Recognizing Disability and Ability in Young Autistic Children

ELISABETH NILSSON JOBS
Abstract

Autism Spectrum Disorder (ASD) is characterized by impairments, or disabilities, in social communication and interaction (SCI), and restricted and repetitive behaviors (RRBs), but is also associated with enhanced abilities. Early identification of disability in ASD has been a primary focus in clinical practice, while abilities associated with ASD have neither been recognized nor assessed. The overarching purpose of this thesis was to improve early recognition of both disability and ability in young autistic children. Three studies were conducted in a largely overlapping sample of 3-year-old high-risk-for-ASD siblings, either with or without ASD, and low-risk-for-ASD siblings. Study I and II focused on the value of preschool staff as informants in early identification of autistic symptoms, while Study III investigated potential strengths in visual ability in autistic children. Study I investigated how accurately parents and preschool staff rated autistic symptoms in relation to diagnoses and clinical assessment of autistic symptoms. Results showed that ratings by preschool staff were more accurate than parent ratings at differentiating the ASD group from the two other groups, and more closely associated with clinical autistic symptoms. Study II focused on preschool staff’s ratings of social communication and interaction (SCI) and restricted and repetitive behaviors (RRBs). Results showed that ratings of SCI were more accurate than RRBs in differentiating the ASD group from the two other groups, and only the SCI ratings correlated with clinical assessment of social impairment. Study III investigated specific aspects of visual ability with five visual tasks. Similar performance on visual ability was found among groups, except for the Hidden Pictures (HP) task. The children with ASD had superior performance on HP compared with the other two groups. Results of Study I and II suggest that preschool staff report on autistic symptoms may complement parent report in diagnostic assessment of ASD, although their report on RRBs should be interpreted with caution. The results of Study III indicate that enhanced visual ability can be identified in autistic children already at age three. Overall, this thesis suggests that information from preschool staff and assessment of visual ability can contribute to the early recognition of disability and ability in young children with ASD.

Keywords: Autism Spectrum Disorder; Early Development; CBCL 1.5 - C-TRF; SRS-2; Preschool Informants; Visual Ability; Local-Global Research; Autistic Empowerment

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“IT WAS MORNING, AND THE NEW SUN SPARKLED GOLD across the ripples of a gentle sea. A mile from shore a fishing boat chummed the water, and the word for Breakfast Flock flashed through the air, till a crowd of a thousand seagulls came to dodge and fight for bits of food. It was another busy day beginning. But way off alone, out by himself beyond boat and shore, Jonathan Livingston Seagull was practising. A hundred feet in the sky he lowered his webbed feet, lifted his beak, and strained to hold a painful hard twisting curve through his wings. The curve meant that he would fly slowly, and now he slowed until the wind was a whisper in his face, until the ocean stood still beneath him. He narrowed his eyes in fierce concentration, held his breath, forced one ... single ... more ... inch ... of ... curve ... Then his feathers ruffled, he stalled and fell. Seagulls, as you know, never falter, never stall. To stall in the air is for them disgrace and it is dishonour. But Jonathan Livingston Seagull, unashamed, stretching his wings again in that trembling hard curve - slowing, slowing, and stalling once more - was no ordinary bird.”

Richard D. Bach,
Jonathan Livingston Seagull
(1970)
This thesis is based on the following papers, which are referred to in the text by their Roman numerals.


II. Nilsson Jobs, E., Bölte, S., & Falck-Ytter, T. Preschool Staff Spot Social Communication Difficulties, but Not Restricted and Repetitive Behaviors in Young Autistic Children. *In revision*.


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The contribution of Elisabeth Nilsson Jobs to Study I, II and III included in this thesis was as follows: Conceived the idea for and designed the studies, collected the data, performed the statistical analyses, had a major role in the interpretation of data and wrote the manuscripts with contributions from the supervisor and co-supervisor.
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<tr>
<td>ADHD</td>
<td>Attention Deficit Hyperactivity Disorder</td>
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<td>ADOS-2</td>
<td>Autism Diagnostic Observation Schedule, second edition</td>
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<td>ADI-R</td>
<td>Autism Diagnostic Interview-Revised</td>
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<td>ANOVA</td>
<td>Analysis of Variance</td>
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<td>ASD</td>
<td>Autism Spectrum Disorder</td>
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<td>ASEBA</td>
<td>Achenbach System of Empirically Based Assessment</td>
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<td>CBCL</td>
<td>Child Behavior Check List</td>
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<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
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<td>CEFT</td>
<td>Children’s Embedded Figures Test</td>
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<td>CS</td>
<td>Comparison Score</td>
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<td>DSM</td>
<td>Diagnostic and Statistical Manual of Mental Disorders</td>
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<td>EAS</td>
<td>Elevated Autism Symptoms</td>
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<td>EASE</td>
<td>Early Autism Sweden</td>
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<td>EFT</td>
<td>Embedded Figures Test</td>
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<td>Figure-Ground</td>
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<td>FPT</td>
<td>Fragmented Picture Test</td>
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<td>HP</td>
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<td>HR-ASD</td>
<td>High-Risk children with ASD</td>
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<td>IQ</td>
<td>Intelligence Quotient</td>
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<td>LR</td>
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<td>MSEL</td>
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<td>NV/VIQ</td>
<td>Non-Verbal/Verbal Intelligence Quotient</td>
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<td>PDP</td>
<td>Pervasive Developmental Problems</td>
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<td>RBS-R</td>
<td>Repetitive Behaviors Scale-Revised</td>
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<td>RRB</td>
<td>Restricted and Repetitive Behaviors</td>
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<td>SA</td>
<td>Social Affect</td>
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<td>SCI</td>
<td>Social Communication and Interaction</td>
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<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
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<td>SRS</td>
<td>Social Responsiveness Scale</td>
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<td>TD</td>
<td>Typical development</td>
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<td>VABS: ABC</td>
<td>Vineland Adaptive Behavior Scale: Adaptive Behavior Composite</td>
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<td>VR</td>
<td>Visual Reception</td>
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Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition that affects approximately 1 in 59 children (CDC, 2018; Idring et al., 2015). The causes of ASD are not yet fully understood, but genetic factors and prenatal development have been found to play a major role (Amaral, 2017). Early identification of ASD in young autistic children is crucial for early intervention, as this can improve social behavior and alleviate anxiety and aggression (Lai, Lombardo, & Baron-Cohen, 2013; Zwaigenbaum et al., 2015). Since the first descriptions of individuals as “autistic” in the 1930’s (Robison, 2017), this condition has been associated with disabilities in social interaction and repetitive behaviors, but also with special abilities (Dell’Osso et al., 2016; Kanner, 1943). It has been estimated that about 37-42% of individuals with ASD, have either exceptional skills (e.g., mathematics) or specific superior cognitive abilities (e.g., enhanced visual performance) in relation to those with typical development (Bennett & Heaton, 2012; Howlin, Goode, Hutton, & Rutter, 2009). Moreover, in general, autistic individuals have been found to pay particular attention to details, which have been observed in everyday life as well as in research on visual perception (de Schipper et al., 2016; Mahdi et al., 2018; Shah & Frith, 1993; Van der Hallen, Chamberlain, de-Wit, & Wagemans, 2018).

Despite the high prevalence of special skills and findings of enhanced perceptual ability, there is no focus on these abilities in clinical assessment of ASD. The major interest has been early recognition of the disabilities, constituting the base for the diagnosis of ASD. However, in order to understand the autistic individual and to plan intervention and support, it would seem natural to consider early recognition of disability and ability as equally important. There are however, challenges in recognizing disability and ability early in the child’s life.

The diagnostic criteria of ASD, require that symptoms are present in multiple contexts (American Psychiatric Association, 2013), which can be hard to verify. Sometimes more information from a context other than the clinical and family contexts is required. Preschool is one such setting, but the value of this information has not yet been investigated.
The challenge for early recognition of ability lies in the fact that the area is largely unexplored. It is not known if specific abilities, found in older autistic children, are also found in younger children. Moreover, there are no recommendations for which tasks to use in clinical assessment. In this thesis, I will explore ways of improving early recognition, in the sense of both identifying and acknowledging disability and ability in young autistic children. I will begin by describing autistic disability in terms of diagnosis, and the challenges associated with getting sufficient information to support the diagnosis. As a possible solution to this challenge, I will introduce preschool staff as a potential source of information in the diagnostic assessment. Finally, I will introduce the research field of local and global visual perception in ASD, and visual tasks that could be relevant in clinical assessment of young autistic children.

Disability in ASD

Even if descriptions of autistic individuals can be found from the late 1800 (Treffert, 2009), and symptoms were more stringently described by Sukhareva, Kanner and Asperger in the 1920s and 1930s (Manouilenko & Bejerot, 2015; Robison, 2017), ASD did not become a diagnosis until the introduction of the Diagnostic and Statistical Manual of Mental Disorders–III (DSM-III, American Psychiatric Association, 1980). Previous to the DSM-III, a psychodynamic approach had been dominant in the understanding of ASD, where parental callousness was seen as a cause of the condition (Volkmar & McPartland, 2014). With the DSM-III, the goal was to move from psychodynamic assumptions about psychiatric conditions, to introducing diagnostic criteria that were explicit and rule-driven (Horwitz, 2014; Wilson, 1993). Since the DSM-III, the core features of social impairment and unusual behaviors and rigidity have been included in the later editions of the DSM. Developmental aspects, types of autistic diagnoses and the number of criteria that need to be met, has however varied. In the DSM-IV (American Psychiatric Association, 2000), the diagnoses of autism, Asperger’s disorder and pervasive developmental disorder were differentiated, but in the latest edition of the DSM (i.e., the DSM-5; American Psychiatric Association, 2013), these diagnoses merged into the concept of ASD. Unlike previous DSM-editions, where the autistic features and other disabilities were intertwined, the core symptoms of ASD were separated from intellectual and language impairment in the DSM-5 (Volkmar & McPartland, 2014).

The core symptoms of ASD are grouped into two domains: the social communication and interaction (SCI) and restricted and repetitive behavior (RRB) (Guthrie, Swineford, Wetherby, & Lord, 2013; Mandy, Charman, & Skuse, 2012; Shuster, Perry, Bebko, & Toplak, 2014). The SCI area is defined by following deficits (A criteria): A1 social emotional reciprocity; A2 non-verbal
communication; and A3 developing and maintaining relationships. The RRB area is defined the following components (B criteria): B1 stereotyped or repetitive movements; B2 insistence on sameness; B3 highly restricted fixated interests; and B4 hyper or hypo sensory reactivity. The SCI deficits must be present within each A-criteria and be persistent across multiple contexts (i.e., in more than one context for diagnosis). For the B-criteria, two out of four criteria must be met, but behaviors need not have been present in multiple contexts for diagnosis. The DSM-5 also states that for diagnosis, symptoms should cause significant impairment in social or other areas of current functioning, and this is why severity level and need for support also are evaluated.

As previously mentioned the DSM-5 separates the core symptoms from intellectual and language impairment. Accordingly, cognitive evaluation is always included in ASD assessment. The presence of intellectual and/or language impairment should be specified for the ASD diagnosis. Intellectual impairment is found in about 30-55% in the ASD group (CDC, 2018; Charman et al., 2011; Suniti Chakrabarti & Eric Fombonne, 2005), compared with about 1% in the normal population (Maulik, Mascarenhas, Mathers, Dua, & Saxena, 2013). Language impairment is present in about 25-30% in the ASD group (Chakrabarti & Fombonne, 2001; Kantzer et al., 2018), compared with 7-8% in the normal population.

Challenges in evaluating diagnostic criteria for ASD

The DSM-5 stresses that symptoms should be impairing and be present in multiple contexts. Diagnostic assessment should include evaluation of core symptoms of ASD, non-verbal and verbal ability, and adaptive functioning. It is recommended to start the assessment with a comprehensive interview with the parent, which maps general developmental and behavioral concerns. Information about specific autistic behaviors is obtained through an in-depth parent interview on autistic symptoms, as well as by clinical observations assessing social-communicative functioning and RRBs (Ashwood, Buitelaar, Murphy, Spooren, & Charman, 2014; Falkmer, Anderson, Falkmer, & Horlin, 2013; Huerta & Lord, 2012; Lord et al., 2012; Rutter, LeCouteur, & Lord, 2003, 2008).

Information from parents has been considered important in the assessment of ASD for young children. However, according to the former DSM-IV, it was possible, in principle, to determine diagnosis by observations in the clinical context alone. However, this is no longer possible in the DSM-5 as SCI symptoms within each criterion must be present in multiple contexts. This means that the parent report on autistic symptoms in the home/family-context is of crucial importance for the decision on diagnosis. However, the reliance on parents makes the diagnostic process vulnerable, as some parents do not report
autistic symptoms to the same extent as clinicians (Kim & Lord, 2012a). For the A3 criteria (which involves play and peer relations), parent report is of particular importance as this criterion cannot be observed in the clinic. The A3 criteria are covered by standard parent interviews for ASD, but it has been found that about 44% of the parents do not report significant autistic symptoms in their 21-47 months old children, although the children are classified as having ASD (de Bildt et al., 2015). Similarly, Kim and Lord (2012a) found that parents did not report significant symptoms in about 20% of the cases when the autistic symptoms were moderate. Thus, discrepancies between parents’ and clinicians’ reports on the child’s autistic symptoms are fairly common.

Parents as informants

Parents can have general concerns for their child’s behavior from an early age (Bolton, Golding, Emond, & Steer, 2012; Herlihy, Knoch, Vibert, & Fein, 2015; Sacrey et al., 2015), but the specific core features of ASD usually cannot be observed until the second year in life. These emerging symptoms may be hard to detect from the more general concerns about the child (Barbaro & Dissanayake, 2013; Bussu, Jones, Charman, Johnson, & Buitelaar, 2018; Chawarska et al., 2014). The home/family-context may not elicit autistic behaviors to the same extent as in the clinical setting, in which specific measures are designed to reveal more or less subtle problems with social communication. Moreover, impairment in peer relationships as well as RRBs in young children can easily be missed. RRBs are present in practically all young children. It can be hard for parents to decide if these behaviors should be noted as age-appropriate or atypical (Achenbach, McConaughy, & Howell, 1987; Charman & Baird, 2002; de Bildt et al., 2015; De Los Reyes et al., 2015; Maenner et al., 2013; Uljarević et al., 2017; Uljarević & Evans, 2017). It could also be the case that although the parents identify the relevant autistic behaviors, they are not perceived as persistent or impairing (Zander, 2015). Further, when the child has higher non-verbal and verbal skills, parents tend to report lower autistic symptoms in their child, compared with children with lower verbal and non-verbal skills. (Kim & Lord, 2012a; Le Couteur, Haden, Hammal, & McConachie, 2008; Risi et al., 2006; Zander, Sturm, & Bölte, 2015). For parents of children who have an older sibling with ASD, severity level can also be hard to estimate as the older sibling may have more profound symptoms than the child due for assessment.

While some parents may not perceive symptoms in the child, the opposite can also be the case: a parent may perceive the child’s autistic symptoms as more severe than the clinician. In some cases, this may reflect that developmental and language delay, as well as challenging behaviors that can “spill over” on the ratings on autistic symptoms. This can also be the case when the child’s
behavior has a significant impact on the family’s everyday life. Moreover, lower maternal education and family income are associated with more false positive cases of ASD (Hus, Bishop, Gotham, Huerta, & Lord, 2013; Moody et al., 2017; Zablotsky, Bramlett, & Blumberg, 2015).

From the abovementioned, one can conclude that, when information on autistic symptoms is discrepant between the parents and the clinicians, there is a need to receive information from other contexts, such as the preschool setting. Otherwise, there is a risk that the diagnostic decision, in cases where clinical symptoms are evident but not supported by parent report, is delayed. This can lead to negative consequences for the child, including delayed support and intervention.

Including the preschool context in the diagnostic assessment

In Europe, the potential to get information from the preschool context is high. About 80% of the 3- to 4-year-olds attend preschool in several European countries. In Sweden, the percentages are as high as 89% for all 2-year olds and over 93% for all 3- to 5-year-olds. The best option to get information about the child in the preschool context would presumably be to let an expert clinician observe the child in that setting (Westman Andersson, Miniscalco, Johansson, & Gillberg, 2013). However, an alternative way to this rather time-consuming procedure is to get information from preschool staff. Preschool staff could be an asset in reporting autistic symptoms as they can observe the child interacting in a natural setting with other children. Moreover, preschool staff can compare the behaviors of the child directly with other children on a daily basis, which is not the case for the clinician (Branson, Vigil, & Bingham, 2008; García-Primo et al., 2014). However, the value of preschool staff as informants on autistic symptoms in relation to parent report is limited. So far, research on parent-teacher information has mainly focused on older children, showing that teachers rate autistic symptoms more in line with clinical findings than parents (e.g., Aldridge, Gibbs, Schmidhofer, & Williams, 2012; Duvekot, van der Ende, Verhulst, & Greaves-Lord, 2015).

The suggestion that diagnostic assessment could gain from receiving information from different contexts is based on the expectation that the child often exhibits different behaviors depending on the setting. Unfortunately, discrepancies between informant observations are often looked upon as a sign of unreliability, as if autistic symptoms should be non-variable between contexts (Lerner, De Los Reyes, Drabick, Gerber, & Gadow, 2017). However, given the different settings, different reports on the child’s behavior should be expected. This view has been common within the diagnostic assessment of ADHD for a long time (Achenbach, 2017; Achenbach et al., 1987; De Los Reyes et al., 2015; Kraemer et al., 2003; Martel, Schimmack, Nikolas, &
Many children with ASD have difficulties in generalizing skills across contexts; therefore, discrepancies in observed behaviors could even be more evident in children with ASD. Moreover, the preschool context is known to elicit autistic behaviors and could cause more frustration and arousal in the child than the home/family context (Stratis & Lecavalier, 2015; Uljarević & Evans, 2017). Preschool staff could thus be important informants on autistic behaviors in the child in the preschool setting when the information from parents is insufficient. However, the utility of preschool ratings in clinical assessment of young children with ASD has not previously been evaluated.

Evaluation of special abilities in young autistic children could also be part of the clinical cognitive assessment, which is conducted in connection to the ASD assessment. Given reports on superior skills in (e.g., calendar skills, music, arithmetic and visuospatial processing), as well as high performance on visual cognitive tasks in older children and adults (Bennett & Heaton, 2012; Howlin et al., 2009; O'Connor, 2012; Shah & Frith, 1993), this could be motivated. However, more knowledge is needed in this area. The area of visual ability in ASD will be introduced below.

Visual ability in ASD

There are many reports that individuals with ASD have enhanced skills in attending to details in everyday life (Baron-Cohen, Ashwin, Ashwin, Tavassoli, & Chakrabarti, 2009; de Schipper et al., 2016; Mahdi et al., 2018; Van der Hallen et al., 2018; van Eylen, Boets, Steyaert, Wagemans, & Noens, 2015). Detail-focus is often referred to as a process involving a “local” level as opposed to attending to wholes or a ”global” level (“not seeing the forest for the trees”). Many different tasks have been developed for investigating local and global ability in ASD (e.g., Almeida, Dickinson, Maybery, Badcock, & Badcock, 2014; Nayar, Voyles, Kiordes, & Di Martino, 2017; Pellicano, Gibson, Maybery, Durkin, & Badcock, 2005; Simmons et al., 2009). Some tasks have also been closely related to theories on local bias in ASD, which will be presented below.

Hierarchical tasks and enhanced perceptual functioning

Local versus global bias or precedence, has been investigated in both individuals with ASD and typical development using hierarchical tasks. These tasks are called hierarchical, as a large feature (global level), a letter or a form is built up from smaller letter or features (local level). In its most basic form, this task investigates the level reported when one can choose freely between the local or global level. Children under the age of six, with typical development,
tend to report the global rather than the local level (but there is a large variability). The general global-over-local precedence is adult-like from 8-10 years of age. However, when exposed to more difficult tasks, like when the angle of the stimulus is changed or when a new task is introduced, the local level is often processed first, even in adults (Dukette & Stiles, 1996; Harrison & Stiles, 2009; Neiworth, Gleichman, Olinick, & Lamp, 2006; Porporino, Shore, Iarocci, & Burack, 2004; Wang, Mottron, Peng, Berthiaume, & Dawson, 2007). In ASD, research suggests that older autistic individuals may respond to the local level, or more evenly to either the local or global level, as in the case of younger children with typical development. Moreover, findings indicate that task difficulty activate local processing faster in individuals with ASD in comparison to those with typical development (Deruelle, Rondan, Gepner, & Fagot, 2006; Muth, Honekopp, & Falter, 2014; R. Van der Hallen, K. Evers, K. Brewaeys, W. Van den Noortgate, & J. Wagemans, 2015; Wang et al., 2007).

Results on hierarchical tasks have often been interpreted within the theoretical framework of enhanced perceptual functioning (Mottron, Dawson, Soulières, Hubert, & Burack, 2006). In this theory, the local bias in ASD is associated with superior low-level processing, such as detection and discrimination of stimuli, and mid-level cognitive processing, involving matching and pattern detection. Low-level perception is assumed to be more autonomous and independent from top-down processes in individuals with ASD. This can lead to more accurate, “pure” visual processing in ASD, as high-order information (e.g., information about the context and rules) is less influential in autistic individuals than in individuals with typical development (Mottron et al., 2013; Mottron et al., 2006).

Dis-embedding and weak central coherence

In contrast to focusing on the level (i.e., local or global) that the individual perceives, the local ability of dis-embedding has been extensively studied. Dis-embedding can be defined as “the ability to detect a visual object, embedded in a picture when knowing what to look for” (Flanagan & Dixon, 2013; Flanagan, Ortiz, & Alfonso, 2007; Milne & Szczerbinski, 2009; Schneider & McGrew, 2012) A well-known dis-embedding task is the Embedded Figures Test (EFT) with the children’s version being the Children’s Embedded Figures Test (CEFT; EFT; CEFT; Karp & Konstadt, 1963; Witkin, Oltman, Raskin, & Karp, 1971). In the CEFT, an identical local feature, a triangle or a house, should be identified in a complex background, which also contains similar features (i.e., smaller triangles or triangle-like features). Some findings show that dis-embedding ability in individuals with ASD is equal to those with typical development. However, many studies also indicate that dis-embedding is superior in autistic individuals, either regarding accuracy or response-latency (e.g.,...
Horlin, Black, Falkmer, & Falkmer, 2016; Muth et al., 2014; Pellicano, 2006; Schlooz et al., 2006; Simmons et al., 2009; Van der Hallen et al., 2018; Van der Hallen, Evers, Breuwaey, Van den Noortgate, & Wagemans, 2015).

The EFT/CEFT have often been used in the context of the theory of Weak Central Coherence (Happé & Frith, 2006; Shah & Frith, 1983). This theory focuses on the relation between attention to local features and the integrating of global wholes. The theory originally assumed that superior local disembedding (the triangle or house in the task) went with inferior weak background in the task). Thus, it was assumed that detail focus came at the expense of seeing the whole. However, this view was modified by Happé and Frith (Happé & Frith, 2006), stating that global integration and local bias should be seen as independent processes. Moreover, it was concluded that global information could be processed equally well when the individual was instructed to do so (Happé & Booth, 2008; Happé & Frith, 2006; Shah & Frith, 1993). Nevertheless, the importance of investigating both these processes, have still been emphasized as inferior global integration cannot be ruled out in ASD. The theory of weak central coherence differs from the enhanced perceptual functioning, as local bias is seen more as a top-down executive deficit rather than an enhanced perceptual ability.

Closure speed

One global task that has been used within the framework of Weak central coherence is the closure speed task Fragmented Picture test (FPT; Kessler, 1993; Snodgrass & Corwin, 1988). Closure speed is defined as the ability “to combine fragments of a visual stimulus into a meaningful whole, not knowing beforehand what is depicted” (D’Souza, Booth, Connolly, Happé, & Karmiloff-Smith, 2015; Flanagan, Ortiz, & Alfonso, 2013; Milne & Szcerbinski, 2009; Reynolds, Keith, Flanagan, & Alfonso, 2013; Schneider & McGrew, 2012). In the FPT, one is asked to name a fragmented picture that successively turns more and more complete, as more images are presented. Due to its reliance on verbal report, the FPT also involves semantic matching. The term “speed” is somewhat misleading as these tasks are also evaluated in terms of accuracy. Research on the FPT is not as extensive as on the EFT/CEFT. Findings suggest either inferior or equal performance in individuals with ASD in comparison to those with typical development (Booth & Happé, 2016; D'Souza et al., 2015; Scheurich, Fellgiebel, Müller, Poustka, & Bölte, 2010).

The concepts of local and global

The labels of tasks as strictly local or global have been questioned, as both local and global cues are used in perceiving most stimuli. For example, both
local and global cues need processing when identifying the triangle in the CEFT, as the “local” triangle can only be dis-embedded in relation to the “global” embedding background (Chamberlain, Van der Hallen, Huygelier, Van de Cruys, & Wagemans, 2017; Happé & Booth, 2008). More often, stimuli are specifically described in terms of their spatial frequency features. Low-frequency information represents coarse “global” features and high-frequency information represents “local” features (Kauffmann, Ramanoël, & Peyrin, 2014; Kéïta, Guy, Berthiaume, Mottron, & Bertone, 2014; Musel et al., 2014; Vanmarcke & Wagemans, 2016). Furthermore, rather than speaking in terms of global-over-local precedence, this relationship is often described as coarse-to-fine spatial frequency perception. The coarse “global” low-frequency spatial information enables scanning the “bigger picture”, whereas the high-frequency spatial information enables focus on the “local” features that are attended to. Moreover, in real life, there is seldom just low-level or high-level frequency information to attend. Instead, there is a constant interplay between what is perceived as the coarse spatial frequency (the background) and what is perceived as the fine spatial frequency (the figure) depending on what one is attending to. This process is active regardless if the features attended to are static or in motion (Musel et al., 2014). Bearing this in mind, in this thesis the terms local and global are kept, however, they are operationalized as specific tasks on dis-embedding and closure speed.

Tasks on visual ability for young children

Older children with ASD, has shown superior performance on clinical subtests such as block-design, object-assembly and matching in relation to those with typical development (Shah & Frith, 1993). Moreover, extraordinary performance on block design tasks, with superior performance in comparison to individuals with typical development, as well as in comparison to the individuals own general cognitive level, has been found in 18% of individuals with ASD (Howlin et al., 2009). In young children with ASD, high general non-verbal ability relative to verbal ability is often found (Ankenman, Elgin, Sullivan, Vincent, & Bernier, 2014; Hedvall et al., 2013; R. M. Joseph, Tager-Flusberg, & Lord, 2002; Rivard, Terroux, Mercier, & Parent-Boursier, 2015; Stack, Murphy, Prendeville, & O’Halloran, 2017). However, we know little about performance on specific subtests in young autistic children. Local-global research has mainly included children from the age of six and most of the tasks have not been developed for young children. For dis-embedding and closure speed tasks, only a few clinical subtests are available.

Tasks on dis-embedding, are the Figure-ground task, which is part of the Leiter-R performance scale (Roid & Miller, 1997) and the Hidden Pictures task which is part of the Merrill Palmer developmental scales (Roid & Sampers, 2004). Performance on the Figure-ground task has been found to be a relative
strength in 3.5 – 5.5 year olds with ASD, with average performance on the this task and non-verbal reasoning below average (Kuschner, Bennetto, & Yost, 2007). However, in other samples with older children and lower IQ, this has not been the case (Mecca, Orsati, & de Macedo, 2014; Tsatsanis et al., 2003). The Hidden Pictures task has not yet been evaluated in children with ASD.

For closure speed, there is the gestalt closure task from the Kaufman Assessment Battery for Children (Kaufman & Kaufman, 1983; Kaufman & Kaufman, 2004). One study has found that accuracy on the gestalt closure is as a relative strength in young children with ASD, with full-scale IQ within the average range (Allen & et al., 1991). It is still largely unknown if enhanced visual abilities are present in very young children with autism. More knowledge within this area is important. If enhanced visual ability was to be found, tasks on visual ability could easily be included in the routine cognitive assessment of ASD that in turn could guide treatment and intervention, which are beneficial for the child’s development and well-being.
ASD is characterized by disabilities, and in many cases also enhanced abilities. Both are important to take into account in the conceptualization of ASD as well as in clinical assessment. The overarching purpose of this thesis was to improve early recognition of disability and ability in autistic children.

Specifically, in Study I, we investigated if ratings of autistic symptoms by preschool staff and parents would discriminate children with ASD from other children (children at risk for ASD but with no diagnosis, and typically developing children). We also investigated if preschool and parent ratings correlated with a clinical measure of autistic symptoms. We expected that both parents and preschool staff could differentiate between the groups and rate clinical autistic symptoms similarly, although preschool ratings were expected to be more accurate than parent ratings.

In study II we investigated if ratings of domain specific autistic symptoms (SCI and RRB) would discriminate children with ASD from other children (children at risk for ASD but with no diagnosis, and typically developing children). Further, a second aim was to investigate if there were specific associations between preschool SCI ratings and clinical assessment of social behavior, and between preschool ratings of RRB and clinical assessment of RRB. We expected that ratings on both SCI and RRB would contribute uniquely to the differentiation between groups and that a positive correlation between preschool SCI and RRB ratings and the corresponding clinical measures of autistic symptoms would be found.

Study III investigated performance on visual behavioral tasks in 3-year-olds with ASD compared with those with high risk for ASD but with no diagnosis, and those with typical development. Specifically, the aim was to investigate performance on dis-embedding (local ability) and closure speed (global ability). Superior local performance was expected in the group of children with ASD, compared with the other groups. In contrast, for global tasks, inferior performance was expected in children with ASD compared with the other two groups.
Methods

Recruitment of participants

The participants in Study I, II and III, were part of the longitudinal Early Autism Sweden (EASE; www.smasyskon.se) high risk infant sibling project, which is approved by the Regional Ethical Board in Sweden. The siblings in the project are referred to as “high-risk” for ASD as they have an older sibling having ASD. About 18-20% of the high-risk siblings are diagnosed with ASD (Messinger et al., 2015; Ozonoff et al., 2011). Of the remaining high-risk siblings with no diagnosis, about 25-30% has elevated autistic symptoms and other neurodevelopmental disorders (see Pisula & Ziegart-Sadowska, 2015 for a review). By also including siblings with typical development with low risk for ASD (i.e., not having an older sibling with ASD), three groups can be studied; the high-risk group with ASD (HR-ASD group); the high-risk group with no ASD (HR-noASD group); and the low-risk group (LR-group). This allows investigating if distinctions can be made between groups showing increasing autism symptoms (Charman et al., 2017; Chawarska et al., 2014; Garrido, Petrova, Watson, Garcia-Retamero, & Carballo, 2017; Messinger et al., 2015; Szatmari et al., 2016). The EASE project follows children from five months to six years of age. In Study I, II and III, 3-year-old high-risk and low-risk siblings from the project were included. The high-risk children had been recruited through advertisement, the project’s website (www.smasyskon.se) or at clinical units. For inclusion, these children should have at least one older sister or brother diagnosed with ASD. The low-risk children had been recruited from a database of families, showing an interest for participating in research projects. For inclusion, these children should have at least one older brother or sister with typical development and no first-hand relatives with known or suspected ASD. Exclusion criteria for both groups were pre-term birth (<36 weeks) and confirmed or suspected medical problems.

Procedures

For Study I and II, data collection was conducted between March 2014 and June 2017 and between August 2014 and July 2016 for Study III. All assessments were conducted by an experienced clinician and took place during one day in a clinical setting. Diagnostic decision at the 36- month visit was based
on consensus of two experienced clinicians according to DSM-5 criteria (American Psychiatric Association, 2013), based on information from the Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012); the Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003, 2008); the Vineland Adaptive Behavior Scales-2 (VABS-II; McDonald, 2014; Mouga, 2014; Sparrow, 2005), and the Mullen Scales of Early Learning (MSEL; Mullen, 1995).

The parent rating scales were sent to the parents about 1.5 months before the EASE assessment day and completed at home, either just before or after the 36-month visit. The preschool rating scales were distributed to preschool through the parents and were sent back directly to the research team by regular mail or returned via the parents at the EASE assessment day. The preschool ratings were completed about one to four weeks before the assessment day. The ratings were collected independent of diagnostic decision-making. All preschool ratings were completed before assessment results were reported to the parents and the preschool informants were blind to the result of the diagnostic assessment.

In Study I, thirty-five CBCLs had been answered by the mother, nine answered by the father and 12 by both parents. The preschool informants for ratings on the C-TRF, consisted of 30 preschool teachers 21 preschool care staff, two with other background and in three cases information on informant profession was lacking. The preschool informants had known the child more than 6 months in 46 cases, less than 6 months in eight cases and familiarity was unknown in two cases. In Study II, the preschool informants consisted of 36 preschool teachers, 23 child care providers with upper secondary high school training, two informants with other background and three cases where information on education was lacking. The staff had known the child more than 6 months in 53 cases, less than six months in nine cases and no information was given on this in two cases.

The visual tasks in Study III were administered in connection to the 36-month EASE assessment day on one occasion in a clinical lab setting lasting about 20 min with a parent present. The order of the tasks was administered according to Latin square counterbalancing.

**Diagnostic measures**

The ADI-R (Rutter et al., 2003, 2008) is a standardized, semi-structured clinical interview for parents. Research algorithms are available, matching the DSM-5 domains and the ADOS-2 algorithms (see below Kim & Lord, 2012b). Items cover the domains of language/communication, reciprocal social inter-
actions and RRBs. Different combinations of items are used in the algorithms to generate a single total score, depending on age and language level. The result is evaluated against a cut-off score indicating ASD or no ASD.

The ADOS-2 (Lord et al., 2012) is a semi-structured clinical observation of communication, social interaction, play and RRBs. Depending on language level and/or age, there are five different modules available. Module 1 and module 2 were used in the studies of this thesis. Each module consists of activities that are administered by a trained clinician who also observes and rates the child’s behaviors, initiatives and responses in the interaction. Items on different behaviors are rated from 0 to 3 (0 = no evidence of abnormality, 3= markedly abnormal). Like the ADI-R, different item-combinations are used in an algorithm to generate a total score, depending on age and language level. The total scores can either be presented as an algorithm score or as a standardized comparison score from 1-10, which allows comparisons between different ADOS-2 modules (in the current case, module 1 and 2). Separate algorithms, as well as comparison scores can also be calculated for the subscales; Social Affect (SA) and RRB. These subscales are consistent with the DSM-5 domains of Social communication and interaction (SCI) and RRBs (Hus, Gotham, & Lord, 2014; Lord et al., 2012). The separate SA and RRB subscales were analyzed in Study II of this thesis and comparison scores for the SA subscale were used. However, for the ADOS-2 RRB subscale, algorithm scores were chosen for the sake of clarity, as the Hus et al. (2014) standardization for RRBs only includes CS of 1 and 5-10 (i.e., 0 raw score corresponds to CS 1, and 1 raw score corresponds to CS 5) whereas the SA subscale includes comparison scores from 1-10. The result for the algorithm score is also evaluated against a cut-off classified as being; within the autism range; the autism spectrum range; or not within the autism spectrum range. In Study I and II of this thesis, the continuous ADOS-2 scores were evaluated as a dimensional measure of clinical autistic symptoms. There are older versions of the ADOS, which are referred to as “ADOS” in this thesis. A major difference between the old versions and the ADOS-2 is that both SA and RRBs are included in the algorithm scores in ADOS-2, whereas only the SA domain is included in the older versions.

The VABS-II (Sparrow, 2005), is a semi-structured parent-report questionnaire on adaptive behavior, covering four different domains: Communication, Daily Living Skills, Socialization and Motor Abilities. These scales can be evaluated separately or as an overall ABC in standard scores (mean = 100, SD = 15).

The MSEL (Mullen, 1995) is a standardized measure of cognitive development from birth to 68 months of age. Composite scores are obtained from the subscales Fine motor-, Visual reception-, Expressive- and Receptive- lan-
guage, which are summarized in T-scores and a total composite standard score as a proxy for IQ. The results can also be presented as non-verbal IQ (visual reception and fine motor subscales) and verbal IQ (expressive and receptive language subscales).

Sample characteristics

The samples in study I, II and III were largely over-lapping. In Study I and II, all participants, except for one participant in the HR-ASD group (attending special education), attended regular preschool. Participant characteristics are presented in Table 1. There were no group differences in age across the studies. Moreover, in all studies, the high-risk children with ASD (HR-ASD), had higher scores on the ADOS-2 than the other groups. In study I and II, the HR-ASD children had lower IQ than the two other groups. For study III, there were no difference between verbal IQ, but the non-verbal IQ was lower in the HR-ASD, group compared to the LR group. In Study III, vocabulary, required in some of the visual tasks, was also assessed, but no group difference was found.

Elevated autistic symptoms and symptoms of ADHD or language impairment are also reported in Table 1. Elevated autistic symptoms were defined as ADOS –2 CS >3, which corresponds to the cut-off for significant autistic symptoms (CS 4) and, as raw scores > 1 for the RRB domain (Lord et al., 2012). Elevated scores were found in about 30% of the HR-noASD group in Study I and II and about 48% in study III. For the low-risk group the percentage was between 12-14%. As expected in the HR-ASD group, all children had elevated autistic symptoms. Symptoms of attention deficit hyperactivity disorder (ADHD), and speech and language impairment (SLI) were also noted. ADHD symptoms were evaluated by observations throughout the day by an experienced clinician, both during formal assessment and during breaks in interaction with the parent. Expressive and receptive language impairment was defined as a T-score ≤ 35 on the Expressive and/or Receptive scale on the MSEL. Hyperactivity or SLI were found in 25% in the HR-noASD group for study I, about 36% in Study II and about 40% in Study III. In the HR-ASD group, ADHD or SLI was found in about 40% in Study I and III and in about 30% in Study II. There were no ADHD or SLI symptoms in the LR group.
<table>
<thead>
<tr>
<th></th>
<th>LR</th>
<th>HR-noASD</th>
<th>HR-ASD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study I</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N (girls)</td>
<td>14 (7)</td>
<td>32 (18)</td>
<td>10 (5)</td>
</tr>
<tr>
<td>Age, months, M/SD</td>
<td>36.7/1.1</td>
<td>37.0/1.1</td>
<td>37.0/1.1</td>
</tr>
<tr>
<td>ADOS-2 CS, M/SD</td>
<td>2.6/1.3</td>
<td>3.2/1.7</td>
<td>7.1/1.7</td>
</tr>
<tr>
<td>MSEL tot, M/SD</td>
<td>115/14.7</td>
<td>110/14.0</td>
<td>90.0/19.9</td>
</tr>
<tr>
<td>Tot elevated autistic and SLI/ADHD symptoms (elevated; SLI/ADHD)</td>
<td>2 (2;0)</td>
<td>13 (10;8)</td>
<td>10 (10;5&lt;sup&gt;1&lt;/sup&gt;)</td>
</tr>
<tr>
<td><strong>Study II</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N (girls)</td>
<td>16 (7)</td>
<td>36 (20)</td>
<td>12 (6)</td>
</tr>
<tr>
<td>Age, months, M/SD</td>
<td>36.6/1.1</td>
<td>37.2/1.3</td>
<td>37.7/2.5</td>
</tr>
<tr>
<td>ADOS-2 SA CS, M/SD</td>
<td>2.8/1.8</td>
<td>3.5/1.7</td>
<td>7.8/2.0</td>
</tr>
<tr>
<td>ADOS-2 RRB, M/SD</td>
<td>1.6/.1.0</td>
<td>2.0/1.1</td>
<td>3.3/1.1</td>
</tr>
<tr>
<td>MSEL tot, M/SD</td>
<td>115/13.7</td>
<td>107/14.8</td>
<td>88.5/19.3</td>
</tr>
<tr>
<td>Tot elevated autistic and SLI/ADHD symptoms (elevated; SLI/ADHD)</td>
<td>2 (2;0)</td>
<td>19 (11;13)</td>
<td>12 (12;5&lt;sup&gt;1&lt;/sup&gt;)</td>
</tr>
<tr>
<td><strong>Study III</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N (girls)</td>
<td>14 (8)</td>
<td>23 (16)</td>
<td>12 (7)</td>
</tr>
<tr>
<td>Age, months, M/SD</td>
<td>37.7/2.3</td>
<td>39.4/4.3</td>
<td>40.1/4.3</td>
</tr>
<tr>
<td>ADOS-2 CS, M/SD</td>
<td>2.4/1.6</td>
<td>2.9/1.4</td>
<td>7.1/1.7</td>
</tr>
<tr>
<td>Mullen: NVIQ, M/SD</td>
<td>117/10.4</td>
<td>113/14.8</td>
<td>103.6/13.1</td>
</tr>
<tr>
<td>SpecVoc, M/SD</td>
<td>17.4/0.9</td>
<td>16.1/2.3</td>
<td>16.5/1.4</td>
</tr>
<tr>
<td>Mullen: VIQ, M/SD</td>
<td>111.8/10.5</td>
<td>103.7/21.4</td>
<td>99.3/23.9</td>
</tr>
<tr>
<td>Tot elevated autistic and SLI/ADHD symptoms (elevated; SLI/ADHD)</td>
<td>3 (2;0)</td>
<td>11 (4;10&lt;sup&gt;1&lt;/sup&gt;)</td>
<td>12 (12;5)</td>
</tr>
</tbody>
</table>

*Note: M = Mean; SD = Standard Deviation; LR = Low-Risk siblings; HR-noASD = High-Risk siblings with no ASD; HR-ASD = High-Risk sibling with ASD; ADOS-2 = Autism Diagnostic Observation Schedule-2; CS = Comparison Score; SA = Social Affect; RRB = Restricted and Repetitive Behavior; MSEL tot = Mullen Scales of Early Learning, total IQ; NVIQ = non-verbal IQ; VIQ = verbal IQ; SpecVoc = specific vocabulary for closure speed tasks; SLI = Speech and Language Impairment; ADHD = Attention Deficit Hyperactivity Disorder; <sup>1</sup> = one participant had combined SLI/ADHD and developmental delay.*
Measures

Rating scales

In Study I, the parent Child Behavior Checklist 1.5 - 5 years (from now parent-CBCL) and the preschool Caregiver-Teacher Report Form 1.5 - 5 years (from now preschool-TRF) (Achenbach & Rescorla, 2004; Rescorla, 2005), were included. The rating scales consist of 100 items that are rated 0, 1 or 2 (from not true, sometimes true, to almost always true). The item scores can be summed into a total problem scale, Internalizing and Externalizing subscales, seven syndrom subscales (Emotional reactivity, Anxious/depressed, Somatic complaints, Withdrawn, Sleep problems, Attention problems and aggressive behavior) or, subscales in line with DSM-criteria (Affective problems, Anxiety problems, Pervasive developmental problems, Attention deficit/ Hyperactivity problems and Oppositional defiant problems). The subscales Withdrawn and Pervasive Developmental Problems (PDP), associated with ASD (e.g., Rescorla et al., 2017), were evaluated in Study I of this thesis. The Withdrawn and PDP scales are in part overlapping, with five items in common, covering social behavior. Internal consistency for the Withdrawn and PDP scales show alphas of .75 - .80 for parents and .83-.80 for preschool, based on a mixed samples of children with typical and untypical development.

It has been found that parents rate significantly elevated scores on these scales for children with ASD, both in relation to children with other developmental disorders, children with TD as well as in relation to high-risk siblings with no ASD (Havdahl, von Tetzchner, Huerta, Lord, & Bishop, 2016; Limberg, Gruber, & Noterdaeme, 2017; Muratori et al., 2011; Myers, Gross, & McReynolds, 2014; Narzisi et al., 2013; Rescorla et al., 2017). Ratings by preschool staff on these subscales have not previously been evaluated in children with ASD.

The Social Responsiveness Scale–Second edition (SRS-2; Constantino, Gruber, & 2012) was evaluated in Study II of this thesis. The SRS-2 has four different forms, depending on age. A preschool research version was used in Study II. The SRS-2 consists of 65 items, rated from 0 (not true) to 3 (almost always true) that map onto the DSM-5 SCI and RRB domains (American Psychiatric Association, 2013; Frazier et al., 2014). Internal consistency of the scales for both parents and teachers show Cronbach’s alphas > .90 in most cases, both in normal population samples and in children with ASD (Constantino et al., 2012; Stickley et al., 2017). The Social Communication and Interaction scale (SRS-2 SCI) is calculated from 53 items, covering social awareness, social cognition, social communication and social motivation. The RRB subscale (SRS-2 RRB) consists of 12 items. There is limited research on parent and preschool SRS-2 ratings for children under the age of four (but see
However, research on older children has found that teacher ratings are associated with the ADOS to a greater extent than parent ratings. Furthermore, teachers, discriminate between children with ASD and children with other developmental disorders to a higher degree than parents (Aldridge et al., 2012; Azad, Reisinger, Xie, & Mandell, 2016; Constantino, 2002; Constantino et al., 2007; Reszka, Boyd, McBee, Hume, & Odom, 2014; Schanding, Nowell, & Goin-Kochel, 2012). The Repetitive Behavior Scale-Revised (RBS-R; Bodfish, Symons, Parker, & Lewis, 2000; Lam & Aman, 2007) were included in Study II of this thesis. The RBS-R consists of 43 items, rated from 0 to 3 depending on behavior severity. The scale covers the areas of stereotyped behavior, self-injurious behavior, compulsive behavior, routine behavior, sameness behavior and restricted behavior. Internal consistencies for the subscales showed between .78-.91 on parent ratings in an ASD sample (Lam & Aman, 2007). Results can be summarized as a total composite score, or as the number of items that indicate the presence of RRBs. Total scores were used in Study II. Research indicates that parents rate children with ASD higher on total composite scores, compulsive and restricted behavior compared to children with typical development and high-risk siblings with no ASD (L. Joseph, Thurm, Farmer, & Shumway, 2013; Wolff et al., 2014). Positive correlations have been found between parent RBS-R ratings and the ADOS-RRB domain scale as well as the parent PDP subscale (Mirenda et al., 2010). The RBS-R scale has not been evaluated for teachers or preschool staff previously.

In study II, the DSM-5 SCI domain was operationalised and measured by preschool ratings of the SRS-2 SCI subscale. The DSM-5 RRB domain was operationalised and measured by preschool ratings of the RBS-R and the SRS-2 RRB subscales. The latter was included for comparison with the more comprehensive RBS-R as the SRS-2 RRB scale psychometrically coheres with the SRS-2 SCI scale. The measures and corresponding DSM-5 domains included in Study I and II, are presented in Table 2.

The tasks included in Study III are presented in Figure 1. Study III included local tasks on “flexibility of closure” also called “dis-embedding” (from now dis-embedding) and “closure speed”: Flanagan and Dixon 2013, p. 8). All tasks included static stimuli (i.e., pictures of objects or animates), and were so called behavioral tasks (i.e., they required an active response such as naming or pointing at the target). Before trials the tasks were piloted in 10-15 three-year-old children, depending on task, for applicability for the age group as well as floor and ceiling effects. For the tasks, not standardised for the age group, items were chosen based on the pictures relevance for children and commonality of the object or animates. The number of items was also kept...
down, in order for the children to stay focused. The tasks are presented more comprehensively in the supplement to Study III in this thesis.

Local Measures

The *Children’s Embedded Figures Test* (CEFT; Karp and Konstadt 1963) was modified to fit the age-group. This task included six pictures (clown, house, truck, boat, umbrella and doll), in which an embedded target triangle shape should be found. The child was first asked to detect the triangle shape spontaneously in the picture. If not finding it, the child was given a cut-out triangle model after 10 s, to search for the embedded triangle. Total exposure time for each picture was 30 s. Spontaneous pointing at the triangle was given 2 points and detection with the model-triangle was given 1 point (max. 12). If the child did not find the target within total exposure time, 0 points were given. Response latency was measured, from the picture being visible to the participant, to the participant pointing spontaneously at the triangle. Due to variations in planning performance, no exact response latency was calculated for the model triangle condition. Finding the target with the model was counted as 20 s and not finding the triangle was counted as 30 s, the latter being maximum exposure time.

Table 2 *DSM-5 domains and corresponding measures, Study I and II*

<table>
<thead>
<tr>
<th>DSM-5 domain</th>
<th>Clinical Symptom assessment</th>
<th>Parent ratings</th>
<th>Preschool ratings</th>
<th>Preschool ratings</th>
<th>Preschool ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI+RRB</td>
<td>ADOS-2 CS scale</td>
<td>CBCL PDP subscale</td>
<td>C-TRF PDP subscale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCI-related</td>
<td></td>
<td>CBCL Withdrawn subscale</td>
<td>C-TRF Withdrawn subscale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCI (A criteria)</td>
<td>ADOS-2 SA CS subscale</td>
<td></td>
<td></td>
<td></td>
<td>SRS-2 SCI subscale</td>
</tr>
<tr>
<td>RRB domain (B criteria)</td>
<td>ADOS-2 RRB subscale</td>
<td></td>
<td></td>
<td>SRS- RRB subscale</td>
<td>RBS-R scale</td>
</tr>
</tbody>
</table>

*Note.* DSM = Diagnostic and Statistical Manual of mental Disorders; SCI = Social Communication and Interaction; RRB = Restricted and Repetitive Behavior; ADOS-2 = Autism Diagnostic Observation Schedule-2; CS = Comparison Score; SA = Social Affect; CBCL = Child Behavior Checklist; C-TRF = Caretaker-Teacher Report Form; SRS-2 = Social Responsiveness Scale-2; RBS-R = Repetitive Behavior Scale.
The *Figure Ground task* (FG) is a task from the test-battery Leiter-R (Roid & Miller, 1997), standardized for children from the age of 2. In the modified version of Study III, the child was asked to point to a part or a detail in each of 14 realistic colored complex pictures. Exposure time was 20 s for each picture. For accuracy, 1 point was given for pointing at the target within 20 s and 0 points when failing to detect the target (max.14). Response latency was measured for the five most frequently answered items (sweater, plant, tap, brush, and tie), from the picture being visible to the participant pointing at the target. If the participant failed to detect the target, the response latency was set to maximum exposure time (20 s).

*Figure 1 Local and Global tasks, Study III*

*Hidden Pictures* (HP; Roid and Sampers 2004) are two tasks from the Merrill Palmer developmental scales (Roid & Sampers, 2004), standardized for children from the age of 1 month to 6.5 years. The HP task is administered at the developmental level corresponding to 4 years of age. The task includes two
pictures, one with moons and stars and one with Xs, depicted in two different backgrounds. In the original task, only the moons should be identified in the first picture. In study III, both identifying the moons serving as a test-trial, and identifying the stars serving as the first task, were included. Thus in this task seven slightly differently depicted stars in the first picture and nine X-shapes in the other were to be dis-embedded from two colored realistic sceneries. Participants were asked to find and point at as many targets as possible. For the X-shape task the target was pointed out after 10 s, if the child had not found any X-shapes. Time limit was 30 s for finding stars and 45 for finding X-shapes. Accuracy was measured as the total amount of correct targets for stars and X-shapes (max. 16). Response latency was measured from the picture being visible to the participant, to the pointing at the first star and X, respectively. When the administrator had to point out the target after 10 s, the latency was measured as 10 s plus the time lapse from the administrator pointing at the X, to the participant pointing at another X. If the participant failed to find the targets, the latencies were set at total exposure times, 30 s for the star task and 45 s for the X-shape task.

Global Measures

The Fragmented Picture Test (FPT; Kessler et al. 1993; Snodgrass and Vanderwart 1980) was modified to fit the age group. In this task, the participant is exposed to a fragmented animate or an object in a white background, which gets more and more complete, and the threshold is set to the picture were the object is correctly named. After two training images (car and mouse), 4 pictures were used (elephant, pig, shoe and scissors). In this modified version four levels (towards completion) retouched into seven levels, were used. The tasks were presented in Windows 2010 Power Point-format on a lap-top computer screen. Each picture-sequence was pre-programmed to be shown for 4 s. Accuracy was the sequence of correct detection. Score 1, was assigned to the complete picture and score 7, to the most fragmented. No or wrong answers were given 0 points (max. 28). This measure reflects both accuracy and response latency as each sequence was set at 4 s. However, results are reported as accuracy scores in the analyses.

The Gestalt Closure task (GC; Kaufman and Kaufman 2004) is a task from the Kaufman ABC (Kaufman & Kaufman, 2004), standardised for children from the age of 2,5 years. In this task, the child is supposed to name inkblot drawings in a white background, representing fragmented objects or animates. The test was administered according to the manual, with the stopping rule of ending the test after four successive failures. Accuracy was the sum of correct answers, 1 point for each correct answer (max. 24). Response latency was based on the six most frequently answered items (butterfly, clock, flower, face, dog, bed), calculated from the picture being visible to the child, to the
first syllable of the correct naming of the target. At least three items had to be correctly answered for the calculation of mean. Maximum exposure time was 15 s.

Analyses

In Study I, II and III, statistics were performed in SPSS 24 (IBMCorp, 2016). In Study I and II, percentile confidence intervals 95%, based on 1000 bootstrap samples, were applied in all descriptive and main results. All analyses of the scales were based on raw scores. Outliers were inspected visually and detected by extreme values for Mahalanobis distances (>11), Cook’s distance (>1) and standardized DFBeta (> 1). In Study I and II, we chose to analyze data both dimensionally and categorically as this could help us to interpret the result. A potential scenario could be that a subscale differentiated between groups, but that this reflected symptoms, other than core autistic symptoms. The dimensional analyses could then help us to draw conclusion about the association between the ratings and autistic symptoms per se, as measured by the ADOS-2 scores. In order to assess the RRB and SA domains separately, the dimensional approach is the only available option (as the diagnosis includes both). Prior to the linear regression, assumptions of normality of residuals and homoscedasticity were inspected and found fulfilled. In the linear regressions we focused on the children at high risk for ASD (i.e., the HR-ASD and the HR–no ASD groups together), excluding the LR group. We chose to focus on the two HR groups as these both come from a similar familial background and had a large variation in elevated autistic symptoms and signs of ADHD/SI. A two-tailed alpha-level of 5% was applied for significance but given our directional hypothesis, trends were also reported. Results were analyzed with Brown Forsyth F*. Corrections of p-values for multiple comparisons were calculated by the method of false discovery rate (Benjamini & Hochberg, 1995). Post hoc results were reported according to Games Howell’s test. For the prediction of group, prior to analyses, all predictor variables were tested for linearity of the logit (binary regression with the predictor variables analyzed separately with the groups LR vs HR-noASD; LR vs HR-ASD; HR-noASD vs HR-ASD as outcome variables). All interactions had greater values than .05 (∆p >.22 in study I and ∆p ≥.098 in study II), indicating no violation of this assumption.

For Study I, Pearson’s r bivariate correlations were computed for the ADOS-2 CS and the informants’ ratings for the HR group. As the Withdrawn and PDP scales partly included the same items, regression analyses were analyzed in pairs (i.e., parent Withdrawn vs. preschool Withdrawn; parent- PDP vs. preschool PDP). Multiple linear forced entry regressions were conducted with scores for the Withdrawn and PDP scales as predictors and the ADOS-2 CS
as outcome variable. One-way ANOVAs, one for each informant and subscale were analysed list-wise. Multinomial logistic regression was conducted with LR, HR-noASD and HR-ASD as categorical outcome variables with HR-ASD as reference category and the two subscale pairs as predictor variables.

For Study II, Pearson’s $r$ bivariate correlations between the ADOS Social Affect and ADOS RRB scales and the variables SRS-2 SCI and RBS-R were calculated. Multiple linear regressions were conducted with the ADOS-2 SA CS entered as the outcome variable, and both the SRS-2 SCI and the RBS-R algorithm scores entered simultaneously as predictor variables in the one and the same block. The corresponding analysis with the ADOS RRB algorithm scores as outcome variable followed. Group comparisons were analysed list-wise with one-way ANOVAs for the SRS-2 SCI and the RBS-R scales. Multinomial logistic regression was conducted with the LR, HR-noASD and HR-ASD as categorical outcome variables, with the HR-ASD group as reference category and the SRS-2 SCI and RBS-R scales entered as predictor variables.

For Study III, sessions were video-recorded for off-line analyses, using an XProtect Smart Client video system. For the global GC test, Adobe Premiere Pro SC5 software was used for off-line auditory and visual analyses. Time resolution was 25 frames per second (i.e., each frame lasts 40 ms). Response latencies were manually coded and stored in an excel file (in seconds). Statistical analyses were conducted variable-wise as the distribution of missing values varied among tasks, due to missing recordings or participants looking away or being distracted compromising analyses of latency or accuracy scores. According to Shapiro Wilk testing, 3 out of 27 variables were not normally distributed (global GC, local HP accuracy, HP latency in the HR-noASD group). Considering the majority of data being normally distributed and analysis of variance (ANOVA) being robust against moderate violations of normality (Lix et al. 1996), parametric inference statistics were chosen. One-way ANOVAs were calculated for group comparisons. Moreover, analyses of co-variance (ANCOVA) were conducted, controlling for non-verbal IQ. A two-tailed alpha-level of 5% was applied for significance. Homogeneity was violated for accuracy and latency on HP and were analysed by Brown and Forsyth’s $F^*$. All other variables were analysed by $F$. Post hoc were conducted with Bonferroni (when F-value) or Games-Howell tests (When Brown and Forsyth’s $F^*$), the latter given the differences in sample size. Effect-sizes for significant results were calculated with Cohen’s $d$, using pooled standard deviations (sp) given the difference in sample size. Partial eta squared ($\eta^2$) was calculated for the ANCOVA result. Corrections for multiple comparisons across the one-way ANOVAs were conducted by the method of false discovery rate (Benjamini and Hochberg 1995). Apart from this correction across the ANOVAs, the Bonferroni/Games Howell p values were also corrected for multiple comparisons by false discovery rate, when the main result
between groups was significant. Post-hoc power analysis (G-power, F-test, post-hoc ANOVA one way) showed that this study had acceptable power to detect large effects ($1 - \beta = 0.64$), but not medium or small effects ($1 - \beta = 0.01–0.56$).
Study I: Spotting Signs of Autism in 3-year-Olds - Comparing Information from Parents and Preschool Staff

Background

It is recommended that assessments of ASD in young children are supported by structured clinical observations with the Autism Observation Schedule-2 (ADOS-2), and the Autism Diagnostic Interview-Revised (ADI-R) (Falkmer et al., 2013; Huerta & Lord, 2012; Lord et al., 2012; Rutter et al., 2003, 2008). In addition, information from other informants such as preschool staff about the child’s behavior in preschool is potentially valuable (Dereu et al., 2012; Gustafsson, Proczkowska-Björklund, & Gustafsson, 2017; Ivanova et al., 2011). It has been suggested that teachers can evaluate children more accurately than parents because they can compare the individual child with a range of peers (Reed & Osborne, 2013). In line with this, research has shown that preschool staff are better at discriminating children with ASD from children with other developmental concerns, compared to parents (Aldridge et al., 2012; Stickley et al., 2017). However, available research in this area has mainly focused on children older than three years. Thus, little is known about the accuracy of the information, provided by preschool informants at younger ages. The objectives of this study was to compare parents’ and preschool staff’s ratings of autistic symptoms in young children in relation both to diagnostic assessments and to a gold-standard diagnostic instrument (the ADOS-2). The first aim was to investigate if ratings on the autism associated Withdrawn and Pervasive developmental problem subscale (PDP) from the parent-CBCL and preschool-TRF (Achenbach & Rescorla, 2000, 2004), would discriminate between groups with and without ASD at 36 months. We hypothesized, based on previous findings that both parents and preschool staff could differentiate between a high-risk group with ASD (HR-ASD), a high-risk group with no ASD (HR-noASD) and a low-risk group with typical development, but that preschool staff ratings would be more accurate than parent ratings. Our second aim was to investigate if variance of the ADOS–2 comparison scores could be predicted by the ratings scores for the informants. Again, in line with previous findings, we expected that results for both informants on the Withdrawn and PDP subscales would predict variance in the ADOS-2 CS,
but that preschool ratings would have a higher predictive value than parent ratings.

Results

Group comparisons for the preschool-TRF showed that preschool staff could discriminate the HR-ASD group from both the LR and the HR-noASD groups. This was found for both subscales with higher mean scores for the HR-ASD group. No difference was found between the HR-noASD and LR groups. Group comparisons for the parent Withdrawn subscale, showed a trend group difference between the HR-ASD and LR groups (\(p = .091\)), indicating higher scores for the HR-ASD group, but non-significant results for the other post hoc comparisons (\(p_s .104 -.557\)). Group comparisons for the parent PDP subscale, showed significantly higher mean scores for the HR-noASD group, and a trend for higher mean scores for the HR-ASD group in relation to the LR group (\(p = .059\)).

Multinomial logistic regression showed that a substantial part of the variance in diagnostic status was explained by the parent-CBCL/preschool-TRF Withdrawn and PDP ratings (\(R^2\) range: .28 - .35), with the preschool ratings contributing uniquely to discriminating between the two HR groups for both subscales. The parent PDP subscale differentiated between the HR-ASD group and the LR group but not the HR-ASD and the HR-noASD groups (\(p = .330\)).

The parent Withdrawn subscale made no significant contribution to the model (\(p_s = .117 -.656\)). In the dimensional analysis, the ADOS-2 CS were positively correlated with the preschool PDP subscale. The preschool Withdrawn subscale showed a trend in the same direction as the PDP ratings, but did not reach statistical significance. The parent Withdrawn and PDP subscales showed no significant correlations with the ADOS CS.

The linear regression showed that together the preschool-TRF and parent-CBCL Withdrawn scores explained variance in the ADOS-2 comparison scores, but only at trend level (\(R^2 = .13, \text{Adj } R^2 = .08, F(2,39) = 2.80, p = .073\)), no subscale showing a significant unique contribution to the model (preschool Withdrawn: \(p = .193, 95\% \text{ CI } .048 -.935\); parent Withdrawn: \(p = .711, 95\% \text{ CI } .266 -.576\)). In contrast, the model with the predictor PDP variables was statistically significant (\(R^2 = .24, \text{Adj } R^2 = .20, F(2,39) = 6.14, p = .005\) and the preschool PDP subscale made a significant unique contribution to the model (\(\beta = .48, p = .031\)), explaining 19.3% of the variance in ADOS-2, CS. The parent PDP scores made no significant contribution (\(\beta = .01, p = .94\)).
Discussion

The results of Study I are in line with studies on the SRS in older children, which found that teachers rated autism symptoms more accurately than parents, both regarding group differences and in relation to ADOS-2 CS (Constantino 2002; Constantino 2012; Aldridge et al., 2012; Duvvokot et al., 2015; Reszka et al., 2014). The correlations between the preschool Withdrawn subscale and the ADOS-2 CS, did not reach statistical significance although in the same direction as for the PDP subscale. This could suggest that the ASD specific items found in the PDP subscale (mainly of restricted and repetitive behaviors), and not the common items represented in both subscales, contribute stronger to the accuracy of the preschool ratings, at least when evaluated against autistic symptoms measured by the ADOS-2 CS. Contrary to preschool ratings, no correlations were significant for the parent subscales in relation to autistic symptoms. Further, parents could only differentiate between the LR and the HR groups (HR-noASD and HR-ASD groups) by the PDP subscale ratings. Taken together, this suggests that whereas parents are able to discriminate between groups that differ substantially in terms of symptoms, they are less able to detect (or report) more subtle differences between affected and unaffected HR siblings. Apart from having less opportunity to compare different children’s behavior than preschool staff, an additional reason might be that all HR families have at least one older child with ASD. The older children may be heterogeneous in their behaviour. This could lead to a “baseline” that may vary substantially between families, which may add noise to the ratings of the younger sibling.

The results of Study I point to the potential value of including information from preschool staff in early ASD assessment. Still, it is important to emphasize that the clinical value of ratings on the preschool-TRF, need further investigation. Results should be interpreted with caution and not be used in isolation to inform diagnostic decisions.

Conclusions

Study I showed that, compared to parent ratings, ratings from preschool staff more accurately differentiate children with ASD from LR children and HR children without a diagnosis. Moreover, preschool staff rate ASD symptoms more in line with clinical observation. Parents can differentiate those who clearly have no autistic symptoms from those who have, but report less fine-grained distinctions between groups. Our results suggest that preschool staff can contribute in important ways to the evaluation of ASD.
Study II: Preschool Staff Spot Social Communication Difficulties, but Not Restricted and Repetitive Behaviors in Young Autistic Children

Background

Autism spectrum disorder (ASD) is behaviorally characterized by difficulties in social communication and interaction (SCI) and restricted and repetitive behaviors (RRBs; American Psychiatric Association, 2013; Guthrie et al., 2013; Mandy et al., 2012). Difficulties in SCI should be present in multiple contexts to fulfill diagnostic criteria. Since only one context is represented by the clinical setting, it is crucial to get information about the child’s behavior from the parents. In cases when parents do not report the presence of autistic symptoms (Kim & Lord, 2012a; Zwaigenbaum et al., 2016), other informants, such as preschool staff, could contribute this information. Clinicians sometimes visit the preschool as part of clinical assessment, but an alternative could be to collect information about autistic symptoms in the child from preschool staff. Preschool staff typically meet many children and may therefore rate behaviors more accurately than other informants (Branson et al., 2008). This has also been found in ratings for school-aged children (e.g., Azad et al., 2016; Duvekot et al., 2015). Yet, to our knowledge, there is no data available showing what kind of autistic behaviors (i.e., difficulties of SCI and/or RRBs), that preschool staff identify. The objective of this study was to investigate how accurate preschool staff are at reporting difficulties in SCI, and RRBs in young children. The first aim was to investigate if preschool ratings of SCI and RRBs would discriminate between groups with and without ASD at 3 years of age. We expected that ratings on both domains would contribute uniquely to the differentiation between the groups. The second aim was to investigate if there was a specific association between preschool ratings on SCI and ADOS-2 SA domain scores, and between preschool ratings on RRBs and the ADOS-2 RRB domain scores. We expected a positive correlation between the measures representing each domain.
Results

Group comparisons for the SRS-2 SCI and the RBS-R subscales showed a significant difference between all three groups on the SRS-2 SCI. There was no significant group difference on the RBS-R scale, however post hoc showing a trend of a HR > LR pattern. Logistic multinomial regression analyses showed that only the SRS-2 SCI subscale contributed uniquely to the differentiation between the HR-ASD and the LR groups as well as between the HR-ASD and HR-noASD groups.

The dimensional analysis showed that the SRS-2 SCI was positively correlated with the ADOS- Social Affect Comparison Scores (AS CS) but not the ADOS RRB scores. The RBS-R was not correlated with any of the two ADOS-2 subscales. The multiple linear regression, with the ADOS-2 SA CS as outcome variable and the SRS-2 SCI scale and the RBS-R as predictor variables, resulted in a significant overall model (F(2,45) = 9.01, p = .001, R^2 = .286; Adj R^2 = .254) with the SRS-2 SCI explaining 27% of the variation in ADOS-2 SA CS. The RBS-R did not contribute significantly to the model (b = -.124 [β = -.217], p = .162). Multiple linear regression with the ADOS-2 RRB scale as outcome variable and the SRS-2 SCI and RBS-R as predictor variables did not result in a significant overall model (F(2,45) = .274, p = .762, R^2 = .012; Adj R^2 = -.032). In the additional analyses for the SRS-2 RRB scale, the results were in line with the results for the RBS-R, the ANOVA showing a HR > LR pattern for group means. Furthermore, no significant correlations were found between the SRS-2 RRB scale and the ADOS RRB scale in the HR sample and the SRS-2 RRB showed no significant prediction on either group or ADOS-2 RRB scores.

Discussion

In line with our expectations, we found that preschool staff’s SCI ratings differentiated between all three groups (LR, HR-ASD and HR-noASD) and that the SCI ratings were significantly associated with clinical assessment on the ADOS-2 SA CS. Our results are in line with earlier research (Azad et al., 2016; Duvekot et al., 2015; Major, Seabra-Santos, & Albuquerque, 2017). However, against our expectations, ratings on the RBS-R scale showed no differentiation between the HR groups, and no correlations with the ADOS-2 RRB subscale. The contrast between the clear differentiation between groups on SCI behaviors and the negative result for RRBs, suggest that preschool staff may find it easier to notice social behaviors that are absent, than RRBs that are present. For example, it may be easier to notice a child does not respond to his or her name during morning assembly than to spot that a child engages in subtle finger mannerism. Not taking part in social activity may also
have a greater impact on group dynamics than if a child plays in a repetitive way. An important clinical implication of our result is that total scale scores on SRS-2 ratings from preschool staff should be evaluated with caution and rather be evaluated by separate subscales on the SCI and RRB domains when possible.

Conclusions

Ratings on SCI behaviors by preschool staff are in line with clinical assessment, and can be a reliable source in differentiating children with ASD from those who have not. However, this is not the case for ratings on RRBs. Our findings indicate that direct observation of the child by the clinician is recommended, especially in regard to RRBs rather than using preschool staff exclusively as informants in the preschool context.
Study III: Local and Global Visual Processing in 3-Year-Olds With and Without Autism

Background

In the assessment of Autism Spectrum Disorder (ASD), disability is focused. However, extensive research has also focused on special ability in ASD, such as visual enhanced performance and attention to details (Baron-Cohen, 2002; Happé & Frith, 2006; Mottron et al., 2006; Plaisted, 2001). Detail focus is often referred to as local ability as opposed to global ability, that is, focusing on the whole. Local ability has often been investigated by figure-ground tasks, such as the Embedded Figures Test (EFT; e.g. Shah & Frith, 1983; Witkin et al., 1971). Even if many studies have suggested superior performance on the EFT/CEFT in individuals with ASD, results have still been inconsistent. Results have either indicated equal or, superior ability in comparison to those with typical development (Muth et al., 2014; R. Van der Hallen et al., 2015). Tasks on global performance vary considerably (Booth, Charlton, Hughes, & Happé, 2003; Jolliffe & Baron-Cohen, 2001; Nakano, Ota, Kato, & Kitazawa, 2010; Olu-Lafe, 2015), but a few studies have used visual global object/animate integration tasks such as the Fragmented Pictures test (Kessler, 1993; Snodgrass & Corwin, 1988). Results for the Fragmented Pictures test are mixed, suggesting equal or, inferior performance in individuals with ASD, in comparison to those with typical development (Booth & Happé, 2016; Bölte, Holtmann, Poustka, Scheurich, & Schmidt, 2007; Mottron, Burack, Iarocci, Belleville, & Enns, 2003; Scheurich et al., 2010; van Eylen et al., 2015). Research has mainly focused on school-aged children and adults, and the understanding of local and global ability in young preschool children with ASD is incomplete. The objective of this study was to investigate local and global visual performance in 3-year-old high-risk-for-ASD siblings, either with or without ASD, and low-risk-for-ASD siblings. We expected superior local performance in the ASD-group compared to the two other groups. For global performance we expected inferior performance in the ASD group compared to the two other groups.
Results

There was a between-group effect, after correcting for multiple comparisons across the one-way ANOVAs, on Hidden pictures (HP) accuracy ($F^* (2, 39.46) = 7.34, p = .018$), with post hoc Games Howell tests showing the HR-ASD group to have higher scores than both HR-noASD ($p = .003, sp = 2.69, d = 1.23$) and LR groups ($p = .001, sp = 1.84, d = 1.90$). There were no group differences for accuracy and response latency for the other local measures ($F/F^* (2, 36–42) \leq 2.18, p \geq .401$), nor for the global measures ($F (2, 40–43) \leq 1.80, p \geq .401$). As non-verbal IQ differed between the LR and HR-ASD groups, a between group ANCOVA was conducted, with HP accuracy scores as dependent variable and MSEL’s nonverbal IQ as covariate. The effect remained between groups ($F (2, 39) = 3.99, p = .027$, partial $\eta^2 = 0.170$), and pairwise comparisons with Bonferroni correction showed that the HR-ASD group had higher accuracy scores (Ma = 13.68) than the LR (Ma = 10.48, $p = .049$) and HR-noASD (Ma = 10.60, $p = .035$) groups.

Discussion

In Study III, and in line with our expectations, it was found that 3-year-old children with ASD performed superior to the other groups on the local measure Hidden Pictures (HP). However, unlike previous studies, finding superior performance on the local Children’s Embedded Figures Test (CEFT) in individuals with ASD (Morgan, Maybery, & Durkin, 2003; Pellicano, 2006), we did not find any group differences on this task. The CEFT tasks pose other executive demands than the HP. As executive functions are often found to be altered in individuals with ASD (Lai et al. 2017), demands on executive control, flexibility and planning might thus have “camouflaged” potential superior local visual ability. It could well be that the simpler testing set-up in HP, such as looking for several targets in the same background, using only two pictures, leads to clearer differences between groups, particularly in young ages. However, talking against this, the result on the global gestalt closure task did not differ between groups, despite similar executive demands as for the CEFT. Unlike the other local CEFT and figure-ground tasks, HP demands to find several of the same targets, different in sizes and angles. Superior HP performance in ASD could then either reflect that individuals with ASD show better visual form constancy (i.e., the ability to recognize similarity in form despite differences in sizes and angels) or enhanced visual search of finding several targets in a background. For the global measures, there were no differences between groups. These findings are inconsistent with specific fragmented picture research by Booth and Happé (2016), finding inferior global performance in older children with ASD. It is possible that divergent trajectories of global performance might not have emerged yet in 3-year-olds.
Conclusions

Study III suggests, that enhanced local performance is evident in children with ASD already at the age of 3. Superior performance was found on the local measure HP, independent of general developmental level. Our findings suggest that the testing of visual local performance, for example by a task as the HP, could add value to the clinical characterization of children with early suspicion of ASD. However, replication studies of the findings are needed.
The overarching purpose of this thesis was to improve early recognition of disability and ability in young autistic children. I wanted to find out if information from preschool could be useful in the diagnostic assessment of ASD, and to know if enhanced visual ability could be found in young autistic children.

In Study I, parent and preschool ratings were compared for the two HR groups and the LR group. The Withdrawn and PDP subscales, part of the broadband parent-CBCL/preschool-TRF scales (Achenbach & Rescorla, 2000), were used. It was expected that preschool staff ratings would be more accurate than parent ratings. In line with this expectation, the results showed that in comparison to parents, preschool staff were more accurate at discriminating the high-risk group with ASD from the two other groups on the preschool PDP scale. It was also found that preschool ratings on the PDP subscale were more in line with clinical autistic symptoms.

In Study II, ratings by preschool staff on the social communication and interaction (SCI) subscale from the Social Responsiveness Scale-2 (SRS; Constantino et al., 2012), as well as the Repetitive and Behavior Scale-Revised (RBS-R; Bodfish et al., 2000) were investigated for the two HR groups and the LR group. It was expected that ratings on the SRS-2 SCI, as well as the RBS-R, would contribute uniquely to the differentiation between groups, and that a positive correlation would be found between preschool ratings and clinical scores on the social SA- and RRB subscales on the ADOS-2. The results showed that preschool staff were more accurate in reporting behaviors within the social SCI domain, both in relation to group and to autistic symptoms. In contrast, results for the RBS-R and the additional SRS-2 RRB subscale showed that preschool staff could neither discriminate the HR-ASD group from the HR-noASD group, nor discriminate the HR-ASD group from the LR group. Moreover, no correspondence was found between RRB ratings and symptoms on the ADOS-2 RRB subscale. The results in Study I suggest that when the DSM-5 criteria of social deficits in multiple contexts (American Psychiatric Association, 2013) are not met according to information from the home-family context, preschool staff can add valuable information to the diagnostic assessment about the child’s behavior in the preschool context. Preschool staff can recognize children with ASD as well as observe and rate dif-
ferent degrees of autistic symptoms in children. The findings in Study I strengthen the view that, in cases of discrepancy between parent and preschool report, information from preschool should be considered as a complementary, rather than a contradictory or invalid, source of information about the child’s autistic symptoms in the preschool context (De Los Reyes et al., 2015). The possibilities of receiving an ASD diagnosis as early in life as possible can increase by including report from other contexts in clinical practice. Study I and II also show that the choice of rating scale for preschool staff is important for valid and reliable information about the child’s autistic symptoms. The preschool PDP subscale appears to be a potent subscale for capturing the core features of ASD. An additional correlation analysis of the preschool data was conducted, in which data from both Study I and II was included. The results, presented in Table A: 1 in Appendix 1, show that the preschool PDP subscale was positively correlated with the ADOS-2 SA subscale, and unlike the other scales also positively trend correlated with the ADOS-2 RRB subscale ($r = .051$), as well as positively correlated with all other social and RRB rating subscales.

In Study III, local (dis-embedding) and global (closure speed) visual ability was investigated for the two HR groups and the LR group. Superior local performance was expected in the group of children with ASD, compared with the other groups. In contrast, for global tasks, inferior performance was expected in children with ASD, compared with the other two groups. Results showed that children with ASD performed as well as the other groups on all tasks, except for one. In line with our expectations, performance on the local HP task (dis-embedding stars and Xs), was superior in the HR-ASD group in comparison to the other two groups. Against our expectations, no group difference was found for the global closure speed tasks. Study III showed that enhanced visual ability is present in young autistic children. This implies, first, that visual ability can be identified in autistic children by behavioral tasks. Second, results suggest that the description of autistic individuals as having both significant disability, as well as specific abilities is valid, even in young children (de Schipper et al., 2016; Howlin et al., 2009).

Ways of recognizing, by which I mean both identifying and acknowledging disability and ability in autistic children, was central in this thesis. Study I, II and III showed how both disability and ability can be identified and acknowledged early in the child’s life. The findings are of great importance. Results suggest that the original concept of the autistic individual as having both disabilities and special abilities (Kanner, 1943; Manouilenko & Bej erot, 2015; Robison, 2017) is true even for young children. The research field on visual ability in ASD has been extensive, but has to my knowledge, not been connected to clinical assessment. In the diagnostic system, the ability dimension of ASD is ruled out, which also is reflected in clinical assessment of ASD,
focusing rather on signs of deficits and cognitive impairment. The findings in the studies, together with previous findings, suggest that the original descriptions of ASD should be reclaimed and that ability should be evaluated alongside disability. Combining the assessment of disability and ability could be cost efficient given the knowledge that it could generate. Results also indicate that preschool staff can contribute with valid information about autistic symptoms. This could contribute to earlier diagnosis in cases when parents do not support clinical findings. Preschool staff could also be a potential source of information regarding special skills and abilities in the child. Including items on enhanced autistic abilities in ratings scales, for both parents and teachers, may be as important as the inclusion of items on disability.

In the following sections, I will further discuss and comment on the main findings of this thesis.

Ratings on RRBs

Study I and II in this thesis show that preschool staff can identify autistic symptoms and that they can play an important part for early recognition of ASD. This is important information to communicate to preschool staff. By identifying autistic symptoms, preschool staff could also give appropriate support the child, even before clinical assessment and diagnosis. However, Study I and II indicated that the choice of rating scales is important. The preschool PDP and SRS-2 SCI subscales were found to be reliable measures, whereas the RRB scales were not. The results for the two RRB scales were rather discouraging. Both categorical and dimensional results for the RRB scales suggest that preschool staff found it hard to rate RRBs in children with ASD. Given the assumption that behavior is context-dependent, one could argue that preschool staff did not report more RRB symptoms in the HR-ASD group than the other groups, because the symptoms simply were not present in the preschool context. However, given findings that clinicians can spot autistic symptoms in preschool settings, RRBs should also be possible for preschool staff to observe (Uljarević & Evans, 2017; Westman Andersson et al., 2013).

Apart from not noticing RRBs, there could be reasons for under-reporting symptoms and these could be similar for parent and preschool staff. Like parents, preschool staff can have limited knowledge of autistic symptoms or may notice symptoms, but not find them impairing, especially when the child has average cognitive abilities (e.g., de Bildt et al., 2015; Kim & Lord, 2012a). Preschool staff may also have a salutogenic approach to the child where the reporting of pathogenic findings goes against professional values. Furthermore, ratings out of social desirability could affect results. Preschool
staff may rate the child as having fewer symptoms in order not to worry the parents (De Los Reyes et al., 2015).

Study I and II of this thesis also suggest possible issues with rating scales on RRBs. Even if preschool staff may lack knowledge about RRBs, results also indicate that questionnaires may need to be revised. Both RRB scales in Study II consist of many items, which stress the oddness of behavior, described as “restricted”, “stereotyped”, “repetitive”, and “ritualistic”. This may mislead informants to think of the expressions of RRBs as being more extreme than what was intended. This in turn may lead to decreased reporting on RRBs. RRBs may be easier to rate correctly when part of a broadband scale, as the items in the PDP scale. Items on autistic symptoms may appear less dramatic together with items covering many different aspects of the child’s behavior (Achenbach & Rescorla, 2000; Rescorla et al., 2017) than when presented in a separate scale. The impact of the vocabulary in the scales and the framing of the items may thus be important and need further investigation. The use of a comprehensive broadband scales could also be more cost effective to use than a specific scale on autistic symptoms as it gives the clinician more information about the child’s behavior. One general scale rather than several scales on specific difficulties may also be less time-consuming for the staff to rate. This can be valuable, given the time-pressure and the stress preschool staff experience (Hozo, Sucic, & Zaja, 2015; Sjödin & Neely, 2017).

Performance on gestalt closure tasks

In Study III, different measures of visual ability were investigated. Given previous findings of inferior performance in ASD on accuracy and response latencies for the global fragmented task FPT (Booth & Happé, 2016; D’Souza et al., 2015; Scheurich et al., 2010), we expected inferior performance on closure speed tasks in Study III. However, this was not found. Our results were in line with previous findings for accuracy on the children’s global closure task GC (Allen & et al., 1991), showing a result within average ranges (i.e., ranges equivalent to an IQ of 90-110). The results on both the FPT and the GC in Study III are interesting, as they imply that the children with ASD were neither impaired in terms of contour integration, semantic matching nor word-retrieval. This result, especially for response latencies, can even appear surprising, as slower response times on word-retrieval (rapid naming) is often found in individuals with ASD (Hogan-Brown, Hoedemaker, Gordon, & Losh, 2014). In the FPT tasks, it has also been found that some stimuli are eliciting more matching options of what is depicted than others (Torfs, Panis, & Wagemans, 2010). In trials where the images elicit more matching alternatives, children with ASD have been shown to be less accurate and slower in responding in comparison with those with typical development (Evers et al.,
2014; van Eylen et al., 2015). It is possible that the longer response latencies found in the older children with ASD by Booth and Happé (2016), are due to the choice of images that may have put greater demands on recognition compared with the images used in study III. Moreover, the images in the GC version for children may be more semantically automatized than the images chosen for the GC version for older children (Kaufman & Kaufman, 2004). Factor analyses indeed suggest that the GC task taps into crystallized IQ (i.e., knowledge that have been taught in a particular cultural setting), as well as the verbal fluid task story completion in older children. However, this influence from other factors has not been found in younger children where the GC loads onto the visualization factor (Potvin, Keith, Caemmerer, & Trundt, 2015; Reynolds et al., 2013). Another explanation for the difference in results may be that the sample in Study III were considerably younger than in the Booth and Happé study. At the age of three, the typical global-over-local precedence is not fully developed. This may have balanced out results between the groups in Study III. Booth and Happe’ included participants between 9-21 years, that is, at an age where global-over-local precedence is fully developed in individuals with typical development and an advantage in global performance would be expected relative to individuals with ASD (Dukette & Stiles, 1996; Harrison & Stiles, 2009; Neiworth et al., 2006; Porporino et al., 2004; Wang et al., 2007).

Performance on dis-embedding tasks

In contrast to the results on the gestalt closure tasks, there were differences in performance for the dis-embedding tasks in Study III. The HP task, but not the other two tasks (the CEFT and FG), differentiated the children in the ASD group from the other two groups. In Study III, we suggested that executive demands, in the CEFT and FG tasks, could have affected results, as children with ASD often have executive difficulties (Lai et al. 2017). Specifically, the requirement to wait for a page to be turned, or to “recharge” for each new task, could mask a potential enhanced ability in the children with ASD. In contrast, the HP task has considerably less executive demands as all the stars and the Xs were to be dis-embedded in one background, respectively. Another potential explanation for not finding any difference between groups for the CEFT, could be that the trials were too easy for both children with and without autism. Schlooze and Hulstijn (2014) investigated results for both the CEFT and the EFT in the same sample. They found that boys, 9-14 years of age with ASD, outperformed children with typical development on accuracy, but not reaction time on the EFT. This was not the case for the CEFT. For the 3-year olds in study III though, no ceiling effects were found, as the highest score was nine out of 12, speaking against this explanation. Furthermore, there may have been certain properties in the stimuli used in the CEFT and the FG that
suppressed superior performance in the ASD group. For performance on the EFT (i.e., the CEFT for older children), Van der Hallen et al. (2017) found that the children with ASD were superior on accuracy. However, they had longer response latencies, compared to the other children, when the target was part of a meaningful context (e.g., a triangular window in a house) than in a meaningless context (e.g., the triangle attached to other abstract figures). In the FG and CEFT images used in Study III, all targets were part of meaningful contexts. It is possible that response latencies but also accuracy may have affected the results in the ASD group, given the young age.

As noted, results for Study III showed that performance on the dis-embedding HP task was superior in the HR-ASD group, compared with the other groups. In Appendix 1, Table A: 2, correlation analyses were conducted for the HR groups, to investigate the association between the visual tasks included in the study and autistic symptoms on the social ADOS-2 AS and RRB domain subscales. HP accuracy was positively correlated with both the ADOS-2 AS and RRB subscales, and HP latency was negatively correlated with the ADOS-2 RRB scales. The only other measure that correlated with the ADOS-2 was the dis-embedding measure for CEFT latency, showing a trend-correlation with the social ADOS-2 SA scale. Moreover, looking closer at the results in Table 2 in Study III, performance on the HP was high for all individuals with ASD, with scores of 12 (of max 16) at the lowest. One of thirteen (0 , 8%) in the LR group, eight of twenty-one (38%) in the HR-noASD group, and seven out of nine (78%) in the HR-ASD group had scores > 12, which suggests an increasing ability on the HP with more and more autistic symptoms. Taken together, results show a rather convincing association between the HP task and diagnosis as well as autistic symptoms. There could be differences between the tasks other than methodological issues explaining the results. All three dis-embedding tasks used in Study III required the ability to dis-embed, as well as to attend to and scan the visual field (Kaldy, Giserman, Carter, & Blaser, 2016). However, the difference between the FG task, and the CEFT in relation to the HP task, lies in the fact that several similar targets should be found in the same background in the HP task. A crucial mechanism for spotting similar features is repetition or inter-trial priming. In repetition priming, “repeated presentation of an object’s features or location in visual search tasks, facilitates subsequent detection or identification of that item” (Kristjánsson & Campana, 2010, p 5). Repetition priming is an active process where attention and working memory are presumed to play major parts. Repetition priming is suggested to be a mechanism that serves as a support in orienting towards a target that one is actively looking for and moreover, to dis-embed the features of that target (Kristjánsson & Campana, 2010; Kristjánsson, Sævarsson, & Driver, 2013). An example from everyday life would be the ability to spot funnel chanterelles. Initially, out in the woods, it is very hard to spot the first mushroom, but once spotted, the subsequent chanterelles are much easier to
find, even if they vary somewhat in shape and size. It may be this process that is captured in the HP task. It is possible, that repetition priming is the process behind superior performance also on the CEFT, found by e.g. Pellicano et al. (2005) and as a trend in Study III as the same target is looked for, although in different backgrounds. However, the CEFT may not be as efficient to capture priming effects, due to confounding executive demands, and demands on retaining information in working memory. Furthermore, the CEFT task in itself may also fail to register repetition priming in an effective way, as only one specific triangle or “house” (i.e., not all similar targets as in the HP task) is counted as correct.

Clinical implications

Information from preschool and the evaluation of visual ability in young children could both be part of the routine assessment of ASD. Preschool information could be included in the phase of recognizing the core symptoms of ASD, relative to clinical findings and parent report. Evaluation of visual ability could be part of the cognitive assessment of ASD, specifying if the ASD is accompanied with intellectual impairment or not. By including assessment of disability as well as ability in the clinical practice procedure, information is gathered that gives justice to the child as an individual.

As previously discussed, the choice of rating scale appears to be of great importance in order to get valid information from preschool. It is important for both preschool staff and clinicians to be aware of possible difficulties in recognizing RRBs, and educational efforts about the core symptoms in ASD should be initiated. Bearing this in mind, with appropriate rating scales, preschool staff can be an important complementary source of information in the diagnostic assessment. Given the high percentage of cases where parents do not report significant autistic symptoms in the child (de Bildt et al., 2015), preschool information could potentially ease the professional dilemma of whether to postpone diagnoses or settle on diagnoses without sufficient information, even when the child shows significant clinical autistic symptoms. Information through rating scales is also a cost-effective way of receiving information about the child. Clinicians may not need to observe the child in the preschool context when receiving information from preschool by ratings. This makes the diagnostic process less time-consuming for the clinician, which gives opportunities for other children to receive earlier assessments.

Study III in this thesis found that it is possible to evaluate visual abilities, such as dis-embedding and closure speed in 3-year-old children, even when using tasks originally developed for older children, such as the dis-embedding CEFT and fragmented FPT task. The inclusion of evaluation of visual ability in cog-
nitive assessment of ASD would require a cross-battery approach, as not all cognitive test batteries include relevant visual tasks. Even if not common in Sweden, cross-battery assessment is common in the US where extensive guidelines have been developed (Flanagan et al., 2013), which probably would be easy to implement in Sweden. There is however a skepticism toward using dis-embedding tasks in clinical assessment due to the inconsistent results (White & Saldana, 2011). Performance on the EFT/CEFT has been found to be superior or equal in individuals with ASD compared to those with typical development. This inconsistency could well be in line with the fact that many (37 - 42%) but not all autistic individuals show superior skills and superior cognitive performance on e.g. block design tasks (Bennett & Heaton, 2012; Howlin et al., 2009). Even if results in Study III need replicating, the association between ASD and superior performance on the HP was significant in children as young as three years of age. We do not yet know if a task like the HP would reveal a more general enhanced ability in autistic individuals or if result would vary in line with previous findings. Regardless of superior abilities, relative strengths in visual ability could also be important to evaluate in the planning of support and intervention (Allen & et al., 1991; Kuschner et al., 2007). Not to introduce systematic evaluation of visual ability and special skills in autistic individuals, for the reason that special skills are not found in all individuals with ASD, would be unfortunate. Intellectual impairment is currently considered critical to assess when diagnosing a child with ASD, even though it is found in only 30-55% of cases. Therefore, it could be argued that visual ability could also be something routinely included in the diagnostic assessment.

Early detection of disability is important for support and intervention for the child, but early detection of enhanced ability could be as important for support, educational guidelines and intervention. However, this is an area currently neglected and unexplored. For example, there are many visual educational materials (e.g., tasks such as spotting the difference, finding the odd one out, or detecting the hidden object), which could be used as possible mediators in social training and intervention for young children. For example, an interest in details could serve as a means for practicing the switching of attention between relative “details” and “wholes” or for the training of turn-taking and joint attention. Further, when using visual material as support for the child, we do not know how these should be designed for the child to perceive the main message in the picture. For example, the balance in the low- and high-frequency information in the materials may be of great importance as to which features the child attends to.

Taking special skills in consideration in clinical assessment is in line with the work within the International Classification of Functioning were abilities are mapped in autistic individuals, and where abilities like attention to details is
recognized as a special strength (de Schipper et al., 2016; WHO, 2007). The United Nations Convention on the Rights of Persons with Disabilities (Article 24 and 26, A/RES/61/106) stresses that strengths must be recognized and encouraged in order for the individual to reach his or her fullest potential. The introduction of ASD in the DSM system in the 1980s took a step forward from the psychodynamic view on ASD. This was a crucial step towards new perspectives on ASD. However, the diagnostic system may also have also resulted in moving away from the ability dimension of ASD, which now is high time to reclaim. The early recognition of ability, both in the home/family context, as well as the preschool context, could lead to more encouragement of special skills. This could in turn, lead to a sense of empowerment in the growing child. More knowledge of how to incorporate ability in intervention is therefore essential. Mapping enhanced skills in the individual could also lead to more information about future possible working areas that would be suitable for the autistic individual, increasing the sense of self-efficacy and well-being. This could also contribute to greater awareness and to the recognition of autistic ability in society.

Both the inclusion of other informants and evaluating specific ability in the assessment of autistic young children could help to ease off burdens for the parents. It can be reassuring for parents that another informant, such as preschool staff, can give valid information about autistic symptoms, and that their own observations of no autistic symptoms in their child need not be invalid but simply an expression of the context that the child is observed in. This could avoid stigmatizing the parents for not reporting significant symptoms in the child. Moreover, the mapping of visual ability and potential findings of enhanced ability could give hope to parents about their child’s capacity and can suggest ways of communicating with the child.

Limitations
Unlike ASD research in general, the studies in this thesis included a higher proportion of girls than boys. Half of the children in the HR-ASD group in Study I and II were girls, and in Study III almost two-thirds were girls. In rating studies from other countries, the impact of gender differences have been mixed but some findings show higher scores for boys (Constantino et al., 2012; Harrop, Gulsrud, & Kasari, 2015; Hartley & Sikora, 2009; Hus et al., 2013; Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015; Lawson, Joshi, Barbaro, & Dissanayake, 2018). In study I and II, autistic symptoms in the HR-ASD group may not have been rated as high for the girls as for the boys, which would lead to lower mean scores and make group discrimination harder. The small group of only nine participants in the HR-ASD group in study III, may not have been representative for the autistic group as a whole,
particularly given the gender ratio. In the HR-ASD group seven out of 12 participants were girls. Performance on visual tasks has been found to differ between males and females (Bölte et al. 2011; Lai et al. 2013; Kimchi et al. 2009). It has been shown that males are faster on the dis-embedding EFT than females, both for groups with ASD as well as typical development (Lai et al., 2012; Schlooz & Hulstijn, 2014). It is possible, that this may have led to less distinct results than if only boys had participated. Nevertheless, Study III of this thesis shows that superior performance on dis-embedding by accuracy on the HP task can be found, even in a sample where the majority of the participants are 3-year-old girls.

As discussed earlier, the parent ratings of the siblings in Study I and II may have been affected by the presence of the older sister or brother with ASD. The younger siblings may be viewed and rated as either less or more affected relative to the severity of symptoms in the older child. Moreover, most sibling parents also take part in behavioral intervention programs for the older child, and interventions may also have been applied onto the younger sibling. This could mean that the sibling with clinical autistic symptoms is not perceived as having significant autistic symptoms in the home/family context.

As pointed out previously, one obvious limitation in the studies, and common for sibling designs, was the small sample size, affecting power to identify group differences and relations between variables. For example, post hoc analyses for the ANOVAs in Study III showed a trend group differences between the LR and the HR-ASD groups for both the dis-embedding CEFT and HP latencies and these may have reached significance in a larger sample. Nevertheless, despite small sample sizes, more accurate ratings for preschool staff and enhanced dis-embedding on the HP task were indeed found.

Lastly, the children in the studies of this thesis had mean non-verbal IQ ≥80, which makes results hard to generalize to children with lower IQ (Brown, Chouinard, & Crewther, 2017).

**Future directions**

Information from preschool and evaluation of visual ability can be part of different steps within the routine clinical assessment in ASD. However, further research is needed within these areas.

In the evaluation of rating scales for clinical assessment and diagnostics, it is important to add sensitivity, specificity and receiver operating characteristics (ROC) to the results. In this way, the actual contribution from each informant (parents and preschool staff) could be evaluated against diagnostic outcome.
There may be differences in sensitivity and specificity between sibling samples and samples including comparison groups with other developmental difficulties. In ASD research, children with ASD from clinical samples are often compared with children with other developmental disorders and those with typical development. In the latter case, both sensitivity and specificity are rather high for both parent and teacher ratings. But, when comparing children with ASD and those with other developmental disorders, sensitivity is often high, but specificity low (Aldridge et al., 2012; Limberg et al., 2017; Muratori et al., 2011; Schanding et al., 2012; Stickley et al., 2017). However, in their sibling study, with similar groups as in Study I and II of this thesis, Rescorla et al. (2017) found high specificity but low sensitivity. In Study I and II of this thesis, 40-50% in the HR-noASD group had elevated autistic symptoms and/or signs of ADHD and/or language deficits. The pattern of sensitivity and specificity in Study I and II is not known, but may resemble the sibling study by Rescorla et al. to a higher degree than a sample where all participants in the comparison group have other developmental disorders. In order to evaluate if the result in Study I and II can be generalized to other groups, further research is needed where both sibling and clinical samples are included.

The possible complementary value of parents and preschool ratings in the diagnostic assessment should also be investigated, as the home/family and preschool context may elicit different degrees of autistic behaviors in the child. For one child, parents ratings could support clinical significant symptoms and diagnosis, and for another child, preschool ratings may support clinical findings. In a third scenario, diagnostic support from neither informant could be the case, and direct observation of the child in the preschool setting by the clinician would be needed. Differentiating these scenarios, could lead to a more systematic and cost-efficient work-flow in the assessment procedure for ASD. A study by Lerner et al. (2017) illustrates how information from teachers could add information to the diagnostic assessment. Parents and teachers rated communication, social, and perseverative behaviour in 218 school-aged children with ASD. In all cases, either the parent or the teacher ratings indicated significant ASD symptoms. Both informants rated significant symptoms in 54% of the cases. Another 29% were identified as having significant symptoms according to parents, and 17% as having significant symptoms according to teachers. Thus, applied on the DSM-5 demands of symptoms present in multiple contexts, 17% (37 out of 218) of the children would not have been diagnosed with ASD, if only based on parent report. This percentage is very similar to what Kim and Lord (2012a) found in the discrepancy (20%) between the ADOS and the ADI-R report. From the findings of Study I and II of this thesis, the parent-CBCL/preschool-TRF PDP and the social SRS-2 SCI subscales would seem most appropriate to evaluate.
Swedish norms are also needed. Today, US norms are used for the CBCL/ C-TRF 1.5-5 years, and the SRS-2. It is well known that raw scores on different rating scales differ between countries (Rescorla et al., 2012; Rescorla et al., 2011), but Sweden has not been a part of these comparisons. Danish raw scores have been found to be considerably lower than US scores and this may indicate that lower raw scores would also be found in Sweden. In this case, using US norms would lead to more false negative cases.

In the additional analyses in Appendix 1 (Table A: 1), the preschool PDP scale was found to be correlated with both of ADOS-2 SA and RRB domains as well as ratings scales tapping into both social behavior as well as RRB. In future studies, besides evaluating the subscale as a whole, the PDP subscale should also be investigated by splitting the items tapping into items on SCI from RRBs, in order to evaluate the separate contribution on core symptoms from the informants. When doing this, the slightly modified, newer version of the PDP-scale should be included (Achenbach, 2014). If results can be replicated for this scale, this 12-item scale could be a cost-efficient subscale to incorporate in clinical routine practice. In future studies of the SRS-2, the separate subscales for the social SCI and RRB should also be evaluated.

There is a general need to learn more about the impact of enhanced ability in everyday life for autistic individuals and questionnaires about the child’s perceptual behavior and special skills in the home/family and preschool contexts need to be developed. This should also be evaluated for other modalities than vision (Remington & Fairnie, 2017). Moreover, the link between enhanced skills and cognitive abilities should be studied. The HP task could in principle be tested as separate subtest already today and there are also equivalent tasks for children from the age of five (Snijders, Tellegen, & Laros, 1989). However, more clinical tasks need to be developed and evaluated.

The possibility of the process of repetition priming being active in dis-embedding tasks such as the HP task, calls for more research. Performance on visual search, has been frequently investigated in individuals with ASD, with findings of superior performance (see Kaldy et al., 2016 for a review). Visual search task could also be investigated in relation to repetition priming. The repetition priming effect in individuals with typical development is quite established in visual search task, but has rarely been discussed within ASD research (Burnham, 2015; Kristjánsson et al., 2013; Plaisted, 2001). These tasks differ from dis-embedding tasks as they are often presented in a white background and do not include dis-embedding. In future research, repetition priming should be evaluated in relation to visual search, dis-embedding and other functions that could be relevant such as form-discrimination (Almeida et al., 2014). If an association between repetition priming effects and ASD was to be found, research could also focus possible associations with general core symp-
toms of ASD. The process has been found to be active in both low- as well as high level visual areas, depending on the stimuli, for example, if looking for features or for objects (Kristjánsson et al., 2013; Lamy, Yashar, & Ruderman, 2010; Wig, Grafton, Demos, & Kelley, 2005). Mottron et al. (2013) suggests a link between local bias and specific enhanced skills, mediated by processes in low- and middle visual areas. In ASD, it may be that repetition priming mechanism could trigger higher order behaviors in an extreme way, resulting in attention to details and behaviors of repetition and sameness.
General conclusions

In this thesis, I introduced two potential ways of improving early recognition of disability and ability in clinical assessment of ASD. The result indicates that information from preschool staff can play an important part in the clinical assessment of core symptoms of ASD and that the evaluation of visual ability can be part of routine cognitive assessment in ASD. The findings support that enhanced visual performance is related to ASD and can be found already early in life. Parents, clinicians as well as preschool staff can all play an important part in recognizing disability and also ability in young autistic children.
Autismspektrumstörning (AST) karaktäriseras av funktionshinder inom social kommunikation och interaktion samt av begränsade och repetitive beteenden, men är även förknippat med specifika färdigheter och kognitiva förmågor (styrkor). Funktionshindret som AST medför har länge varit i fokus emedan specifika styrkor hos autistiska personer inte har bedömts eller uppmärksam- matts kliniskt. Det övergripande syftet med den här avhandlingen var att förbättra tidig identifikation och tidigt erkännande av både funktionshinder och styrkor hos autistiska barn. Tre studier av 3-åringar genomfördes inom ramen för Projekt Småsyskon (www.smasyskon.se). Grupperna som ingick var en grupp med barn som hade hög risk för AST, dvs. med en bror eller syster med AST, och som själva hade AST; en grupp med hög risk för AST men utan AST själva; samt en grupp med låg risk för AST, dvs. utan en bror eller syster med AST och med typisk utveckling. Studie I och II fokuserade på värdet av förskoleskattningar i den diagnos- tikiska bedömningen av AST och Studie III undersökte presumtiva specifika styrkor hos autistiska barn.

Studie I undersökte i vilken grad föräldraskattningar och förskoleskattningar stämde överens med diagnos och autistiska symptom hos barnen. Diagnoskriterierna anger att de autistiska symptomen ska vara observerbara i olika miljöer (kontexter). Förskoleskattningar kan vara ett viktigt komplement i den diagnos- tikiska bedömningen av AST när de autistiska symtomen hos barnet inte är tydliga i hemmiljön. Men värdet av förskoleskattningar i förhållande till föräldraskattningar har dock inte studerats tidigare. Resultatet visade att förskolepedagogerna kunde särskilja barnen med AST från de andra barnen i högre grad än föräldrarna, och att pedagogerna skattade mer i linje med kliniska mått på autistiska symptomer än föräldrarna. Studie II fokuserat på förskolepedagogernas specifika skattningar av barnets sociala kommunikation och interaktion å ena sidan och begränsade intressen och repetitiva beteenden å andra sidan. Resultatet visade att pedagogerna kunde särskilja barnen i de tre grupperna när det gällde social kommunikation och interaktion och att skattningarna var i linje med kliniska mått på autistiska symptom. Detta gällde dock inte skattningarna av begränsade intressen och repetitiva beteenden. Resultaten från studie I och II visar att förskolepedagog kan vara en tillgång i den diagnos- tikiska bedömningen, men valet av skattningskala är viktigt och skalor som fokuserar på begränsade intressen och repetitiva beteenden bör användas med försiktighet.
Specifika färdigheter och kognitiva styrkor har konstaterats i minst en tredjedel av personer med AST, men har inte undersökts hos små barn. Mer kunskap om styrkor hos autistiska barn skulle kunna leda till mer individanpassat pedagogiskt stöd och mer riktade behandlingsinsatser än vad som kan erbjudas idag. Flera studier av äldre barn med AST visar att de har bättre visuell förmåga än barn med typisk utveckling, men detta har ännu inte undersökts hos små barn med AST. Studie III jämförde visuell förmåga mellan högriskbarnen med och utan AST och lågrisk- barnen med typisk utveckling. Fem visuella uppgifter genomfördes och omfattade dels att urskilja en inbäddad form eller detalj i en eller flera olika bakgrunder och dels, att namnge objekt som var avbildade på ett ofullständigt, fragmentariskt vis. De tre grupperna presterade lika på alla uppgifter förutom på uppgiften Hidden Pictures. På den uppgiften presterade barnen med AST signifikant högre än barnen utan AST. Resultatet tyder på att även små barn med AST har bättre visuell förmåga på vissa uppgifter än barn utan AST.

Även om fler studier behövs inom skattnings- såväl som det visuella området, visar det sammantagna resultatet i den här avhandlingen, att information från förskolan och bedömning av visuell förmåga kan förbättra tidig identifikation av AST såväl som erkännande av specifika styrkor hos 3-åriga autistiska barn.
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Dear everyone,

This PhD-journey of mine cost an awful lot. But that does not matter now. I am happy!

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Lastly, thank you, all clinicians working with the assessment of ASD. Do not forget to specify:

- ASD with or without accompanying intellectual impairment
- ASD with or without accompanying language impairment
- ASD with or without accompanying enhanced abilities or skills
References


# Appendix 1

Study I and II

Table A: 1 Pearson r, preschool rating scales and ADOS-2 Subscales (HR groups, Study I and II)

<table>
<thead>
<tr>
<th></th>
<th>PDP</th>
<th>ADOS-2 SA CS</th>
<th>ADOS-2 RRB</th>
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<th>SRS-2 SCI</th>
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*Note.* †p < .1; *p ≤ .05; **p ≤ .01; ***p ≤ .001; PDP = Pervasive Developmental Problems subscale; ADOS-2 SA CS = Autism Diagnostic Observation Schedule – 2 Social Affect domain Comparison Scores; RRB = Restricted and Repetitive Behavior; SRS-2 = Social Responsiveness scale -2; SCI = Social Communication and Interaction; RBS-R = Repetitive Behavior Scale- Revised.
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*Note. † p < .10; * p ≤ .05; ** p ≤ .01; *** p ≤ .001; FPT = Fragmented Picture Test; GC = Gestalt Closure; CEFT = Children’s Embedded Figures test; FG = Figure Ground; HP = Hidden Pictures; acc = accuracy; lat = latency; ADOS-2 SA CS = Autism Diagnostic Observation Schedule – 2 Social Affect subscale, Comparison Scores; ADOS-2 RRB = Autism Diagnostic Observation Schedule – 2 Restricted and Repetitive Behavior subscale.
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