second, the relationships between parenting stress, children's behaviour problems, and parenting behaviours that we have found suggest that an individualised approach is needed when choosing an early intervention. Numerous types of early intervention exist in clinical practice, but the heterogeneity that exists in the autistic population is reflected in the treatment outcomes (for a review, see Vivanti et al., 2014). Consequently, the authors state that "the critical issue (…) is not as much a lack of evidence-based treatments, but rather an inability to predict which treatment will work best for each child" (Vivanti et al., 2014, p. 6). Interventions can target parental emotions, provide knowledge, focus on stimulation of a child's development or management of additional behaviour problems, and individual families may need different combinations. Assessing the strengths and needs of families with a pre-schooler on the autism spectrum and choosing interventions accordingly thus seems crucial in supporting families throughout this critical age period.

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General discussion

The main aim of this dissertation was to paint a picture of parenting in the context of (emerging) autism, in all its colours and complexity. We investigated both action-oriented (parent and child behaviours) and meaning-oriented (parenting stress, maternal well-being) parenting components, using observations of mother-child interactions and self-report questionnaires. Although the separate studies cannot be directly compared, they all show us something about young children and their mothers, within an autism context. Together, they teach us how colourful parenting in the context of (emerging) autism is, but also how complex the study of parenting can be. In this discussion, I will describe our main research findings, provide conceptual and methodological reflections, propose recommendations for future scientific research, and discuss implications for clinical practice.

Main research findings

Five research aims were addressed within this doctoral dissertation. First, we aimed to study how parenting has been conceptualised in observational measures that are used to assess parent-child interactions among children with or at EL of autism (**Chapter 1**). Second, we wanted to develop a coding scheme that would allow for a detailed investigation of parenting behaviours during parent-child interaction among parents of young children at EL of autism (**Chapter 2**). Third, we aimed to investigate the development of both action- and meaning-oriented parenting components, and explore possible differences between two EL groups (i.e., siblings and preterms), and between autistic and non-autistic pre-schoolers (**Chapters 3, 4, 5**). As per the bidirectional nature of parenting and the broader (dyadic) context in which parenting takes place, our fourth aim was to explore how child factors, such as temperament, externalising behaviour problems, and autism characteristics were associated with the different parenting components (**Chapters 3 and 5**). Finally, we aimed to explore relationships between the action- and meaning-oriented components of parenting, i.e., whether maternal parenting stress and well-being were related to parenting behaviours (**Chapters 4 and 5**).

A conceptualisation of parenting in observational research

We conducted a systematic review to investigate which parenting constructs have generally been included in observational research among parents of children below the age of four with or at EL of autism (**Chapter 1**). Through a comprehensive consensus decision-making process, we categorised 63 parenting constructs into seven overarching parenting categories: Warmth, Responsiveness, Scaffolding, Proactive Control, Intrusiveness, Negativity, and Dyadic. Two additional categories were formed to categorise parenting constructs that did not fit into any category ("Other") or into multiple categories ("Multiple"). Conclusions were drawn both at the methodological and conceptual level.

At the methodological level, we found large heterogeneity in observational measures, and hence, in parenting constructs, in line with previous studies (Bohr et al. 2018; Ku et al. 2019; Wan et al. 2019). This heterogeneity could be explained by the different research foci of the studies included in this review, and by the fact that researchers often develop their own observational measure to suit their particular interest or for practical reasons. Second, we found that descriptions of parenting constructs lacked uniformity, and strikingly, that sometimes descriptions were not provided in the manuscript at all. Since research findings are used to develop and test theories and to design interventions, future studies should define their parenting constructs clearly and carefully and report this information in a standardised way (for recommendations, see Uzonyi et al., 2023).

At the conceptual level, we found that it was possible to create seven overarching categories of parenting behaviours using a bottom-up approach, suggesting that some common core concepts of parenting behaviour exist in observational research in the context of autism. These seven categories are more specific than those used by Ku and colleagues (2019) in their top-down approach (i.e., warmth/support, behavioural control, negativity, neutral), indicating that a bottom-up approach may yield a more nuanced perspective. Taraban and Shaw (2018) however described that parenting constructs are generally categorised into *two* broad dimensions: positive and negative. 'Positive parenting' includes warmth, sensitivity, limit-setting, appropriate scaffolding, and contingency-based reinforcement, while 'negative parenting' refers to parenting behaviours that are inconsistent, overreactive, controlling, and harsh. It is not yet clear whether this dichotomy found in general parenting research, using both observations and questionnaires, also applies to parenting in an autism context.

A closer look at parenting behaviour constructs: Development of the CoPIT

In this pilot study, we developed and tested the Coding of Parenting Infants and Toddlers (CoPIT) among 10-month-old infants and their mothers, who participated in the TIARA study (**Chapter 2**). The CoPIT is a coding scheme with a broad range of specific parenting behaviours, based on the findings of our systematic review, parenting constructs assessed with a parental self-report questionnaire (Van Leeuwen et al., 2015; Van Leeuwen et al., 2011), and the Parent-Infant/Toddler Coding of Interaction (PInTCI; Pijl et al., 2016) coding scheme. The CoPIT includes seven parenting behaviour constructs, divided in 14 scales: Warmth (Affective behaviour, Supportive Presence), Responsivity (Sensitivity, Following Child's Lead, Appropriateness), Scaffolding (Technical Scaffolding, Motivational Scaffolding), Proactive Control (Structure, Limit-setting), Directivity (Direction of Behaviour, Direction of Interaction), Reactive Control (Discipline), and Intrusiveness (Overstimulation, Intrusiveness).

We wanted to explore if assessing multiple specific behaviours in a neutral way (i.e., fewer/more, instead of adaptive/maladaptive) could provide insight into the dichotomy in parenting dimensions that is generally found in parenting research (i.e., positive vs. negative, 'warmth/support'

vs. ‘control/directivity’) in light of emerging autism. We were especially interested in parenting behaviours often viewed as ‘negative’ in the general population, such as a parent directing the play interaction, and hypothesised that these behaviours could have a different meaning in the context of early autism. Van keer and colleagues (2017) for example found that more demonstration of directive behaviours during play interaction was associated with more observed encouragement of sensorimotor and cognitive achievement and more self-reported autonomy support among mothers of children with significant cognitive and motor developmental delay. Moreover, Blacher and colleagues (2013) noted that in their coding scheme, there was no differentiation between appropriate direction and unnecessary intrusion.

As per the applicability and usability of the CoPIT, we found that interrater agreement ranged from good to excellent, and that range and variance were sufficiently large for 10 out of 14 scales. We also found significant associations between most – but not all – theoretically similar constructs within the CoPIT and between the CoPIT and the PInTCI. Correlational analyses suggested that an overarching ‘warmth/support’ dimension exists, including warm, sensitive, responsive, non-directive, and motivational behaviours. We did not find evidence for a ‘control/directivity’ dimension, but we could not fully investigate this hypothesis, due to the limited range and variance of the scales that measured limit-setting, disciplinary, intrusive, and overstimulatory parenting behaviours. This also meant that we could not investigate associations between the Proactive Control subscales Structure and Limit-setting of the CoPIT. Most mothers namely demonstrated few structuring and no limit-setting behaviours, likely related to their children’s young age and the free play nature of the situation.

Further inspection of directive and controlling behaviours is needed to investigate when these behaviours are neutral, intrusive, or supportive for young children with or at EL of autism. A first step would be to elicit these behaviours intentionally during the assessment. This could be done by observing parents and children in a more challenging situation than the free play scenario, for example by asking parent and child to perform a task that is too difficult for a child of a given age (e.g., shape sorter, making a puzzle). It may also be useful to include a slightly older sample, as studies have indicated that mothers of older (autistic) children demonstrated more proactive behaviours during interaction (Madarevic et al., 2022; Oosterling et al., 2010). In a second step, associations could be investigated between directive and controlling parenting behaviours on the one hand, and child outcomes on the other hand.

Structure seems a useful scale for longitudinal follow-up studies, as structuring behaviours were already observed in this pilot study (although at this young age related to maternal positive affect and not to any other subscale) and would likely be observed more often as children grow older.

The development of parenting: Infants, toddlers, pre-schoolers

Chapter 3 described a two-wave study, in which 89 siblings and 58 preterms participated with their mothers. Mother-child interactions were observed during free play at five and 10 months of child's (corrected) age, and interactive behaviours were coded with the PInTCI by a team of trained Master's students that were blind to EL status. Linear mixed models (LMMs) and, where appropriate, generalised linear mixed models (GLMMs) with logit link function, were fitted to investigate differences between five and 10 months and between (mothers of) siblings and preterms.

Regarding the development of interactive behaviours, we found that the odds of demonstrating negative affect were higher at 10 than at five months for the EL sample as a whole, contrary to previous findings (Pijl et al., 2021). Unfortunately, we could not investigate whether mothers also demonstrated more controlling behaviours at 10 months, as the subscale (Absence of) Negative Control was not reliably coded. No change was observed in any of the other child behaviours, while Pijl and colleagues (2021) found an increase in positive affect between five and 10 months. Regarding maternal interactive behaviours, we found that mothers generally demonstrated fewer sensitive and responsive behaviours (e.g., comforting the child, labelling feelings, or responding to their child's requests) at 10 months compared to five months of child's age, while they tended to demonstrate more scaffolding behaviours (e.g., labelling of objects, give hints to complete a task) at 10 months. Mother-child interactions did not differ between siblings and preterms. Our findings regarding maternal behaviours are both consistent and inconsistent with findings among EL and TL siblings (Pijl et al., 2021) and among preterms and full-terms (Stack et al., 2019), which is not surprising given our mixed EL sample. We found a similar increase in scaffolding as Pijl and colleagues (2021), in contrast with a decrease found by Stack and colleagues (2019). However, we found a similar decrease in sensitive and responsive behaviours as Stack and colleagues (2019), while Pijl and colleagues (2021) observed an increase.

Our findings suggest that mother-child interactions do not differ between (mothers of) preterms and siblings during the first year of life. Further steps could include an exploration of change in mother-child interactions throughout toddlerhood, and complementing between-group comparisons with a person-centred approach, such as the identification of parent-child interaction clusters.

Chapter 4 presented a three-wave longitudinal study on self-reported parenting behaviours and maternal well-being. Mothers of 81 siblings and 40 preterms were followed between 10 and 24 months of child's (corrected) age. LMMs were fitted to investigate change in parenting behaviours and well-being over time. Mothers from both EL groups reported more disciplinary behaviours over the course of the study, in line with findings from the general population (Van Leeuwen et al., 2015; Verhoeven et al., 2007; Vittrup et al., 2006). The only group difference in self-reported parenting behaviours that we found was in Warmth/Support (e.g., doing play activities, showing affection, being responsive to their child's needs). Mothers of preterms reported an increase in warm and supportive behaviours, while mothers of siblings reported no change. Our findings suggest more similarities than differences between

mothers of siblings and preterms, and between mothers of EL children and those from the general population. Further longitudinal research should investigate if and when differences in parenting behaviours and well-being emerge between mothers of siblings and preterms, or between mothers of EL children that did and did not develop autism, and what drives them, taking into account that individual trajectories may differ between mothers within EL groups.

Chapter 5 described findings of a cross-sectional multi-method study conducted among 21 pre-schoolers with ("autism group") and 21 without ("non-autism group") autism (aged 26 to 66 months) and their mothers. Data had been collected by fellow researchers in the context of their doctoral project, prior to the start of this doctoral project, but had never been fully analysed or published in a peer-reviewed journal. Mother-child interactions were observed at the family home in three different tasks: (a) free play with a small set of toys, (b) free play with a wide range of toys, (c) structured play task: building a Duplo house. We used the Parenting Rating Scale of Karreman and colleagues (2008, 2010), based upon McHale's Coparenting and Family Rating System (CFRS; McHale, 1995). Seven parenting dimensions were rated on a 7-point Likert scale: Warmth, Negativity, Investment, Limit-Setting, Sensitivity, Provision of Structure and Creativity. To measure Autonomy Support, the coding system of Whipple and colleagues (2011) was used. In addition, parenting behaviours and parenting stress were assessed with self-report questionnaires. Covariance Pattern Models (CPMs) were fitted to investigate whether the associations between the study variables differed between the autism and non-autism group.

We found more similarities than differences in parenting behaviours between the two groups. Mothers of autistic pre-schoolers demonstrated more Negativity and less Sensitivity during observation, compared to mothers of non-autistic pre-schoolers. These findings are in line with those of Boonen and colleagues (2015), who found that mothers of school-aged children on the autism spectrum received lower scores on Sensitivity, compared with mothers of non-autistic children. However, mothers of adolescents on the autism spectrum received *higher* scores on Sensitivity during interaction with their child than mothers from a general population control group (van Esch et al., 2018). Mother of autistic pre-schoolers also reported lower scores for the autism-specific subscale Stimulation of the Development than mothers of non-autistic pre-schoolers, in line with prior results in a larger sample of autistic and non-autistic pre-schoolers (Lambrechts et al., 2015). We could not confirm the significantly lower scores on Discipline that Lambrechts and colleagues (2015) had found in the autism group. The differences in observed parenting behaviours could be explained by additional behaviour problems in the autism group, as mothers of autistic pre-schoolers reported more externalising behaviour problems than mothers of non-autistic pre-schoolers. The group difference in reported Stimulation of the Development could be related to the content of some of the items, that may be less applicable to mothers and children from the autism group.

Future research should further investigate the nature of 'negative' behaviours, i.e. the "differentiation between appropriate direction and unnecessary intrusion" (Blacher et al., 2013, p. 771), as our coding scheme was not developed for use with children on the autism spectrum and may thus not

be suited to capture "negative" parenting behaviours in this population. Moreover, qualitative research could help us understand parents' cognitions behind the observed behaviours.

Associations between child factors and parenting components

Temperament could be a relevant transdiagnostic construct for understanding heterogeneity in autism. Several studies already investigated child temperament among infants at EL of autism (see reviews of Mallise et al., 2020 and Chetcuti et al., 2021), but not in relation to parenting behaviours. In **Chapter 3**, we investigated if child temperament (Surgency, Negative Affectivity, and Orienting/Regulation) was associated with mother-child interactions among five and 10-month-old infants at EL of autism. As hypothesised, we observed change in child temperament during the first year of life for both EL groups. Mothers of siblings and preterms reported more Surgency and Negative Affectivity, and less Orienting/Regulation at 10 months, compared to five months. Mothers of preterms reported more Surgency behaviours than mothers of siblings, especially at five months, providing some preliminary evidence for the value of temperament as transdiagnostic construct. Overall, it seems that children in our EL sample follow temperament trajectories that are most similar to those found in the general Flemish population (Van Cauwenberghe et al., 2012), except for the decrease in Orienting/Regulation that was found among EL siblings that later developed autism (Paterson et al., 2019; Pijl et al., 2019) and the general Flemish population (Van Cauwenberghe et al., 2012). However, methodological differences between studies make it difficult to compare findings, as studies differed in child's age at assessment waves and analytical approach (e.g., model choice and inclusion of covariates, such as child sex or cognitive ability and maternal age or educational level).

Contrary to previous findings (Feldman et al., 1997; Mills-Koonce et al., 2007; Vaccaro et al., 2019), higher levels of child Negative Affectivity were not associated with lower levels of observed maternal sensitive and responsive behaviours. This could be related to the generally high educational level of mothers in our sample, as associations between child Negative Affect and supportive parenting behaviours were more apparent for lower socio-economic status (SES) than higher SES samples (Paulussen-Hoogeboom et al., 2007). Moreover, the lack of associations between Surgency and Orienting/Regulation on the one hand and mother-child interactions on the other hand was also found among preterm and full-term infants (Vaccaro et al., 2019).

Future longitudinal studies should investigate temperament and parent-child interactions across infancy and toddlerhood, as change in temperament may go in a different direction during the second year of life. Moreover, between-group comparisons should be complemented by more person-centred approaches, such as the identification of temperament or parent-child interactions clusters, to increase our understanding of heterogeneity in autism.

In **Chapter 5**, associations were investigated between child externalising behaviour problems and autism characteristics on the one hand, and parenting behaviours and parenting stress on the other

hand, among pre-schoolers with and without autism. Maternal reports of their children's externalising behaviours were used, while autism characteristics were estimated with the total severity scores of the Autism Diagnostic Observation Schedule, second edition. Mothers reported on their parenting behaviours and parenting stress with self-report questionnaires.

In line with previous findings, mothers in the autism group reported significantly more parenting stress than mothers in the non-autism group (Tint & Weiss, 2016), and pre-schoolers on the autism spectrum were reported to demonstrate more externalising behaviour problems than non-autistic pre-schoolers (Estes et al., 2013; Wilson et al., 2013). In the autism group, externalising behaviour problems were significantly and positively correlated to maternal parenting stress, but children's autism characteristics were not, in line with previous work (Estes et al., 2013; Hastings et al., 2005; Lecavalier et al., 2006; Lin et al., 2021; Peters-Scheffer et al., 2012). However, other studies found evidence for a relationship between parenting stress and autism characteristics (Davis & Carter, 2008; Firth & Dryer, 2013; Lyons et al., 2010), likely due to differences in measures. For example, we operationalised autism characteristics as the ADOS total severity scores, while Davis and Carter (2008) additionally used the Social Relatedness index of the ITSEA, a parent-report scale, and only found a significant association with this index and not with the ADOS domains. For our sample as a whole, more child externalising behaviour problems were associated with more negative behaviours of mothers during the play interaction. Moreover, more child externalising behaviour problems were related to fewer reported indulging behaviours in the autism group, but to more indulging in the non-autism group.

Our findings indicate that additional externalising behaviours can, at least partly, explain the group differences in parenting stress and maternal negative parenting behaviours that were found between mothers of autistic and non-autistic children.

Relationships between parenting-related feelings and parenting behaviours

Chapter 4 reported on the associations between maternal well-being and parenting behaviours between 10 and 24 months of child's age. Given the importance of responsive parenting behaviours, it is crucial to understand the factors that could increase a parent's ability to carry out the parenting role in a sensitive and responsive manner, especially for those parents whose well-being is challenged. Well-being was defined as a subjective concept in itself, distinguishing it from mental health, in line with recent studies among parents of autistic pre-schoolers and school-aged children (Cai et al, 2020; Green et al., 2021; Salomone et al., 2018). Subjective psychological well-being includes a positive mood, vitality, and general interest (Topp et al., 2015). As such, it also differs from parenting stress, which indicates stress regarding the parenting role.

Exploration of the well-being trajectories indicated no group differences in initial well-being or change over time. Compared to women from the general Flemish population (European Quality of Life Survey, 2003-2016), mothers of siblings reported lower well-being at all three waves, but mothers of

preterms at the first wave only. However, mothers from both EL groups reported an increase in well-being between 10 and 24 months, indicating change toward the mean well-being score of women from the general population. Previous research among mothers of autistic and non-autistic pre-schoolers and school-aged children found significant associations between well-being or parenting stress and reported parenting behaviours (Boonen et al., 2015; Likhitweerawong et al., 2020; Madarevic et al., 2022; Osborne & Reed, 2010), but maternal well-being was not associated with any of the reported parenting behaviours in this study. Our findings could indicate that well-being is not related to parenting behaviours in the same way as parenting stress or mental health, or, alternatively, be explained by methodological differences between studies (such as children's age). Further longitudinal research should investigate if and when differences in parenting behaviours and well-being emerge between mothers of siblings and preterms, or between children that later do and do not develop autism, and what drives them, taking into account that individual trajectories may differ between mothers. Moreover, associations between well-being, mental health and parenting stress need to be investigated to shed more light on the concept of well-being. Finally, the relationship between well-being and observed mother-child interaction needs to be explored to confirm the lack of associations between well-being and parenting behaviours.

In **Chapter 5**, we studied the associations between parenting stress and reported and observed parenting behaviours among mothers of autistic and non-autistic pre-schoolers. In line with previous findings, mothers in the autism group reported significantly more parenting stress than mothers in the non-autism group (Tint & Weiss, 2016). However, parenting stress was significantly associated with maternal reports of children's externalising behaviour problems, but not with observed autism characteristics. While we found no significant associations between maternal *well-being* and reported parenting behaviours (Chapter 4), we found that higher levels of maternal *parenting stress* were associated with lower scores for self-reported autonomy support for mothers of autistic and non-autistic pre-schoolers alike, but not with any of the other reported or observed parenting behaviours. However, this was not what we had hypothesised. We namely expected that parenting stress would be associated with self-reported disciplinary behaviours and observed negative parenting behaviours in the autism group, but not – or less strongly – in the non-autism group, in line with Boonen and colleagues (2015). The lack of significant associations could be (partly) explained by the different ages of the samples (pre-schoolers vs. school-aged children) and the different methodologies (CPMs vs. Pearson correlations).

Our findings underline the need for concurrent measures of parent and child behaviours to explore how parent and child react to one another during interaction, and suggest that the assessment of parenting behaviours during observation may need further fine-tuning. For example, parents receive higher scores on the Negativity subscale when they ignore their child, when they criticise their child, or when they are visibly annoyed. These behaviours could be independent of the child's behaviour and be characteristic for the parent, but they are more likely reactions to the child's behaviour. Moreover, the relationships between parenting stress, children's behaviour problems, and parenting behaviours that we

have found suggest that an individualised approach is needed when choosing an early intervention. Numerous types of early intervention exist in clinical practice, but the heterogeneity that exists in the autistic population is reflected in the treatment outcomes (for a review, see Vivanti et al., 2014). Consequently, the authors state that "the critical issue (…) is not as much a lack of evidence-based treatments, but rather an inability to predict which treatment will work best for each child" (Vivanti et al., 2014, p. 6). Assessing the strengths and needs of families with a pre-schooler on the autism spectrum and choosing interventions accordingly thus seems crucial in supporting families throughout this critical age period.

Conceptual and methodological reflections

In all its colours

In this doctoral project, I investigated differences between (mothers of) siblings and preterms, and between (mothers of) pre-schoolers with and without autism. In this section, I will summarise what these between-group comparisons have taught us about parenting in the context of (emerging) autism, and explain why and how we should move in a different direction to capture parenting in all its colours.

Between-group comparisons: a first sketch

Across the studies conducted within this doctoral project, we mainly found similarities between (mothers of) siblings and preterms. Regarding the action-oriented component of parenting (i.e., parent and child behaviours), the only difference we found regarded the rate of change in reported warm and supportive parenting behaviours. As we had not included a control group of TL children and their mothers, we could not directly compare our findings to those from general population studies. However, viewing our findings in light of previous studies suggests that parenting in the context of emerging autism is quite similar to parenting in the general population. Gutman and Feinstein (2010) namely found a similar increase in reported supportive and interactive parenting behaviours as in our preterm group, while stability over time was in line with two other population studies (Van Leeuwen et al., 2015; Verhoeven et al., 2007). Moreover, the increase in disciplinary behaviours that we observed in both groups indicates that children at EL of autism follow a typical developmental path towards more autonomy (Van Leeuwen et al., 2015; Verhoeven et al., 2007; Verhoeven, 2019; Vittrup et al., 2006). In addition, a recent study that used the same coding scheme to investigate mother-child interactions found no differences between (mothers of) EL and TL siblings, except for child initiations at 10 months, with EL siblings making fewer and less clear initiations (Pijl et al., 2021). While previous observational studies found that mothers of EL siblings were more directive than mothers of TL siblings (Harker et al., 2016; Wan et al., 2012; Wan et al., 2013), this was not confirmed in the study of Pijl and colleagues (2021). Differences between studies could be explained by sample characteristics (e.g., children's age, country) or methodological differences (e.g., coding schemes, data-analysis). Regarding the meaning-

oriented component of parenting (i.e., maternal well-being), we found no differences between mothers of siblings and preterms in their initial scores or change over time. However, comparing their well-being scores to those of women from the general Flemish population revealed consistently lower well-being levels in the sibling group, and in the preterm group at 10 months. This could be due to sample characteristics, but also to the COVID-19 pandemic that may have had a larger impact on mothers of siblings than on mothers of preterms or women in the general population. This aligns with findings among parents of autistic toddlers, as they reported well-being scores significantly below the population norm (Green et al., 2021). These (relatively) low well-being levels were not associated with any of the parenting behaviours under study, which could suggest that there is no relationship between these two factors, or that mothers of EL infants that participated in our study were quite resilient.

The group comparisons between mothers of autistic and non-autistic pre-schoolers also yielded more similarities than differences. Regarding these differences, it seems that autism is not the differentiating factor. Mothers of autistic pre-schoolers namely reported more externalising behaviour problems, and more behaviour problems were associated with more criticising or ignoring of the child across both groups. Externalising behaviours problems did not only explain group differences in parenting behaviours, but also in parenting stress. Consistent with previous research, mothers from the autism group reported more parenting stress than mothers from the non-autism group (e.g., Tint & Weiss, 2016). However, parenting stress was unrelated to children's observed autism characteristics, while it was positively and significantly associated with mothers' reports of children's externalising behaviour problems.[5] Our findings suggest that externalising behaviour problems may function as *transdiagnostic* factor, i.e., independent of any conventional clinical diagnostic category.

Within-group clusters: in search of colour harmony

Although between-group comparisons have provided a first sketch of parenting in the context of (emerging) autism, group comparisons are based on one important assumption: that variation *between* groups is greater than *within* groups. As described above, siblings and preterms have only one thing in common: an increased chance of developing autism (probably with a different origin for both groups). This assumption is likely not valid, and hence, we should look for *individual differences* that could help us understand heterogeneity in emerging autism. Moreover, we should not simply investigate individual colours, but colour *combinations* that can be experienced as more or less harmonious.

A first set of individual differences has already been mentioned above. Our pre-schoolers study namely demonstrated that an autism diagnosis (the distinguishing factor) alone may not explain group differences in parenting and interactive behaviours, and that externalising behaviour problems (a transdiagnostic factor) may provide a better insight in the dynamics between mother and child.

[5] Although our findings align with those of several previous studies (Estes et al., 2013; Hastings et al., 2005; Lecavalier et al., 2006; Lin et al., 2021; Peters-Scheffer et al., 2012), they contradict others (Davis & Carter, 2008; Firth & Dryer, 2013; Lyons et al., 2010). See also the discussion of our main findings.

Temperament may be another relevant transdiagnostic construct for understanding heterogeneity in emerging autism, as it is generally believed that temperament manifests itself from infancy onward, has a strong genetic or neurobiological basis, and is relatively consistent across situations and time (Rothbart, 2012). Moreover, temperament was found to predict challenging behaviours in autistic pre-schoolers (Korbut et al., 2020). In our study on temperament and mother-child interactions, we found that preterms received higher Surgency scores from their mothers compared to siblings, a difference that was mainly situated at the age of five months. However, differences in temperament may not (only) exist between (sub)groups, but (also) within a group of children at elevated likelihood of autism.

Two alternatives for group-based comparisons were described by Astle and colleagues (2021) in the context of transdiagnostic approaches to neurodevelopmental disorders: dimensional and clustering methods. A dimensional approach focuses on overlapping continuities of characteristics, that likely result from a common underlying latent construct. Clustering methods, on the contrary, group individuals based on particular characteristics. They reveal the different colour *shades*, to stay in theme. Chetcuti and colleagues (2020, 2022) took this latter approach in characterising temperament subgroups *within* a group of infants who showed early signs of autism. Children did not form a homogenous sample, but could be categorised as 'inhibited/low positive', 'active/negative reactive', and 'sociable/well-regulated' at 12, 18, and 24 months, with an additional 'reactive/regulated' subgroup at 24 months. Moreover, they found that these subgroup classifications were relatively consistent, and that temperament subgroups were differently associated with internalising and externalising behaviour problems and with autism characteristics. In a similar way, we could try to find clusters of parenting behaviours or parent-child interactions among children at EL of autism and their parents. Previous studies have, for example, identified parenting style groups based on parent-reported warmth/support, behavioural control, and psychological control in samples of school-aged children from the Flemish (Kuppens & Ceulemans, 2019) and Finnish (Mikkonen et al., 2022) general population.

Investigating temperament or parenting behaviour clusters seems a promising method for the study of heterogeneity in autism, as these clusters could be differently associated with children's behaviour problems and autism characteristics, or with parenting stress, parenting competence, and parental well-being. However, we may need to explore clusters in which *both action- and meaning-oriented parenting aspects* come together to paint a proper parenting picture. The recent study of Greenlee and colleagues (2023) may be especially relevant in this respect, as they identified profiles of parenting experience, based on parenting style, parenting stress, and parenting competence, among parents of autistic children. As described in more detail in the General Introduction, they found that mothers could be grouped according to three different profiles, and fathers to four. These profiles were differently associated with children's externalising and internalising behaviour problems, with children of mothers classified as adaptive (high authoritative parenting, lowest stress, and highest competence) or fathers classified as adaptive or average (sample average of all parenting indicators) demonstrating the fewest behaviour problems and autism characteristics. Apart from demonstrating heterogeneity

among parents of autistic children, this study showed once again how parenting behaviours, feelings and cognitions are interrelated, and how they are entangled with children's behaviour problems and autism characteristics.

Greenlee and colleagues' (2023) approach however excluded other parent and child factors that have previously been found to be associated with action- and meaning-oriented parenting components, such as child temperament, externalising behaviour problems or interactive behaviours, parental temperament or personality, or the social context. A possible cluster could consist of a child temperament factor or cluster (e.g., negative affectivity, active/negative reactive cluster), a parenting behaviour factor or cluster (e.g., responsiveness, authoritarian style), and parenting stress. As many combinations would be possible, further scientific research is needed to define meaningful and feasible key characteristics that, clustered together, may help clinicians to identify those parents in need of intervention and to provide tailored support. It is however important to acknowledge that not all parents need support. For example, if a child demonstrates challenging behaviour or difficult temperament, but parents do not experience this as extremely stressful or they feel competent in handling the situation, and combine this with responsive and consistent parenting behaviours, a family may not be needing intervention. On the contrary, when parents experience high levels of parenting stress, do not feel competent, and/or use maladaptive parenting strategies, the family could benefit from a tailored intervention.

In order to investigate possible clusters, the individual components need to be assessed first. As assessments of parenting behaviours, parenting stress or well-being, child externalising behaviour problems or temperament, and parental self-efficacy are used to draw conclusions about family dynamics, both in research and clinical practice, it is of utmost importance that they are reliable and valid. In the next section, I will describe the complexity of assessing the action-oriented component of parenting, i.e., parenting and interactive behaviours, as this was central to my doctoral project.

In all its complexity

Parenting and interactive behaviours can be assessed in many different ways, for example with observations, questionnaires, interviews, and experience sampling methods. In this doctoral project, we used observations of parent-child interactions and administered (self-report) questionnaires. While observation "provide[s] a window on real processes and outcomes of interests" (Aspland & Gardner, 2003, p. 136) as they happen in front of the assessor, self-reports can be used to obtain additional information about parenting in a great variety of circumstances outside the laboratory setting. The two methods should thus be viewed as complementary.

As already mentioned in the General Introduction, observations of parent-child interactions are assumed to be representative for interactions outside the research setting (Aspland & Gardner, 2003). Researchers and clinicians should therefore make well-considered choices regarding the observational

measure that they use, based on their study questions, reliability and validity, and feasibility (Aspland & Gardner, 2003; Bohr et al., 2018; Lotzin et al., 2015). Similarly, researchers and clinicians should consider the validity of parental self-reports (Morsbach & Prinz, 2006).

In the following, I will describe these considerations and discuss how they guided our choices for this doctoral project. I will focus on the complexity of assessing the action-oriented component of parenting in scientific research, and will discuss implications for clinical practice at the end of the General Discussion.

Choosing and using a parental self-report questionnaire

Self-reports in general and parental reports *of their own parenting behaviours* in particular, are vulnerable to bias. In their review, Morsbach and Prinz (2006) described three elements that may endanger the validity of parenting behaviour self-reports. First, parents often need to make estimates of behaviours over a longer period of time, which may decrease the accuracy of their response. Second, no consensus may exist in the general population about the definition and interpretation of parenting behaviours that are assessed. Third, parenting is a very sensitive topic, and parents may respond in a socially desirable way or may feel that some items are offensive. As the outcomes of parenting behaviour questionnaires are used to guide decision-making of researchers and clinicians, they need to be reliable and valid. To increase validity, Morsbach and Prinz (2006) recommend using questionnaires (to reduce socially desirable responses given during interviews) with clear and unambiguous questions, and of which internal consistency and convergent validity have been demonstrated. Ideally, multiple informants or methods should be used to assess parenting behaviours.

In this doctoral project, we used the Parental Behavior Scale for Toddlers (PBS-T; Van Leeuwen et al., 2011), an adaptation of the Ghent Parental Behaviour Scale (GPS; Van Leeuwen & Vermulst, 2004). This self-report questionnaire includes a wide range of parenting behaviours that are crucial for child development, was easily accessible, has shown acceptable to good internal consistency for most scales, and the same seven scales could be used across toddlerhood. Moreover, investigation of the French version of the GPS indicated low and nonsignificant correlations with social desirability in a study that used anonymous reports (Meunier & Roskam, 2007). The PBS-T has already been used in Flemish general population studies (Van Leeuwen et al., 2015; Van Leeuwen et al., 2011) and among mothers of autistic pre-schoolers (Lambrechts et al., 2015). In this doctoral project, reports were pseudonymised, which should decrease social desirability of parents' responses.

Although descriptive statistics of the parenting behaviour subscales in Chapters 4 and 5 seemed comparable to those in general population studies using the same (Van Leeuwen et al., 2015; Van Leeuwen et al., 2011), or a different questionnaire (Verhoeven et al., 2017), we noticed several floor and ceiling effects. When most scores are clustered around the lower (disciplinary behaviours) or upper end (supervisory behaviours or social rewarding) of the scale, this likely limits the detection of significant effects in small to medium samples. Future research may want to consider ways in which a

greater variety in responses can be generated. This could for example be done with enhanced items, that include preambles with supportive statements about behaviours that could be viewed as nonnormative (Catania et al., in: Morsbach & Prinz, 2006), or by contrasting direct and indirect methods of asking about (harsh) disciplinary behaviours (DiFranceisco et al., in: Morsbach & Prinz, 2006). Applied to the PBS-T, an item about disciplinary behaviours could be reformulated in two ways: (a) it could include a statement about parents being rougher than usual towards their children ("Parents differ in their way of dealing with challenging behaviours from their children. Some parents report to raise their voice, others are more rough with their children") before the question is asked, (b) it could first ask about the frequency of parents reacting to challenging behaviours, and then have them estimate the percentage of the time they were rougher than usual towards their child.

Choosing and using a coding scheme for observation of parent-child interactions

As stated above, parental self-reports and observation of parent-child interactions are complementary methods. When the choice for observation has been made, a coding scheme needs to be selected. A first step in choosing a coding scheme is to define target behaviours, in order to answer your study questions (Aspland & Gardner, 2003; Lotzin et al., 2015). In this doctoral project, we aimed to characterise parenting behaviours among children with or at EL of autism, in line with previous work from our research group (e.g., Boonen et al., 2015; van Esch et al., 2018). However, this project was also part of the TIARA study, a multi-site longitudinal study that aims to identify and understand the factors that play a role in the early development of autism (www.tiara-onderzoek.be). Within the TIARA study, parenting and interactive behaviours were part of the work package that investigated the predictive value of a child's proximal environment to the development of autism. Hence, we had to strike a balance between the aims of the TIARA study and this doctoral project, which had implications for the selection of a coding scheme. As per the aims of the TIARA study, we chose the Parent-Infant/Toddler Coding of Interaction (PInTCI; Pijl et al., 2016) as coding scheme. To gain an in-depth understanding of parenting behaviours among mothers of children at EL of autism, we additionally developed the Coding Parenting of Infants and Toddlers (CoPIT; Chapter 2). We were especially interested in parenting behaviours often viewed as 'negative' in the general population, such as a parent directing the play interaction, and hypothesised that these behaviours could have a different meaning in the context of early autism. As not much additional variance was captured with the CoPIT and we did not have the time and resources for its further development within this doctoral project, we however discarded it as possible coding scheme.

If multiple coding schemes seem appropriate, a second step is choosing a coding scheme that has been shown to be reliable and valid (Lotzin et al., 2015). Reliability assesses if an instrument is consistent in its measurement, while validity indicates the extent to which the instrument is measuring what it is supposed to measure (Aspland & Gardner, 2003). Unfortunately, reliability and validity of observational measures are not always reported in manuscripts (Lotzin et al., 2015; Uzonyi et al., 2023).

The PInTCI had already been used in a comparable prospective longitudinal study, and had shown good to excellent interrater reliability for almost all scales (Pijl et al., 2021). Except for the preliminary evidence of its convergent validity (Chapter 2), only unpublished indications of validity were available. As the PInTCI includes constructs that were previously found to be predictive for subsequent child development, this could however indicate predictive validity. For the TIARA study and this doctoral project, we tried to increase ecological validity and minimise reactivity of our participants[6] in several ways: (a) observation of mother-child interaction was often assessed at the end of the visit, when parents were habituated to the research setting, (b) the researchers were not present during the play interaction, (c) we used non-invasive surveillance cameras to record the interaction, (d) we included another task (reading a book) before the first 'target' task. Reliability of the PInTCI was established through intensive training by or under supervision of one the developers (Prof. Dr. Petra Warreyn).

A final consideration concerns the feasibility of the coding scheme. Feasibility includes the availability of a coding manual, accessibility of training, required time and resources for training, observation, and coding, and the extent to which the coding scheme is used by others and findings can be compared (Lotzin et al., 2015). The PInTCI has been co-developed by one of the co-investigators of the TIARA study, Prof. Dr. Petra Warreyn, which facilitated training in and use of this coding scheme. Moreover, we could count on a great number of raters, as new Master's students joined us every year as part of their Master's thesis projects. However, not everyone was equally skilled in the coding of parent-child interaction videos, and videos from one rater needed to be recoded in a second wave. Finally, we could learn from a previous study with the PInTCI (Pijl et al., 2021), and use a similar strategy to analyse our data.

This last advantage brings me to an important consideration that has not yet been mentioned: all the time and effort put into the coding of the videos or the administration of parenting questionnaires need to generate reliable and valid data that can be properly analysed to answer research questions that may guide future research or clinical practice.

Analysing parenting data

Within the TIARA study, infants at EL of autism have been followed up over the course of 2,5 years, with observation of mother-child interactions taking place at all assessment waves and administration of parenting self-report questionnaires at four out of five waves. The generated data have a hierarchical or multilevel structure, as they include repeated measures of the same mother-child dyad. Hence, to investigate the predictive value of parenting and interactive behaviours, to assess group differences between (mothers of) siblings and preterms, or to explore change over time, appropriate analytic techniques should be used.

[6] Reactivity refers to the phenomenon whereby the process of being observed affects participants' behaviours, which may negatively affect the generalisability of the findings (Aspland & Gardner, 2003).

Linear mixed models (LMMs), or growth curves fit within a multilevel modelling framework, are a rather intuitive and feasible way of analysing multilevel data, especially to investigate inter-individual variability in intra-individual change over time (for a comprehensive Q&A, see Curran et al., 2010; for the disaggregation of within- and between-person effects, see Curran & Bauer, 2011). Hence, we wanted to fit LMMs to analyse our parenting data, including random intercepts and random slopes if possible (Chapters 3 and 4).

LMMs however assume a continuous dependent outcome (i.e., interval scale), while macro-level coding schemes (including the PInTCI) often use Likert scale ratings (i.e., ordinal scale) and have integers as outcomes. Parenting questionnaires fall between these options, as they generally use Likert scale ratings for each item, but average items to create a parenting subscale. It is still very common that outcomes measured with an ordinal scale are analysed with linear models, although this approach assumes that the data contain more information than they actually do, and may thus be over-confident (Christensen, 2015). If there are many answer categories (e.g., a 9-point Likert scale) and the ordinal outcome has a relatively normal distribution (i.e., no tendency towards one end of the scale), linear models may be rather sensitive (Christensen, 2015). Although exploration of the dependent variable provides important information about the appropriateness of a data analysis method, one can only know for sure after running the model and carefully checking its assumptions. This is however not routinely nor correctly done in clinical psychology research practice (for a review, see Ernst & Albers, 2017).

We did not encounter many problems in our analysis of reported parenting behaviours (Chapter 4), as the outcome measures included parenting behaviour subscales that were created by averaging item scores. However, our assumption checks showed a violation of the linearity assumption for several models in our study on temperament and mother-child interactions (Chapter 3), and we needed to find an alternative. As not all scores were given (e.g., no scores of 2 on a scale from 1 to 7) or equally given, ordinal logistic regression was no option. We therefore decided to recode the scales child Initiations and child and maternal Negative Affect into binary outcome variables and use generalised linear mixed models with logit link function instead.

While analysis of the generated data is often the last step of a study, it is unquestionably linked to the sample size, the structure of the data, and the methods that were used to investigate parenting and interactive behaviours. Hence, methods need to be selected with data analysis in mind. If researchers plan to collect longitudinal parenting data and want to separate within- from between-person effects of one or more predictors, they need multilevel techniques and a large sample to yield adequate power and be able to also detect small effects. LMMs offer an intuitive approach to analysing hierarchical data, but in this case, researchers may want to consider using parenting behaviour composites (i.e., averaging the scores of several behaviours/subscales) or subscales (i.e., scales calculated by averaging several item scores). Multivariate ordinal regression could be an alternative for the analysis of multilevel ordinal data (e.g., Hirk et al., 2020), although this may require more expertise, and the interpretation of the results

may be less straightforward. It would therefore be good practice to include a statistician in the planning and throughout a project.

Strengths and limitations

For the first time, action- and meaning-oriented parenting components and the role of child temperament were directly compared between (mothers of) siblings and preterms, providing insights into heterogeneity in emerging autism. Moreover, we followed these two groups of children at EL of autism over the course of infancy and toddlerhood (i.e., from five to 24 months), allowing us to investigate the development of parenting and interactive behaviours, maternal well-being, and child temperament. We also included a study on parenting among mothers of autistic and non-autistic pre-schoolers (aged 32-66 and 26-47 months, respectively), using similar or the same instruments, which enabled us to view the bigger picture of parenting in the context of autism.

A second major strength of this doctoral project is our comprehensive approach to the study of parenting in the context of (emerging) autism, from reviewing parenting behaviour constructs in observational studies, over the development of a coding scheme, to an investigation of parenting among infants, toddlers, and pre-schoolers and their mothers using both observation and maternal self-reports. Different methods and different samples complemented each other, showing how colourful parenting is, but also how complex it can be to study.

A third strength includes the rigour with which we have analysed our data and the fact that we have made our work openly available. As I have become increasingly aware of the importance of Open Science during this doctoral project, I have tried to implement its principles (e.g., scientific rigour, transparency, open access to data, code, and manuscripts) within my own limits and those of the TIARA study. For example, I pre-registered our last two studies (Chapter 3 and 4) on Open Science Framework, and published all manuscripts (except for our pilot study, Chapter 2) as pre-prints on PsyArXiv or Open Science Framework. Regarding data analysis, I consistently checked and reported the assumptions for all models, and shared the code that I have written for the studies described in Chapters 3 and 4.

The limitations of the individual studies have already been addressed in the corresponding chapters. I would however like to briefly touch on our focus on (biological) mothers, and our decision to exclude parenting cognitions, beliefs, and attitudes from our investigation of parenting.

We deliberately chose to focus on *mother*-child interactions, *maternal* parenting behaviours, *maternal* well-being, and *maternal* parenting stress, as the TIARA study was rather time-consuming for participating families and we expected a higher response rate from mothers than fathers. As explained above, multilevel analyses require a large sample and as many repeated observations as possible, and we expected that mothers would be more inclined to have or make time for the lab visits and self-report questionnaires over the course of 2,5 years. In Belgium, where the TIARA study has been conducted, it is namely more common for women than men to work parttime, especially when they have children

(Nautet & Piton, 2021). Although our approach is in line with the majority of parent-child interaction studies in the context of emerging autism, it excludes fathers and co-mothers[7], limiting the generalisability of our findings. Fathers have increasingly been included in parenting research, and both similarities and differences have been found at the group level (Taraban & Shaw, 2018). In the context of parenting and autism, a recent study found that mothers generally reported more and better positive coping than fathers, but similar levels of parenting stress and perceived social support (Grebe et al., 2022). Using a person-centred approach, Greenlee and colleagues (2023) also found much overlap between parenting experiences of mothers and fathers, but they found that twice as many fathers were characterised as distressed (high levels of parenting stress, low sense of competence) compared with mothers. The authors suggest that "focusing on sample means has been 'hiding' significant variability in parenting distress for fathers in particular" (Greenlee et al., 2023, p. 10). However, they still characterised clusters for mothers and fathers separately, again assuming more between-group than within-group variation. More research is needed to investigate whether this is actually the case.

Another limitation of this doctoral project is that we did not investigate meaning-oriented parenting components such as cognitions, beliefs, and attitudes, or contextual factors such as social support or relationship conflict, that were previously found to be associated with parenting behaviours and parenting stress (e.g., Greenlee et al., 2023; Greenlee et al., 2021; Kuhn & Carter, 2006; Meirsschaut et al., 2010; Taraban & Shaw, 2018). We deliberately made this choice due to time constraints, although it could have shed more light on the meaning of the parenting and interactive behaviours that we have observed during our research. An interview study including parents of children participating in the TIARA study already lifts a tip of the veil (Vanaken et al., 2023). All interviewed parents felt that an autism diagnosis would allow (or already allowed[8]) them to do things differently as a parent. They shared how they expected to attune their parenting behaviours towards their child to accommodate its needs, for example by providing more predictability and structure or using strategies that may prevent meltdowns. Moreover, parents from the sibling group also described how an autism diagnosis of the older sibling(s) decreased their feelings of guilt and increased their perception of parental competency.

Recommendations for scientific research

This doctoral dissertation contributes to a better understanding of parenting in the context of (emerging) autism, by comparing (sub)groups of children with or at EL of autism and their mothers. Several future directions have been proposed in the individual chapters and the General Discussion, both for researchers and clinicians. In this section, I provide a (non-exhaustive) list of recommendations for (a) the TIARA study specifically, and (b) (longitudinal) parenting research in the context of (emerging)

[7] We included biological mothers, regardless of their partner's gender or sex.
[8] Parents of children participating in the sibling group had one or more autistic children, allowing them to reflect on what it meant for their parenting experiences when their child was diagnosed with autism.

autism in general. These recommendations result both from our direct findings and from my reflections on these findings.

TIARA study

1. Extend the work presented in this dissertation

My first recommendation for the TIARA study is to extend our findings regarding the development of parenting by including the subsequent assessment waves in the analyses and using LMMs. As per the limited sample size, it may not be possible to include multiple predictors and interactions between them, and also separate within-person from between-person effects. My suggestion would thus be to investigate whether change in parenting or interactive behaviours is associated with a best-estimate research diagnosis of autism (at 36 months), child temperament, or parenting stress. I would also be interested in the associations between parental well-being and parenting stress, and whether these trajectories could be predicted by child temperament, externalising behaviour problems, or autism characteristics. Similarly, it could be investigated how child temperament and externalising behaviour problems develop over time, and whether this change can be predicted by EL group, best-estimate research diagnosis of autism, or parental temperament. It would be very interesting to investigate bidirectional effects, for example of child temperament on parent-child interaction, but these models (such as dynamic structural equation modelling, see Asparouhov et al., 2018), are only suitable for analysing *intensive* longitudinal data, i.e., including *many* individuals measured at *many* points in time. Finally, I would compare parenting and interactive behaviours during free play and a structured task, as we hypothesised that challenging tasks would elicit more directive behaviours from parents.

2. Complement between-group comparisons with within-group clusters

At the start of this doctoral project, our idea was to compare groups of (mothers of) siblings and preterms. However, as we and the field developed, we gained new insights about future directions of parenting research in autism. Hence, a second recommendation, both for the TIARA study and other prospective longitudinal studies, is that between-group comparisons should be complemented by a person-centred approach, i.e., by identifying clusters within a broader EL group. For example, temperament clusters, externalising behaviour problem clusters, or parenting behaviour clusters could be identified, independent of EL group. This can be done per assessment wave, for example with latent profile analysis (Chetcuti et al., 2020, Chetcuti et al., 2022), but also per trajectory, using longitudinal cluster analysis based on participants' intercepts and slopes (Den Teuling et al., 2021). Clusters can be compared based on their associations with child, parent, and parenting factors. In addition, it would be worth investigating clusters in which multiple aspects come together, as was recently done by Greenlee and colleagues (2023). For example, clusters could consist of (a) a child temperament factor or cluster (e.g., negative affectivity, active/negative reactive cluster) or externalising behaviour problems, (b) a

parenting behaviour factor or cluster (e.g., responsiveness, authoritarian style), and (c) parenting stress or well-being.

3. Investigate what parenting behaviours mean in the context of (emerging) autism

As mentioned earlier, we need a better understanding of what directive parenting means in the context of (emerging) autism. Some observational studies found that mothers of children at EL of autism were more directive during interaction than mothers of TL children (Harker et al., 2016; Wan et al., 2012; Wan et al., 2013), while others found no differences (Pijl et al., 2021). Directive parenting behaviours, with parents leading the interaction, are generally viewed as 'negative parenting' in the general population, but it is not yet clear whether this also applies to parenting young children with or at EL of autism. Coding schemes that are commonly used may not be so helpful either, as they often do not "differentiat[e] between appropriate direction and unnecessary intrusion" (Blacher et al., 2013, p. 771). An exploration of proactive (structuring, limit-setting), reactive (criticising, disciplinary), and intrusive parenting behaviours, and their associations with child externalising behaviour problems, autism characteristics, and/or social-communicative development is therefore needed.

(Longitudinal) Parenting research in the context of (emerging) autism

1. Consider your methods and report them in detail

A first recommendation to parenting researchers is to make well-considered choices regarding the assessment of parenting behaviours and parent-child interactions, based on the study questions, reliability and validity of available measures, and feasibility. In addition, and I am repeating after Uzonyi and colleagues (2023), researchers should report information about the reliability and validity of their methods in detail to guide other researchers in their selection of a coding scheme or questionnaire. This transparency also resonates with the philosophy of Open Science, and would best be complemented by sharing methods openly and freely.

2. Hire a statistician and a data manager

A second recommendation is to get a statistician and data manager on board from early on, preferably when planning a (longitudinal prospective follow-up) study. As described above, methods need to be selected with data analysis in mind, and data analysis depends on the structure of the data and the sample size. A statistician could provide the Principal Investigators with advice on the feasibility of the proposed project, and the doctoral students with support during their data analysis. Moreover, longitudinal studies yield large quantities of data that need to be managed well to facilitate analysis.

3. Investigate meaning-oriented parenting components

It has become clear from this doctoral dissertation that parenting stress, mental health, and quality of life have already received quite some research attention in the context of autism, but that we do not know much about parenting goals, beliefs, competence, and self-efficacy among parents of young children with or at EL of autism (except for Greenlee et al., 2023; O'Nions et al., 2021). However, investigation of these parenting components could help explain differences in parenting that have been found and suggest ways to adequately support families.

4. Combine quantitative with qualitative research to add colours

In line with the previous recommendation, qualitative methods could be used to gain a better understanding of what it means to parent a young child with or at EL of autism, extending previous work in this area. Meirsschaut and colleagues (2010) for example interviewed parents about the impact of an autism diagnosis on family and personal life, and combined this with a quantitative investigation of parenting cognitions. In addition, videos of parent-child interactions could be viewed together with parents, as a starting point for a conversation about their specific parenting strategies or goals. Interviews with parents could explore what makes parenting challenging in some situations, what makes parents feel more or less competent, and how they cope with difficult parenting situations. This could help explain relationships between child externalising behaviour problems or temperament, parenting or interactive behaviours, parenting stress, and feelings of parenting competence.

5. Complement global ratings with micro-analytic approaches to study bidirectionality in parent-child interactions

Micro-analytic approaches can be used to study bidirectional relationships between parent and child behaviours within the dyadic interaction. Bodner and colleagues (2018) described a three-step sequential analysis approach, in which the frequency, the co-occurrence, and the temporal dependency of the behaviours for both interaction partners are consecutively charted. This could be a valid alternative for longitudinal bidirectional analysis, for which samples are generally not large enough.

6. Increase sample size, or repeated measures

Large samples are needed for the analysis of multilevel data, as collected in longitudinal follow-up studies. Researchers could increase their sample size by designing less loaded study protocols or performing home visits. Alternatively, they could increase their repeated measures. In case of observations, multiple ratings per observation could be obtained by coding the first, middle, and last minute of one or more tasks, as was done in our pre-schoolers study (Chapter 5). Ideally, large projects would make their data FAIR (i.e., findable, accessible, interoperable, reusable), so that datasets could be merged to yield a larger sample size. A good example is the Eurosibs consortium, that has a core

protocol of which data can be pooled, and that strives towards a higher quality of scientific reporting (Jones et al., 2019).

7. Do a case study

As it may not be feasible to investigate action- *and* meaning-oriented parenting components quantitatively *and* qualitatively over longer periods of time in a large sample of parents, case studies could be an alternative. Following one child and its family could provide valuable insights into the development of dynamics between parent(s) and child factors.

Implications for clinical practice

Although this doctoral project was conducted in a scientific context, our findings and those of previous studies that are discussed in this dissertation may also have implications for clinical practice. Some of the implications mentioned in this section may be familiar to some clinicians or in some settings, but are no common ground in clinical practice in general.

A first implication regards the support offered to parents of young children with or at EL of autism. Our findings and previous research has shown that variation exists among children with or at EL of autism and their parents in terms of the development of autism characteristics (Kim et al., 2018; Lord et al., 2012), child temperament (Chapter 3; Chetcuti et al., 2020; Chetcuti et al., 2022), parenting behaviours (Chapters 4 and 5), and parenting experiences (Greenlee et al., 2023). This means that not all families may need the same type of support at the same time in their lives. As per this heterogeneity in (emerging) autism, offering pre-emptive interventions (i.e., interventions that address early autism symptoms before a full diagnosis can be established) to all children at EL of autism (for a review, see Hampton et al., 2022) could be questioned. An alternative approach could be to focus on the optimalisation of social interactions (e.g., between child and parents, and between child and kindergarten or school) for *all* children, and to provide easy and timely access to specialised support services to families when needed. Although primary care services are fairly accessible for young children and their parents in Flanders, Belgium, children and their parents face long waiting lists when they need clinical diagnostics or specific or long-term support, rendering it more difficult to timely intervene.

A second implication of the work conducted in this doctoral project concerns the observation of parent-child interactions. Observation is regularly used to assess parenting in a clinical setting, next to interviews, and the administration of parental self-report questionnaires. However, this dissertation underscores that both researchers and clinicians should base their choice for an observational measure on their research questions, and the validity and reliability of a coding scheme. This implies that clinicians should reflect on the behaviours that they want to observe beforehand, departing from a specific theoretical framework, instead of being guided by what stands out during observation. For

example, they could ask themselves whether they want to observe sensitive and responsive behaviours of a parent, or want to gain insights in how parents manage challenging behaviours of their child. According to the research questions, they could opt for a free play situation or a structured task, eliciting the behaviours of interest.

Finally, this dissertation demonstrated that parenting-related behaviours, feelings, beliefs, and goals are entangled, and associated with child and parent characteristics, providing many different starting points for tailored interventions. For example, interventions could include learning more adaptive parenting strategies, coping with parenting stress, improving parental sense of competence, working on the partner relationship, and broadening the social network of parents. The workbook for parents of autistic children that was developed in our research group could be a helpful tool, as it addresses parenting behaviours, feelings, and cognitions and provides information on autism and parenting, quotes from other parents, and assignments for parents (Peeters et al., 2018). Parents can use this workbook to reflect on their own situation, and/or to discuss experiences with care providers or other parents. This last point, exchanging experiences with other parents, has not been discussed in detail in this dissertation, although it was found that social support was related to higher parental self-efficacy and well-being (Feng et al., 2022). However, the EPANEMA project will work on designing an emancipatory group-based intervention programme, that could boost a family's network while empowering parents at the same time (Vanaken, 2023). This seems a promising way to acknowledge that parenting in the context of (emerging) autism is colourful *and* complex for parents, researchers, but also for clinicians.

Conclusions

- Mainly similarities between (mothers of) siblings and preterms, and more similarities than differences in parenting between (mothers of) autistic and non-autistic pre-schoolers
- Diversity in child temperament in the first year of life and in externalising behaviour problems during pre-school age support the claim that these may be relevant transdiagnostic constructs
- Child temperament, maternal well-being, and maternal parenting stress were generally not associated with observed and reported parenting behaviours
- Future studies should complement between-group comparisons with a person-centred approach, for example by identifying within-group clusters that combine different parenting components
- Researchers and clinicians should make well-considered choices regarding the measures that they use, based on study questions, reliability and validity of measures, and feasibility
- Meaning-oriented parenting components need to be further investigated to fully acknowledge the colours and complexity of parenting in the context of (emerging) autism

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