ARE PICTURES WORTH A THOUSAND WORDS? TESTING TWO VERSIONS OF THE PICTORIAL INFANT COMMUNICATION SCALE

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Abstract

In an attempt to improve the information parents provide on screening measures for autism spectrum disorders (ASD), Delgado, Venezia, and Mundy (2004) incorporated pictures next to each item depicting the behaviours parents were asked to rate on a new tool called the Pictorial Infant Communication Scale (PICS). The psychometric properties of the PICS appear promising, yet a question only version of the PICS without pictures has not yet been examined against the PICS with pictures. Understanding the role pictures play to clarify constructs for parents on screening tools may result in a more time and resource efficient screening process. A series of analyses were conducted to examine differences between the two versions of the PICS questionnaire, the PICS version with pictures (PPICS) and the PICS version without pictures (NPICS). The participants included 66 typically developing infants and one parent per child. The PPICS was administered to one group and the NPICS to the other. When the children were 12 months of age, parents completed the PICS and the MacArthur Communication Development Inventories - Short Form (MCDI), a questionnaire that measures language development and the children were assessed with the Early Social Communication Scale (ESCS) to obtain a clinical measurement of the child's joint attention skills. When the children were 18 months of age the PICS, MCDI and ESCS were administered again, along with the Expressive and Receptive Language Scales of the Mullen Scales of Early Learning, a standardized measure of language development. When the children were 24 months of age the MCDI and Mullen were re-administered. Cross-sectional and longitudinal correlations between scores on the PICS, MCDI, ESCS and Mullen were assessed for both groups. The overall findings revealed the PPICS, as compared to the

NPICS, at 12 months of age was more highly correlated to the ESCS. Both the PPICS and the NPICS did not correlate to language development. However, there was a trend for the PPICS than the NPICS at 12 months of age to have stronger correlations with language development at 18 months of age. These findings support the inclusion of pictures in screening tools for autism when administered in the child's first year of life.

Résumé

Dans le but d'améliorer les renseignements que les parents fournissent lorsqu'ils sont soumis aux outils de mesure des examens de dépistage des troubles du spectre autistique (TSA), Delgado, Venezia, et Mundy (2004) ont intégré des images à côté de chaque point décrivant les comportements que les parents doivent évaluer, et créé un nouvel outil appelé le Pictorial Infant Communication Scale (PICS) (échelle illustrée : communication de l'enfant). Les propriétés psychométriques de PICS semblent prometteuses. Pourtant une version avec seulement des questions de PICS, sans images, n'a pas encore été comparée au PICS sans images. Un procédé de dépistage plus efficace en termes de temps et de ressource permettra peut-être de comprendre le rôle que jouent les images dans la clarification des constructions destinées aux parents, soumis aux outils de dépistage. Une série d'analyses a été conduite pour examiner les différences entre les deux versions du questionnaire PICS, la version de PICS avec images (PPICS) et la version de PICS sans image (NPICS). Ont participé : 66 enfants au développement typique et un parent pour chaque enfant. Un groupe a été soumis au PPICS et un autre groupe au NPICS. Au 12 mois de l'enfant, les parents ont complété le PICS et les Inventaires Macarthur du Développement de la Communication- Forum court (IMDC), un questionnaire qui mesure le développement du langage et les enfants ont été évalués avec l'Echelle de Communication Sociale Précoce (ECSP), afin d'obtenir une mesure clinique des capacités d'attention conjointe de l'enfant. Au 18 mois de l'enfant, on a de nouveau administré les PICS, IMDC et ECSP, ainsi que les Echelles d'évaluation du langage expressif et réceptif des Echelles Mullen d'apprentissage précoce, un outil de mesure standardisé du développement du langage. Au 24 mois de l'enfant on a de

nouveau administré le IMDC et le Mullen. Les corrélations longitudinales et trans-sectionnelles entre les résultats obtenus aux PICS, IMDC, ECSP et Mullen ont été évaluées pour chacun des deux groupes. Les résultats généraux montrent que le PPICS, comparé au NPICS, pour l'âge 12 mois sont beaucoup plus corrélés au ECSP. Le PPICS et le NPICS ne sont pas corrélés au développement du langage. Pourtant, on peut remarquer que le PPICS tend, plus que le NPICS pour l'âge 12 mois, à avoir plus de corrélations avec le développement du langage à l'âge pour l'âge 18 mois. Ces découvertes soutiennent l'inclusion des images dans les outils de dépistage du TSA lorsqu'ils sont administrés dans la première année de la vie de l'enfant.

Are Pictures Worth A Thousand Words?

Testing Two Versions of the Pictorial Infant Communication Scales (PICS)

Autism Spectrum Disorders (ASD) are neurological disorders that range in severity from nonverbal, autistic disorder to a milder form of Asperger syndrome that is defined by typical verbal development and normal to high IQ (American Psychiatric Association, 1994). When the criteria for either autism or Asperger syndrome are not met, the classification of Pervasive Developmental Disorder-Not Otherwise Specified (PPD-NOS) is often used (American Psychiatric Association, 1994). Autism is considered to be the core of the ASD group of disorders, affecting an estimated 60 in 10,000 births (Baird et al., 2000; Chakrabarti & Fombonne, 2001, 2005). Although a diagnosis of autism is usually made no earlier than 3 to 4 years of age (Wiggins, Baio, & Rice, 2006), a significant proportion of parents with children diagnosed with autism report that they suspected something might be wrong before their child was 1 year old (Gillberg et al., 1990), and most consult their pediatrician about their concerns by the time their child reaches 18 months of age (Wing, 1997). Despite evidence that many symptoms of autism appear during infancy (Gillberg et al., 1990; Howlin & Moore, 1997), considerable time elapses between the initial appearance of the first signs of autism, when parents seek professional involvement, and finally to the age that a reliable diagnosis can be made.

The diagnosis of autism during infancy is optimal because early intervention is now thought to lead to improved behaviour management, communication, and functional skills among children with autism (for a review, see National Research Council, 2001), and to fewer secondary difficulties such as psychopathology associated with autism

(Scott, Baron-Cohen, & Brayne, 2002). Parents also benefit from early diagnosis because they may alleviate concerns about their child's atypical behaviours, join parent support groups to manage stress, and access genetic counseling about subsequent children (Baird et al., 2000). With the many benefits of early diagnosis, one way to ensure children are diagnosed early is to develop screening measures that reliably identify infants at-risk for developing autism.

The development of valid and reliable screening measures for autism is largely contingent on identifying the discriminating features of autism early in development. Two discriminating features that are consistently restricted or entirely absent in the autism population at a very young age are joint attention and pretend play (Baron-Cohen, 1987, 1989; Mundy, Sigman, Ungerer, & Sherman, 1986; Sigman, Ungerer, Mundy, & Sherman, 1986; Wing, Gould, Yeates, & Brierley, 1977). Joint attention begins to develop far earlier than pretend play, so it is the skill that is commonly incorporated into screening measures designed for use with young infants.

Once joint attention behaviours are translated into verbal descriptions and incorporated into screening tools, researchers must establish that the items reliably measure joint attention behaviours. Because joint attention is a developmental predictor of language skills among typically developing and developmentally delayed children (Calandrella & Wilcox, 2000; Markus, Mundy, Morales, Delgado, & Yale, 2000), the initial steps in developing screening tools is to confirm that the items on the screener predict language skills. Once it is established that the items on screeners reliably predict language skills further development of the screener is warranted.

Although several screening tools that incorporate joint attention constructs to identify infants at risk for autism are being developed (Baron-Cohen et al., 1996; Reznick et al., 2007; Robins, 2008), each has its limitations. One problem is that parents do not necessarily provide accurate information about their children's behaviours on screening tools. This may be because of the difficulty in translating joint attention behaviours into verbal descriptions that parents understand and interpret accurately (Delgado et al., 2004). For example, joint attention behaviours, such as pointing for interest and gaze following, were items that parents disagree upon most with clinicians (Baron-Cohen, Allen, & Gillberg, 1992) or leave blank on parent report screening measures (Swinkels et al., 2006), suggesting either that parents have difficulty understanding these constructs or that the constructs are not translated into easily comprehended verbal descriptions.

Some researchers attempted to improve the accuracy of the information that parents provide on screening instruments in various ways (Scrambler et al., 2006; Stone et al., 2004). Some attempts to improve screeners include incorporating a follow-up phone call by a clinician to clarify concepts that parents may misunderstand on the screener, having a clinician attempt to elicit behaviours in the child in order to check observed behaviours against the parental report, or even eliminating the role of the parent entirely and relying solely on clinical evaluations (Stone et al., 2004). These modifications improve the screening tools, but as they further complicate the screening process and significantly increase the amount of time and number of resources required, they are not feasible for screening at the population level.

A more time and resource efficient way to clarify concepts and improve the accuracy of the information parents provide may be to incorporate pictures next to items

on screening tools. Pictures provide parents with a visual representation of the behaviour described in the verbal description and may clarify the construct about which they are asked to report. For example, a screening instrument called the Pictorial Infant Communication Scale (PICS; Delgado et al., 2004, Venezia, & Mundy, 2004) was designed to improve the accuracy of the information that parents provide by incorporating pictures next to each item depicting the behaviours that parents are asked to rate.

The PICS is a brief parent report questionnaire that consists of 16 items, which makes it a time and resource efficient tool. The parents' rate the behaviours described in the questions and depicted in the pictures during the past two-week period. They answer the questions on the PICS using a 4-point frequency scale including 'not sure', 'never', 'sometimes' and 'frequently'. Subscores are calculated for initiating and responding to joint attention, initiating behaviour requests, and an overall score.

Research on the psychometric properties of the PICS is underway and two studies have been completed. In a first study on its reliability and validity, the PICS was administered to 30 parents when their children were 15 and 18 months of age (Delgado et al., 2004). The children's vocabulary skills were assessed at 15, 18, 24 and 30 months of age with the short version of the MacArthur Communicative Developmental Inventories (MCDI, Fenson et al., 1994), and their overall developmental functioning was assessed at 18, 24, and 30 months of age with the Bayley Scales of Infant Development (BSID; Bayley, 1993). Test-retest reliability from 15 to 18 months was found to be high ($r(30) = .63$, $p < .001$). The PICS scores at 15 months were significantly, positively correlated with MCDI expressive language scores at 15, 18, and 24 months but not at 30 months of age.

The PICS scores at 18 months were marginally correlated with MCDI scores at 18, 24 and 30 months of age, but did not reach statistical significance. With regard to cognitive development, the PICS scores at 15 months were significantly, positively correlated with the BSID scores at 18 and 30 months, and the PICS scores at 18 months were significantly positively correlated with the BSID scores at 30 months. Therefore, the PICS provides a valid index of differences in early social-communication and cognitive development in normally developing children.

In a second study, the PICS differentiated children with autism from children with developmental delay (Thorpe & Mundy, in submission). Further validation of the PICS is currently underway to determine the ability of this screening tool to identify children with autism from an unselected sample (Delgado et al., 2004). Additional research to determine whether the addition of the pictures actually improves the accuracy of the information parents provide is warranted.

Aims of the Present Study

The main goal in the development of the PICS was to incorporate pictures in order to clarify concepts such as joint attention behaviours and to improve the accuracy of the information that parents provide without the need for a clinician. The primary purpose of the present study was to determine if the pictures on the PICS actually help parents to understand the items on the measure, by comparing the version of the PICS with pictures (PPICS) to a question only version of the PICS without pictures (NPICS) (see Appendix A and B). The role of pictures to improve screening tools is important to understand because other screening tools may be improved by incorporating pictures next

to items and omit the need for more time and resource consuming methods such as a clinical evaluation.

As joint attention predicts language development in very young children (Barton & Tomasello, 1991; Markus et al., 2000), the first analysis conducted was to compare the relationship between the joint attention items from the PPICS and NPICS to concurrent and later language development. The second analysis conducted was to compare the relationship between the joint attention items from the PPICS and NPICS to the joint attention items on the Early Social Communication Scale (ESCS), a clinical measure of joint attention skills among infants (Guidetti & Tourrette, 1995).

The PPICS was expected to help parents understand the items on the questionnaire so that the information they provide would be more accurate than with the NPICS. Therefore, the PPICS was expected to be more strongly related to concurrent and later language development and the ESCS than the NPICS.

The Development of Joint Attention among Typically Developing Children

Among typically developing children, the emergence of joint attention, defined as the process of sharing one's experience of observing an object or event, by following gaze or pointing gestures (Mundy et al., 2007), is closely linked to the emergence of intentional communication in early infancy (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). A component of intentional communication is the transition from the lack of awareness of one's surroundings to the realization that behaviour has consistent and predictable effects on the world. One way this transition in awareness occurs is when infants realize their communicative partners attribute meaning to their actions and react accordingly (Bates, Camaioni, & Volterra, 1975; Dersochers, Morisette, & Ricard, 1995).

Infants develop these skills gradually and over time are able to coordinate their behaviour, modify communication signals, and direct bids of communication to more than one person if their needs are not met by the first person. These skills begin to develop around 6-9 months of age, and by 12 months, most typically developing infants show intentional communication that is goal directed, conventional, and purposeful (Wilcox, Hailey, & Ashland, 1996).

Bates et al. (1979) identified three main skills associated with intentional communication. First is the emergence of joint attention and specifically the ability to coordinate eye gaze between an object and the communicative partner. Second is the child's ability to continuously modify their gestures, such as pointing, until their communicative goal is met. Third is that vocalizations begin to resemble speech patterns or conventional sounds during intentional communication. An example of the development of intentional communication among infants is the progression from a cry for a bottle, to looking at the bottle while making a sound such as "bobo", which resembles the actual word for bottle more closely, to finally coordinating their eye gaze and attention between the bottle and their communicative partner, while pointing to the bottle and saying "bobo" until they obtain the desired object. Thus, the emergence of intentional communication among infants involves a complex interaction of nonverbal and verbal communication acts between the infant and their communicative partner (Bates et al., 1979).

The first step of intentional communication involves the development of many skills because a child advances from using eye contact with the communicative partner alone to mastering gaze alternation which requires dividing and alternating attention

between the communicative partner and the object of interest. Gaze alternation between object and person is known as coordinated joint attention and develops between 12 and 18 months of age. Bakeman and Adamson (1984) examined the development of coordinated joint attention among mother-infant dyads and found that in a ten minute free play session with the mother, about a third of the one year old infants engaged in coordinated joint attention, whereas all of the infants at 18 months of age engaged in coordinated joint attention with their mothers at least once. This suggests that coordinated joint attention is acquired by 18 months of age and contributes to intentional communication (Bakeman & Adamson, 1984).

Intentional communication also involves the development of gestures such as pointing and is required for more complex joint attention episodes. At about 6 months of age, infants begin to reach for desired objects, but are unable to coordinate their reaching with gaze alternation between the desired object and communicative partner until 11 or 12 months of age. At about 13 months of age, reaching for objects is first combined with pointing to the desired object while coordinating eye gaze (Bates et al., 1975), and this behaviour becomes more frequent and complex at 15 months of age (Sugarman, 1984). The development of pointing was illustrated by Dersochers et al. (1995) among 25 typically developing infants who began to show pointing behaviour at 6-9 months of age. At 12 months of age, 67% pointed without eye contact and 13% with eye contact. By 18 months of age, all of the children pointed, but only 79% pointed with eye contact. By 24 months of age, all of the children pointed with eye contact. Among typically developing infants between birth and 2 years of age, the various skills of joint attention, such as eye

gaze and pointing operate in concert and contribute to intentional communication (Dersochers et al., 1995).

The Development of Joint Attention among Children with Autism

The emergence of joint attention primarily involves the division and alternation of a child's attention between the communicative partner and the object (Mundy & Willoughby, 1996). This coordination involves eye contact, one of the most reported deficits among children with autism. Evidence for the relative absence or atypical nature of eye contact in children with autism is evident a variety of studies. In an initial study, Ornitz, Guthrie, and Farley (1977, 1978) asked parents of 74 children with autism and 30 typically developing children to complete a retrospective questionnaire pertaining to the first two years of the child's life. The average age of the children with autism was 45.2 months and the majority of the children had not yet developed speech. These children were distinguished from the typically developing children by their characteristics of avoiding eye contact, being hard to reach, and ignoring others (Ornitz et al., 1978). The children in this study were already diagnosed with autism and the parents responses may have been biased due to familiarly with the diagnostic criteria for autism.

The finding of atypical eye contact among children with autism was replicated by Wimpory, Hobson, Williams, and Nash (2000) who conducted an interview with mothers of 10 preschoolers suspected to have autism but who had not yet received a diagnosis and 10 mothers of children with developmental delay who were not considered to be autistic. The mothers were administered the Detection of Autism by Infant Sociability Interview (DAISI), which elicits data on whether 19 aspects of social engagement characteristic of typically developing infants were present during the child's first 24 months. The children

who were suspected of having autism were distinguished from the children with developmental delay by the reports of their diminished frequency or intensity of eye contact and inappropriate use of referential eye contact. They were also characterized by problems related to joint attention behaviours such as giving, showing, pointing at objects, following others pointing, and using preverbal noises communicatively.

Since joint attention behaviours emerge during infancy and well before a diagnosis of autism can be made, home videos of children between the first and second years of life have been examined to determine if the finding of delayed joint attention skills among children with autism can be replicated at this very early stage in development. For example, Adrien et al. (1993) examined home videos and found avoiding eye contact was rated as the most distinguishing feature among children with autism during the first year of life. Although improvements in eye contact were noted during the second year of life of the children with autism, they were still distinguished from the typically developing children due to their patterns of avoiding eye contact, ignoring others, preference for being alone, and failing to exhibit appropriate gestures such as pointing and emotional expressions.

Retrospective video analysis has also been used to examine differences among a group of 9 and 12 month old children with autism, typically developing children, and children with developmental delays including Down syndrome and Williams syndrome. The children with autism were differentiated from other groups by their patterns of avoiding eye contact, attention to nonsocial visual stimuli, lack of response to name, and aversion to social touch. These findings were replicated by Osterling, Dawson, and Munson (2002) who found that children with autism could be distinguished from other

children with developmental delays in their home videos at one year of age by the amount of time they spent looking as others. Although these studies provide additional support for the notion that children with autism are distinguishable from other children based on specific characteristics and at a very early age, the findings may be somewhat compromised since the obvious physical features of the children with Down syndrome could be easily recognized by the coders and affect their ratings of the participants in this subgroup.

Since home videos may not capture the full range of skills in a child's repertoire, empirical studies have been designed to obtain multiple samples of a child's joint attention skills. In these studies, the ESCS which is designed to elicit nonverbal social behaviours among children between birth and 30 months of age is commonly used. The ESCS provides detailed information pertaining to joint attention behaviours and differentiates between the abilities to initiate and respond to joint attention. With this task, children with autism are found to be significantly different from typically developing children and children with developmental delays because of their deficits in initiating joint attention behaviours including pointing, showing, and eye gaze alteration (Charman et al., 1997). For example, both Charman et al. (1997) and Mundy et al. (1986) found that children with autism engaged in far less eye contact and pointing with an examiner during play with a windup toy, both when the examiner was holding the toy and when the toy was on the table and out of reach. Therefore, children with autism show deficits in joint attention behaviours to share enjoyment and to make requests for assistance.

Although children with autism point less overall, when they do point they tend to be simple and nonsocial forms, such as protoimperative pointing, which is used to ask for an object or a toy that is out of reach (Goodhart & Baron-Cohen, 1993). However, socially oriented pointing such as protodeclarative pointing, which is used to indicate interest in an object, is often severely impaired or not evident at all among children with autism (Baron-Cohen, 1989). Although children with autism are capable of using simple and non social forms of pointing, they do not use these skills during bids for social communication, as in the case of joint attention. Since children with autism most often exhibit a severe and unique deficit in joint attention behaviours, specifically with the use of eye contact and pointing, these are useful behavioral patterns to measure in screening measures. These constructs are not only useful for early screening but their presence is associated with language development and can be used as a marker for developmental outcomes (Markus et al., 2000).

Joint Attention as a Predictor of Later Language Development

Individual differences in joint attention skills are a significant predictor of later language development among typically developing children. The more time that mother-child dyads spend in joint attention episodes, the greater that vocabulary that is obtained by children later in life (Barton & Tomasello, 1991; Markus et al., 2000; Tomasello & Todd, 1983). For example, Yoder and Warren (1993) found that the number of joint attention episodes initiated by the children at 12 months of age predicted the expressive and receptive language skills of the children at 18 months of age. In a slightly older sample at initial assessment, a direct clinical assessment of joint attention skills with the ESCS was used to elicit a wide array of joint attention behaviours in 22 typically

developing children with a mean age of 16.6 months. Their rates of requesting, social interactions and responding to joint attention were all positively correlated to both expressive and receptive vocabulary one year later (Mundy et al., 1996). Multiple researchers have reported that both language ability and language delay in the second year of life are reliably predicted by individual variations in joint attention skills when infants were one year of age (Markus et al., 2000; Morales et al., 2000; Mundy & Gomes, 1998).

Joint Attention as a Predictor of Later Language Development among Children with Autism

The relationship between joint attention and later language development among children with developmental delays and autism seems to mirror that of typically developing children. Mundy et al. (1990) examined groups of children with autism, children with mental retardation, and typically developing children matched on IQ and verbal mental age, and found that the children with autism displayed deficits in joint attention skills on 2 testing sessions, 13 months apart, after language level was controlled. Despite the group differences in IQ, joint attention skills were similarly predictive of language skills at the 13 month for all of the groups.

The finding of a predictive relationship between joint attention skills and language development was also replicated among prelinguistic children with developmental delay. The rates of prelinguistic vocalizations that were used to make requests, engage in social interactions, and achieve joint attention with the experimenter among children 17-34 months of age were all strongly correlated with expressive vocabulary 12 months later (McCarthen, 1999). Calandrella and Wilcox (2000) extended

this work by examining the potential relationship between children's prelinguistic communication behaviours and later expressive and receptive vocabulary among 25 children with developmental delays and their mothers when the children were about 18, 24 and 36 months of age. The children's intentional nonverbal communication acts, including joint attention, strongly predicted later expressive vocabulary, and their rate of gestural indicating acts, including pointing, reaching, or giving without eye contact predicted later receptive vocabulary.

The Relationship Between Joint Attention, Language Skills and the Development of Screening Tools for Autism

Before a new screening instrument can be recommended for use in the general population to reliably identify children at risk for developing autism, the screener must demonstrate sufficient validity and reliability. One way for researchers to measure the attributes of a new screener is to rate whether the items on the tool provide a valid index of differences in language development. Specifically, when the items on the screener pertaining to joint attention reliably predict language skills, then the items are reliably providing a valid index of differences in language skills and further examination of the tool is warranted. Validation of screeners to identify children with disabilities, particularly language delays and autism would be the next steps.

The Development of Screening Tools for Autism: From the Beginning with the CHAT

In the last two decades, numerous screening instruments were developed to prospectively identify cases of autism and each has its strengths and weaknesses. However, no screening tool can be recommended for identifying cases of autism prospectively at the population level, because too many children with autism are either

missed or are falsely identified as having autism (Charman, 2003). To improve the instruments, researchers attempted numerous modifications such as altering the number and type of questions used, informants, age of the participants, and answer format (Swinkles et al., 2006). Each of these modifications led to some improvements, but all the modifications require further investigation before they can be recommended for routine screening of all children.

The Checklist for Autism in Toddlers (CHAT; Baron-Cohen, Allen, & Gillberg, 1992; Baron-Cohen et al., 1996) was one of the first screening tools that was developed to prospectively identify children with autism (see Appendix C). It was designed to measure deficits in joint attention and pretend play that are either absent or restricted among children with autism (Baron-Cohen, 1987, 1989; Mundy et al., 1986; Sigman, Ungerer, Mundy, & Sherman, 1986; Wing, Gould, Yeates, & Brierley, 1977). The CHAT is administered at 18 months since that is the age that the majority of children display joint attention and pretend play skills (Carpenter, Nagell, & Tomasello, 1998). In the first section of the CHAT, parents are asked to answer ‘yes’ or ‘no’ questions about their child’s behaviour. Then a clinician attempts to elicit behaviours in the child in order to check the child’s observed behaviour against the parental report. Scores are calculated from both sections and the thresholds set for autism are the *high risk for autism* for children who fail all 5 key items on the CHAT and *medium risk for autism* for children who fail 2 key items related to protodeclarative pointing. Failure on any of the key items during the first administration is always followed by a second administration (CHAT-2) a few weeks later.

In a first study with the CHAT, Baron-Cohen, Allen, and Gillberg (1992) focused on establishing whether the detection of autism is possible at 18 months of age. Forty-one 18-month old children who were at higher risk for developing autism because they had an older sibling with autism and fifty randomly selected 18-month old children who attended a London health centre in the UK for their routine check-up were screened with the CHAT, which was administered by a General Practitioner (GP) or by a health care professional who visited the children in their homes. The majority of the children (n=87) passed 4 or more of the key items on the CHAT at 18 months of age and continued to develop normally at 30 months of age. However, 4 children in the high risk group failed 2 or more key items at 18 months of age and by 30 months of age all four of these children were diagnosed with autism. The key items failed by the children who were later diagnosed with autism included joint attention, protodeclarative pointing, social interest and pretend play. Overall, the CHAT was considered to be a valid instrument for identifying high risk children at 18 months of age for possible autism.

In order to investigate the effectiveness of the CHAT in a large general population, general practitioners and health visitors administered the questionnaire during a regular developmental check-up to sixteen thousand 18 month old children in the South Thames Region of the UK (Baird et al., 2000). Children who failed any of the 5 key items were administered the CHAT a second time (CHAT-2), usually within one month of the first administration. This 2-stage screening procedure was incorporated to minimize the number of children who were falsely identified as having autism by allowing parents an opportunity to clarify the items on the screener and ask parents to confirm the information they were providing on the initial administration of the CHAT. Of the 12

children who consistently failed the three key items of protodeclarative pointing, gaze-monitoring, and pretend play on the CHAT and CHAT-2 at 18 months of age, 10 were diagnosed with autism at 20 months of age (Baird et al., 2000). When the 10 children were 42 months of age they were reassessed and all 10 children received a diagnosis on the autism spectrum (Baird et al., 2000). Although the remaining two children from the 12 who failed the three key items on the CHAT were falsely identified as having autism, they were not typically developing and received a diagnosis of developmental delay. Children who were found to be developmentally delayed without autism lacked only protodeclarative pointing or protodeclarative pointing and pretend play at 18 months of age, but none of these children failed gaze-monitoring in combination with the other key items. Therefore, the combination of failure on the three key items of protodeclarative pointing, gaze-monitoring, and pretend play at both administrations of the CHAT appeared to distinguish autism from other developmental delays.

The same group of children from the population screening study of the CHAT participated in a series of follow-up screening and surveillance procedures at 7 years of age (Baird et al., 2000). The aim was to establish the CHAT's sensitivity, the proportion of children with a disorder identified by the screen; the specificity, the proportion of children without the disorder who the screen identified as normal; and the positive predictive value (PPV), the proportion of children with a positive screen result who have the disorder. With a one stage administration of the CHAT, 11 of the 38 children identified with the high risk threshold for autism were correctly identified, for a fairly low PPV of 28.9%. Combining the children who met criteria for autism with the medium and high risk threshold together, 33 of the 407 who were identified met criteria for

autism, for a much lower PPV of 8.1%. About 1 month later, a second administration of the CHAT was conducted by a member of the research team, and 10 of the 12 children who continued to meet the high risk threshold and 20 of the 34 children who continued to meet the combined high and medium risk threshold were correctly identified as having autism, indicating significant improvements in the PPV to 83.3% and 58.8% respectively. Of the 16 children who did not receive a diagnosis of autism after the second administration of the CHAT, 9 were diagnosed with other developmental delays. Thus, the two-stage administration of the CHAT can be used to prospectively identify cases of autism at 18 months of age with much more accuracy than the 1-stage approach and with minimal increase in time and resource consumption. However, the sensitivity, specificity and PPV of the CHAT need to be improved to recommend using it at the population level in a clinical setting.

The original key items of the CHAT required parents to always indicate a failure of protodeclarative pointing, but Scrambler et al. (2001) found that by including failure on either the protodeclarative pointing item or an item about pretend play, the properties of the CHAT improved. Using this so-called Denver modification, Scrambler et al. administered the CHAT to a group of 44 children between 2 and 3 years of age with autism and other developmental concerns. Although the chronological age of this group was slightly older than the age for which the CHAT was developed, the mental ages were appropriate as they ranged from 12 to 43 months of age. Each child was seen for a laboratory visit, and both the CHAT and ADOS were administered during the 1 to 3 hour visit. When the medium to high risk criteria were applied, the CHAT showed reasonable sensitivity at 65% and perfect specificity at 100%. When the new Denver Modification

risk criteria were applied the sensitivity was improved to 85% and specificity remained at 100% (Scrambler et al., 2001). Therefore, by using the Denver Modification significantly improves the properties of the CHAT without increasing the amount of time and resources required.

The Denver Modification criteria were later applied to a subgroup of the children who participated in the original Scrambler et al. (2006) study at a 2 year follow up. These participants included 19 children diagnosed with autism and 11 children diagnosed with other developmental concerns who had all been administered the CHAT at 2-3 years of age (Time 1) and received diagnostic and developmental reevaluations between 4 and 5 years of age (Time 2). With the original CHAT criteria for medium to high risk of autism, the diagnostic classification was predicted for 83% of the group at Time 2. However, when the Denver modification criterion was applied, 93% of the sample was correctly classified at Time 2. The children who were incorrectly classified as not having autism but were later diagnosed with autism at Time 2 were all children who had higher cognitive functioning as measured by the Mullen Scales of Early Learning (Mullen, 1995). This may indicate that the CHAT is less sensitive to autism symptoms in children with milder symptoms and is consistent with findings that the CHAT is less sensitive when administered to children with a PDD-NOS diagnosis (Baird et al., 2000).

Other Screening Measures

Other groups have modified the original CHAT in order to improve its psychometric properties. A shortened version of the CHAT including only the five key items for the high-risk threshold was introduced by Drew et al. (2002) to identify children at risk for autism below 2 years of age. This version also included the parent report item,

"Does your child use his/her index finger to point to ask for something?" from the original CHAT. The physicians were asked to only refer children who failed all six key items on the CHAT and those who there was a concern about possible autism, and to exclude those with severe developmental delay. Once these criteria were met and a child was referred to the study, the CHAT was administered for a second time by a member of the research team. A total of 51 children were referred to the study and of those, five no longer met the cut-off criteria after the second administration of the CHAT. Therefore, 46 children went on to receive a full clinical assessment that involved the Autism-Diagnostic Interview - Revised (ADI-R; Le Couteur, Lord, & Rutter, 2003), joint structured clinical observations, and cognitive testing with the Griffiths Scale of Infant Development (Griffiths, 1967). Of the 46 children who were assessed, 31 were diagnosed with autism, 5 with atypical autism or pervasive developmental disorder - unspecified, 6 with a receptive-expressive language disorder, 2 with global developmental delay, and 1 with attention deficit hyperactivity disorder. One child appeared to be developing normally. Thus, when the CHAT was combined with a clinicians concern for possible autism, the positive predictive value was good at 71% for all ASDs and 88% for all developmental disorders (Drew et al., 2002).

M-CHAT

In a modified version of the CHAT known as the Modified-Checklist for Autism in Toddlers (M-CHAT) (see Appendix D), Robins, Fein, Barton, and Green (2001) eliminated the role of the clinician in part B of the original CHAT entirely in order to decrease the amount of time and resources needed for the screening process. Accordingly, the M-CHAT relies entirely on parent report and consists of 23 items,

including the first 9 items of the original CHAT, as well as an additional 14 items pertaining to other aspects of early social communication impairments, repetitive behaviors, and sensory abnormalities characteristic of autism. These were added in an attempt to identify a greater range of children with autism. Initially, children were screened with the M-CHAT at either 18 or 24 months of age. However, following preliminary data analysis on the first 600 children screened, the age criteria of the participants at time of study entry was changed from 18 to 24 months of age exclusively in order to diminish the possibility that regressions, which most often between the ages of 15 and 24 months, would occur after the testing.

Following preliminary data analysis of the first 600 participants who were administered the M-CHAT, 8 items were discarded because they were not as discriminatory as the other items or because many parents misunderstood them. Items representing atypical sensory responsiveness were eliminated (e.g., Does your child seem undersensitive to noise?). Another eight items on the M-CHAT were considered critical and a cutoff criterion of failing 2 of these 8 critical items or any 3 items in total was established (Robins et al., 2001). The critical items were related to interest in other children, protodeclarative pointing, bringing objects to show, imitating, responding to name and following a point. When a child failed 3-5 items, a clinician contacted the family to re-administer the M-CHAT, and if they continued to fail the items, a full developmental evaluation was offered.

In the original study of the M-CHAT a total of 1,293 children were screened and of those, 51 children from the high- risk group and 7 children from the low-risk group failed either 2 of the 8 critical items or any 3 items on both administrations of the M-

CHAT (Robins et al., 2001). All of these children were offered a developmental evaluation and were seen within 1 to 7 months after failing the second administration of the M-CHAT. Of the 51 children in the high risk group, 36 were diagnosed on the autism spectrum and 15 with a developmental delay and from the low risk group, 3 were diagnosed with autism spectrum and 4 with a developmental delay and no children were found to be typically developing. The 6 items on the M-CHAT that were found to be the best discriminators between the children with autism and the other children in the sample were related to social relatedness, joint attention, and communication. The M-CHAT was slightly better than the original CHAT at detecting autism without compromising the false positive rate.

Recently, Robins (2008) evaluated the properties of the M-CHAT among 4797 children during their regular toddler checkups when they were between 18 and 24 months of age. Of the 4797 cases screened, 466 were screened positive on the M-CHAT and of these, 362 agreed to participate in the follow-up interview. The follow up interview was similar to those used in the previous M-CHAT studies, and tailored to clarify and elicit examples of the child's typical behaviour related to each critical M-CHAT item that indicated risk for autism. After completion of the interview, 61 children continued to show risk for autism. Of these, 41 were evaluated and 21 were diagnosed with autism, 17 were classified with delays unrelated to autism and three were typically developing. Of the 21 children diagnosed with autism, only four were flagged by their pediatrician during their regular toddler checkup as possibly at risk for autism. These findings provide additional support for the M-CHAT as an effective tool to screen for autism in primary

case settings, however longitudinal data from this sample would help to confirm the diagnosis of these young children.

Q-CHAT

The Quantitative - Checklist for Autism in Toddlers (Q-CHAT; Baron-Cohen et al., 2002) (see Appendix E) is another revised version of the CHAT which does not require a clinical evaluation. The Q-CHAT is a parent report questionnaire on which questions entail a 5-point frequency scale, from a score of 1, which means 'no symptoms' to a score of 5 which means 'maximal symptoms'. The Q-CHAT incorporates the 23 items from the M-CHAT pertaining to language development, social communication, and repetitive or restricted behaviors.

In a pilot study with the Q-CHAT among 18- and 24-month old infants already diagnosed with autism or mental retardation and a group of typically developing infants (Allison et al., 2008; Baron-Cohen et al., 2002), 70% of infants with autism scored at or above the cut-off for autism on the Q-CHAT, compared to only 0.9% of the unselected 18 month olds, 0.7% of the 24 month olds, and 35.5% of the group with mental retardation. The sensitivity of the Q-CHAT for correctly identifying autism was good and warrants further investigation of identifying cases of autism from the general population with this instrument.

CHAT-23

The answer format of the original CHAT was altered again to create the CHAT-23 (Wong et al., 2004). The CHAT-23 was developed by combining the 23 questions from the M-CHAT with the 5 direct observational items from the CHAT. A graded answering system (never, seldom, usually, or often) for 22 of the 23 M-CHAT questions

instead of the original yes/no format was incorporated. The graded system was then collapsed into yes (usually/often) and no (never/seldom) to define pass/fail and this resembles the original answer format of the CHAT. Initial data from the CHAT-23 was collected by administering it to 87 children with autism and 125 children without autism with mental ages between 18-24 months of age (16-86 months chronological age) and mental ages were determined with the Symbolic Play Test (Lowe & Costello, 1988). The sensitivity of the CHAT-23 was excellent at 93% when parents indicated their children failed any 2 of the 7 key questions and 84% sensitivity on any 6 of the overall 23 questions in the parent report section of the questionnaire. Thus, these psychometric properties of the CHAT-23 appear to closely resemble those of the M-CHAT and add further support for the further development of these instruments.

FYI

The graded answering system of the CHAT-23 was incorporated into the First Year Inventory (FYI; Reznick et al., 2007), a parent report questionnaire designed to assess behaviours among 12 month old infants at risk for autism (see Appendix F). The FYI consists of 63 questions, including the first 46 on which parents rate their children's behaviours as either "never", "seldom", "sometimes" or "often". The FYI is unique as it includes 14 questions with three or four ad hoc multiple choice answers, one question with which parents indicate the sounds produced by their infant from a list of consonants and on two open-ended questions parents provide information about their concerns and unusual physical or medical characteristics. Normative data on the FYI reflect the distribution of the FYI scores in a community sample and establish a general risk index and scoring method (Reznick et al., 2007).

Watson et al. (2007) examined the construct validity of the FYI by comparing retrospective responses of parents of preschool children with autism, other developmental delays, and typical development. The parents of the children with autism rated them at significantly higher risk on the FYI than did the parents of the children with developmental disabilities and typical development. The children with developmental delays were rated at intermediate risk and at significantly higher risk for autism than were the typically developing children. This suggests that the properties of the FYI are promising and further research is warranted to examine it as a prospective screening instrument among 12 month olds.

ESAT

The Early Screening of Autistic Traits Questionnaire (ESAT; Swinkels et al., 2006) was designed for use with 14-15 month olds and aspects of various other tools were incorporated in this measure to obtain optimal performance (see Appendix G). The ESAT is similar to the CHAT in that it includes a series of “yes” and “no” questions, and similar to the MCHAT in that it is administered only to parents, thereby eliminating the role of the clinician entirely. A group of parents with children already diagnosed with autism (n=153), a comparison group of parents with children already diagnosed with ADHD (n=76) and a group of parents with typically developing infants (n=478) were asked to complete the ESAT retrospectively with reference to their child’s behaviour at 14 months of age. The omission of 5 items out of the original 19 items improved the specificity of the ESAT without affecting the sensitivity. The new 14-item version of the ESAT detected 0% of the non-selected sample, 90.1% of the children with autism, and 19.0% of the children with ADHD as screening positive for autism.

In a follow-up study, Dietz et al. (2006) further examined the properties of the ESAT with a two-stage protocol for screening autism in 31,724 children aged 14 to 15 months. The children were pre-screened during a compulsory visit to their pediatricians' office using a shortened 4-item version of the ESAT. The two first items are used to measure play behavior (interest in different toys and varied play), item 3 is used to measure the readability of emotions, and item 4 is used to measure the reaction to sensory stimuli. The children who failed at least one item on the initial 4-item ESAT were considered screen-positive and were administered the 14-item ESAT during a home visit. The 14-item ESAT was completed by both the parent and psychologist conducting the home visit. The children who failed both administrations of the ESAT completed by the parent, psychologist or both were invited for a further diagnostic assessment including the Vineland Adaptive Behaviour Scale (VABS; Sparrow, Cicchetti, & Balla, 1984), Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, & DiLavore, 1997), a pediatric evaluation, and a medical work-up. The addition of the psychologist improved the properties of the ESAT but significantly increased the amount of time and resource consumption of this tool. Of the 73 children who were identified as screen positive and received a full assessment, 18 were diagnosed with autism, 18 had a language disorder, 13 had mental retardation, and 24 had problems that would fit other diagnostic categories of the DSM-IV. Of the 18 children who were diagnosed with autism at 14 to 15 months, 14 continued to meet criteria for autism at 42 months of age. Two of the other children left the study at re-evaluation and the other two were diagnosed with either an articulation or regulatory disorder at 42 months, which include difficulties making sounds and an impairment of the normal ability to process sensations, respectively. The items of the 14-

item ESAT that best identified children with autism were related to eye contact, stereotypical movements, and interest in people. The items that were predictive of autism from 14 to 42 months were related to social communication, such as interest in people, direct smiles and reaction when somebody spoke to the child. The ESAT is one of the first measures to test children as young as 14 months of age.

The various screening instruments all differ in various ways, but are common in that all of the items are contingent on verbal descriptions. However, these verbal descriptions are often misunderstood entirely by parents (Swinkels et al., 2006) and may lead to inaccurate reporting about children's behaviours. One way to facilitate more accurate responding is to incorporate pictures next to the items that parents are asked to report about. The visual representation of the behaviour combined with the verbal description may provide parents with enough information to interpret the items accurately. A new measure that incorporates pictures depicting the behaviours known to be early markers of autism and designed to improve the information parents provide is the PICS.

Purpose, Experimental Design and Hypothesis

The main purpose of the present study was to examine whether the pictures presented next to the items on the PICS improves the psychometric properties of this measure. Two versions of the PICS, the PPICS and the NPICS were evaluated. Since joint attention behaviours are predictive of language skills, the first analyses were conducted to compare the joint attention items on the PPICS and NPICS to concurrent and later language development. The second analyses were conducted to compare the joint attention items on the PPICS and NPICS to joint attention items on the ESCS, a

valid clinical measure of joint attention skills among children (Mundy, Hogan, & Doehring, 1996).

The present study was a longitudinal study including 66 typically developing infants and one of their parents. Data was collected when the infants were about 12, 18 and 24 months of age. When their children were 12 and 18 months of age, half of the children's parents were asked to complete the PPICS and the other half the NPICS. The parents were also asked to complete the Macarthur Communication Development Inventories – Short Form (MCDI; Fenson, Pethnik, & Cox, 1994), a questionnaire used to measure language development, when their children were 12, 18, and 24 months of age. In order to obtain a clinical measurement of the child's joint attention skills, the Early Social Communication Scale (ESCS; Mundy, Hogan, & Doehring, 1996) was completed at 12 and 18 months of age. The Mullen Scales of Early Learning - Expressive and Receptive Language (MSEL-ERL; Mullen, 1995), a standardized measure of language development was completed at 18 and 24 months of age. Cross-sectional and longitudinal correlations between scores on the PICS, MCDI, ESCS and MSEL-ERL were assessed for both groups.

As the inclusion of pictures was expected to be associated with enhanced abilities of the parents to accurately report their infant's behaviours. The PPICS was expected to be more strongly correlated to concurrent and later language development than the NPICS. Similarly, PPICS was expected to be more strongly correlated to the ESCS, a clinical measure of joint attention skills, than the NPICS.

Method

Participants

The participants included 67 typically developing infants between 11.2 and 13.2 months of age (Mean = 12.4, SD = .59 months) and one of their parents at the time of enrollment into the study. The participants were recruited from three pediatric clinics in the greater Montreal area during their regular first year check-up. In each of the pediatric clinics, parents were presented with a brochure that described the research project. The pediatricians obtained verbal consent from parents to give their name and contact information to a researcher who would phone them with further information pertaining to the study. Parents were then contacted by a researcher and home assessments were arranged with parents who were interested in participating in the study. The study included 3 home visits when the infants were approximately 12, 18 and 24 months of age (T1, T2 and T3 respectively). The participants were divided into two groups. One group was administered the PPICS and the other group was administered the NPICS. At T1, the participants in the PPICS group included 34 children (19 male) between 11.4 and 13.2 months of age (Mean = 12.2, SD = .60 months) and the participants in the NPICS group included 33 children (18 male) between 11.2 and 13.2 months of age (Mean = 12.5, SD = .58 months). At T2, the participants in the PPICS group included 30 children (18 male) between 17.9 and 19.3 months of age (Mean = 18.5, SD = .71 months) and the participants in the NPICS group included 31 children (17 male) between 17.1 and 19.3 months of age (Mean = 18.9, SD = .64). At T3, participants in the PPICS group included 28 children (16 male) between 23.1 and 25.5 months of age (Mean = 24.2, SD = .59) and the participants in the NPICS group included 30 children (16 male) between 23.3 and

26.1 months of age (Mean = 24.1, SD = .76). All of the participants who left the study after T1 or T2 did not complete any of the subsequent time points in the study. Participant characteristics and the number of parent-infant dyads and their ages at the three time points in the study are presented in Tables 1 and 2.

Table 1

Participants Characteristics

	PPICS Group	NPICS Group
% First Born	65.7%	54.3%
% White	71.3%	74.1%
% Mothers Education Level=/> Bachelors Degree	80%	84.8%
% Household Income=/> $40,000/year	87.1%	90%
% Exposed to more than one language	46.8%	49.2%
% Born Preterm (<37 weeks)	0	0
% Birth Complications	3%	4%

Table 2

Sample Size and Age of Participants in the PPICS and NPICS Groups at Time 1, 2, and 3

	PPICS Group		
	n	Mean Age in Months (SD)	Range
Time 1	34 (19 male)	12.2 (.60)	11.4 - 13.2
Time 2	30 (18 male)	18.5 (.71)	17.9 - 19.3
Time 3	28 (16 male)	24.2 (.59)	23.1 - 25.5
	NPICS Group		
	n	Mean Age in Months (SD)	Range
Time 1	33 (18 male)	12.5 (.58)	11.2 – 13.2
Time 2	31 (17 male)	18.9 (.64)	17.1 – 19.3
Time 3	30 (16 male)	24.1 (.76)	23.3 – 26.1

Study Measures

Background Questionnaire

At time 1 of the study, the parents were asked to complete a background questionnaire about the current age of the child, family composition, ethnicity, annual family income, parent education level and occupations, exposure to other languages, birth complications and health concerns for the child and extended family (See Appendix H).

Joint Attention Measures

The Pictorial Infant Communication Scale (PICS; Delgado, Venezia, & Mundy, 2004). The PICS is a brief parent-report measure that incorporates pictures to improve parents' abilities to recognize and rate nonverbal communication behaviours such as joint attention among their children. Responses on the 16 questions of the PICS were converted to numerical values in the following manner: "Never" = 0; "Sometimes" = 1; "Frequently" = 2. An average score was computed by summing the item scores and dividing by the total number of valid items. Items left unanswered or marked as "Not Sure" were considered invalid and not included in the calculation of the average score.

The PICS yielded an Initiating Joint Attention (IJA) score from 6 of the 16 items and included questions such as "How often does your child look at you when he/she sees an interesting object?" and "How often does your child point to draw your attention to something?" A score for Responding to Joint Attention (RJA) was computed from 4 of the 16 items and included questions such as "If you point to something behind your child that is interesting to see, how often does your child turn his/her head and look behind?" and "When you look at and point to a toy how often does your child turn and look at the same toy?" The PICS yielded an Initiating Behavior Regulation (IBR) score from 6 of the

16 items and included questions such as “How often does your child let you know that he/she wants an object by looking at you and reaching for the object at the same time?” and “How often does your child give an object to you to get help operating or opening it?” The overall score was computed by averaging the valid scores from all 16 items on the PICS (see Appendix A for all the questions of the PICS and Appendix I for the PICS scoring guidelines).

The Early Social Communication Scale (ESCS; Seibert & Hogan, 1982). The ESCS is a structured assessment designed to measure a child’s non-verbal social communication abilities, particularly joint attention and behaviour requesting from 6 to 30 months of age (see Appendix J). The ESCS was video taped for coding purposes and required between 15 to 20 minutes to administer. The examiner sat at a table and presented the child with a variety of toys (e.g., wind-up mechanical toys, nerf ball) designed to provide observations of the tendency of the child to initiate social and communicative bids with the tester, and to respond to the tester’s social and communicative bids. The validity and reliability of the ESCS has been confirmed among typically developing and developmentally delayed children and children with autism (Mundy, Seibert, & Hogan, 1984; Mundy, Sigman, Ungerer, & Sherman, 1986).

The ESCS yielded an Initiating Joint Attention (IJA) score and was measured as frequency counts and coded when the child made eye contact with the examiner while manipulating a static or active toy or alternating eye contact between a distal, active toy and the examiner. IJA episodes were only coded if the child alternated eye contact between the examiner and the inactive toy within 2 seconds of the toy becoming inactive. This ensured that the infant’s behaviour was actually related to the object. There were

both lower and higher level IJA scores. Lower level IJA behaviours included gazing at an examiner while watching or holding an active toy, or making eye contact while holding or touching an inactive toy. Higher level IJA behaviours included pointing, with or without eye contact, at an object of interest or clearly holding up a toy and showing it to the examiner.

The Responding to Joint Attention (RJA) score was used as an index of the child's ability to follow the joint attention behaviour (e.g., pointing) of the examiner. RJA was coded when the infants followed the examiners point combined with calling their name to a distal stimulus located to the right/left of the child and behind them. All RJA scores were calculated as a percentage of trials correct out of the total number of trials attempted.

Episodes of Initiating Behavior Regulation (IBR) were computed as frequency counts and included a child's request for help or response to a direct question. There were lower and higher level IBR behaviours. Lower level IBR behaviours included making eye contact to request a toy or reaching toward a toy, either with or without eye contact. Higher level IBR behaviours included pointing at a desired toy, with or without eye contact, or giving the examiner a toy, either with or without eye contact.

Language Measures

The Mullen Scales of Early Learning (MSEL; Mullen, 1995). The MSEL is an individually administered standardized test of development for use with children from birth to 68 months of age (see Appendix K). The MSEL is comprised of 5 scales including gross and fine motor skills, visual reception, expressive and receptive language skills. The MSEL demonstrates strong concurrent validity with other developmental

measures (Mullen, 1995). For the purpose of the present study, the Expressive and Receptive Scales were only administered to obtain a clinical assessment of the infants' language skills. The items from these two scales were administered by a research assistant and were presented to the child in the form of interactive games and took approximately 10-15 minutes to complete. A raw score for the MSEL Receptive and Expressive Scales were computed based on the appropriate items for the chronological age of the child.

The MacArthur Communication Development Inventories-Short Form (MCDI; Fenson, Pethnik, & Cox, 1994). The MCDI is a one page parent-report questionnaire that asks parents to report on the words that their child was able to say and/or understand within the past 2 week period (see Appendix L). Level 1 of the MCDI is the infant form and is comprised of an 89 word vocabulary checklist with separate columns for comprehension and production. The total number of words the parent indicated the child could comprehend and produce were each summed and comprised an expressive and receptive vocabulary score respectively. Two equivalent versions of the toddler MCDI are Level 2, Form A and B and contain a 100 word productive vocabulary checklist. The scores from the MCDI Level 2, Forms A and B were computed by summing the total number of words the parent indicated the child could produce and comprised an expressive vocabulary score. MCDI scores have shown sufficient reliability and validity in toddlers with autism and in typically developing infants (Charman, 2004; Fenson et al., 1994).

Procedure

At T1, when the children were about 12 months of age, the parents were asked to complete the background questionnaire, the PICS and the MCDI Level 1. The PICS served as a parent-report measure of the child's joint attention behaviour and other nonverbal social communication skills. The MCDI Level 1 form was administered to obtain a parent-report measure of the child's language development. The ESCS was completed by a research assistant to obtain a direct clinical measure of the child's joint attention and other nonverbal social communication skills. The ESCS was videotaped and the examiner sat across the table from the child and slightly to the side to allow for video recording of the child. The video camera was positioned so that the child's face was in full view, while also capturing a profile view of the examiner. The child sat either in a highchair, booster seat or on their parents lap. Four large and colourful posters were hung on the wall. Two posters were placed to each side of the child and within the child's view at about 60 degrees from the child's midline. Two posters were placed slightly behind the child and outside the child's view at about 150 degrees from the child's midline (see Figure 1 for room configuration for the ESCS).

At T2, when the children were about 18 months of age, the parents were asked to fill out the PICS and the MCDI, Level 2 Form A. A research assistant completed the ESCS. Immediately after the administration of the ESCS, the expressive and receptive scales of the MSEL were administered to obtain a direct clinical measure of the child's language development. The items for the MSEL were placed in front of the child and were presented as interactive games.

At T3, when the children were about 24 months of age, the parents were asked to complete the MCDI Level 2 Form B and a research assistant completed the expressive and receptive scales of the MSEL.

At each of the three time points, the clinical administrations took approximately 20-25 minutes to complete and the parent forms took approximately 10 minutes to complete. The parent filled out the forms while the research assistant completed the clinical measures and the parent remained near the child throughout the session. All of the children received prizes at the end of each testing session. The schedule of assessments at T1, T2 and T3 are presented in Table 3.

Table 3

Schedule of Assessments

	Age (Time point)		
	12 Months (T1)	18 Months (T2)	24 Months (T3)
Joint Attention Measures			
Parent report	PICS	PICS	
Clinical	ESCS	ESCS	
Language Measures			
Parent report	MCDI	MCDI	MCDI
Clinical		Mullen	Mullen

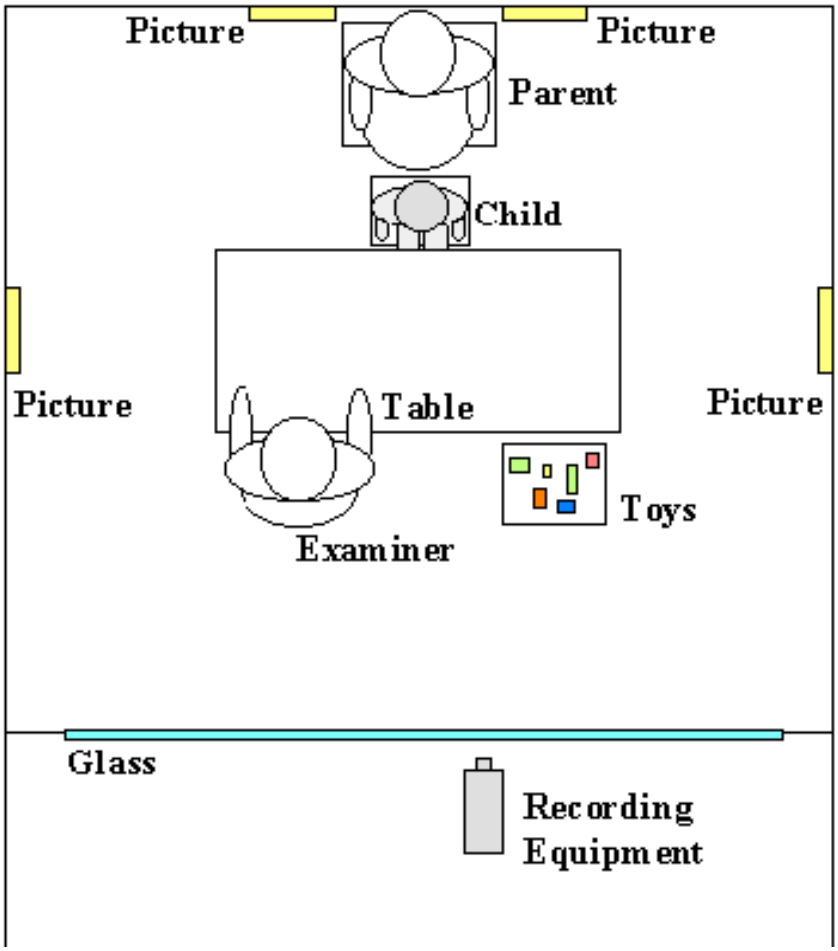

Figure 1. Room configuration for the Early Social Communication Scale (ESCS)

The ESCS videos were scored by a main coder and 20% of the videos were double coded by a second coder in order to establish inter-rater reliability. The main coder was blind to group status at the time of coding for 60% of the participants videos and the second coder was blind to group status of all the participants. Agreement was defined as +/- one tally on the subscales that involved frequency counts (Goldberg et al., 2005). Any discrepancies were resolved through review of tapes to reach consensus. With this agreement, the two raters were within one point for 84.3% of the scores across each subscale.

Results

Developmental Trends

The first series of analyses were conducted to examine the developmental trends across the various measures for the PPICS and NPICS groups. Independent samples T-Tests were performed to examine any differences between the PPICS and NPICS groups across the measures. There were no group differences between the PPICS and NPICS groups on the PICS questionnaire and ESCS across the three time points and therefore, the groups were combined to depict the overall developmental trends across these measures. However, at T2, the scores on the MCDI expressive scale were significantly higher for the NPICS (M = 27.5, SD = 21.5) than the PPICS (M = 17.8, SD = 13.1) group, ($t(59) = -2.11$, $p = .001$) and accordingly, these scores are presented for the PPICS and NPICS groups separately.

Developmental Trends for the PICS Questionnaire

On the PICS questionnaire, the parents reported that their infants initiated joint attention more often in T2 (M = 1.66, SD = .24) than in T1 (M = 1.47, SD = .31); $t(59) = -4.47$, $p < .000$, responded to joint attention more often in T2 (M = 1.7, SD = .36) than in T1 (M = 1.46, SD = .50); $t(59) = -3.34$, $p = .001$, and initiated behaviour requests more often in T2 (M = 1.71, SD = .28), than T1 (M = 1.43, SD = .44), $t(59) = -4.96$, $p < .000$ (see Figure2).

Developmental Trends for the MCDI and MSEL

On the MCDI, the parents of the PPICS group reported that their infants spoke more words at T2 (M = 17.8, SD = 13.1) than at T1 (M = 2.3, SD = 2.8); $t(59) = -6.12$, $p < .000$ and spoke more words at T3 (M = 52.6, SD = 22.4) than at T2; $t(56) = -9.16$,

$p < .000$. Parents of the NPICS group reported that their infants spoke more words at T2 ($M = 27.5$, $SD = 21.5$) than at T1 ($M = 3.7$, $SD = 5.6$); $t(59) = -4.12$, $p < .000$, and spoke more words at T3 ($M = 59.4$, $SD = 27.8$) than at T2; $t(56) = -7.16$, $p < .000$ (see Figure 3). Increased scores on the MSEL from T2 to T3 were found on the expressive ($M = 17.28$, $SD = 3.68$; $M = 24.91$, $SD = 4.69$); $t(57) = -13.85$, $p < .000$) and the receptive scale ($M = 22.6$, $SD = 3.33$; $M = 26.95$, $SD = 3.57$; $t(57) = -8.08$, $p < .000$) (see Figure 4).

Developmental Trends for the ESCS

The low level IJA subscores on the ESCS decreased from T1 ($M = 11.96$, $SD = 6.53$) to T2 ($M = 8.82$, $SD = 4.9$), and indicated that the infants used eye contact alone to initiate bids for joint attention more often at T1 than T2; $t(56) = 3.43$, $p = .001$. The high level IJA subscores increased from T1 ($M = 2.51$, $SD = 3.12$) to T2 ($M = 4.96$, $SD = 4.55$) and indicated that the infants coordinated eye contact and pointing with the index finger to initiate bids for joint attention more often at T2 than T1; $t(56) = -3.84$, $p < .000$ (see Figure 5). The low level RJA subscores increased from T1 ($M = 81.79$, $SD = 21.54$) to T2 ($M = 96.91$, $SD = 9.71$), and indicated that the infants followed the examiners proximal point to objects in a book more often at T2 than at T1; $t(56) = -5.08$, $p < .000$. Similarly, the high level RJA subscores increased from T1 ($M = 16.45$, $SD = 17.7$) to T2 ($M = 55.7$, $SD = 28.45$) and indicated that the infants followed the examiners point to posters placed to the left, right and behind of them more often at T2 than at T1; $t(56) = -9.45$, $p < .000$ (see Figure 6). The low level IBR subscores decreased from T1 ($M = 13.63$, $SD = 5.56$) to T2 ($M = 11.39$, $SD = 4.18$) and indicated that the

infants used eye contact or reaching alone to obtain a desired object more often at T1 than T2; $t(56) = 2.36$, $p = .022$. However, the high level IBR subscores increased from T1 ($M = 6.14$, $SD = 6.18$) to T2 ($M = 8.95$, $SD = 4.91$) and indicated that the infants used pointing with the index finger alone or coordinated with eye contact to obtain a desired object more often at T2 than at T1; $t(56) = -2.69$, $p = .009$ (see Figure 7). All descriptive information for the PPICS and NPICS groups across the measures are depicted in Tables 4-6.

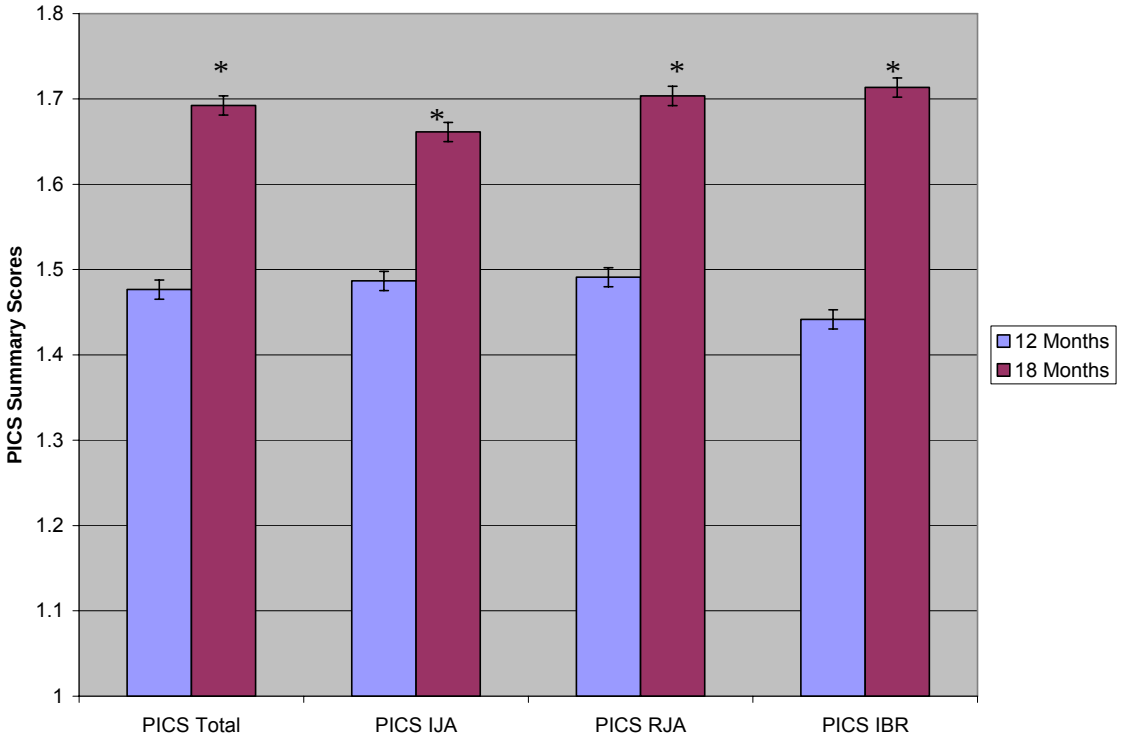

Figure 2. PICS questionnaire scores for PPICS and NPICS groups combined at 12 and 18 months of age. * $p < .001$. Error bars represent standard error of the mean (SEM). Scores on the PICS Total, IJA, RJA and IBR subscales significantly increased from 12 to 18 months of age.

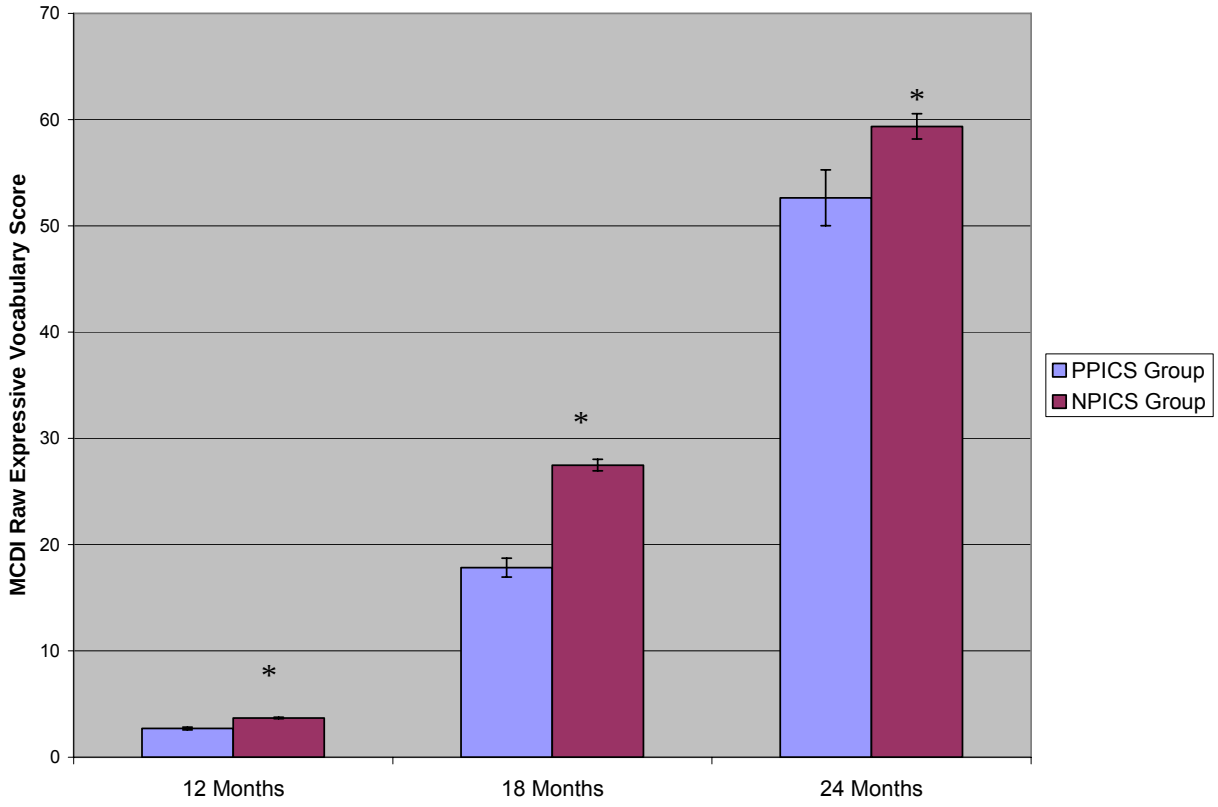

Figure 3. MCDI scores for PPICS and NPICS groups at 12, 18 and 24 months of age. * $p < .001$. Error bars represent SEM. Scores on the MCDI for both the PPICS and NPICS groups significantly increased from 12, 18 and 24 months of age. Scores on the MCDI for the NPICS group at 18 months of age were significantly higher than the PPICS group.

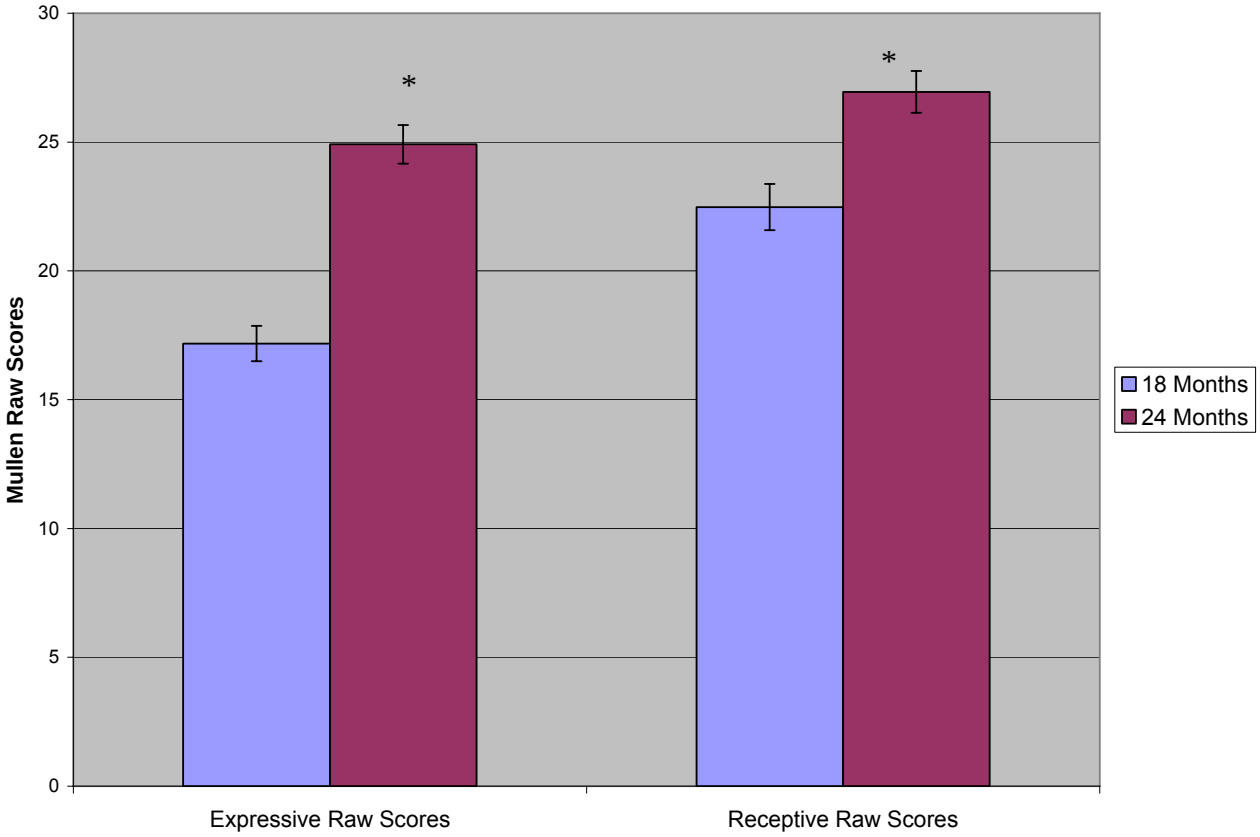

Figure 4. MSEL raw scores for PPICS and NPICS groups combined at 18 and 24 months of age. * $p < .001$. Error bars represent standard error of the mean (SEM). Scores on the MSEL significantly increased from 18 to 24 months of age for both the PPICS and NPICS groups on the expressive and receptive scales

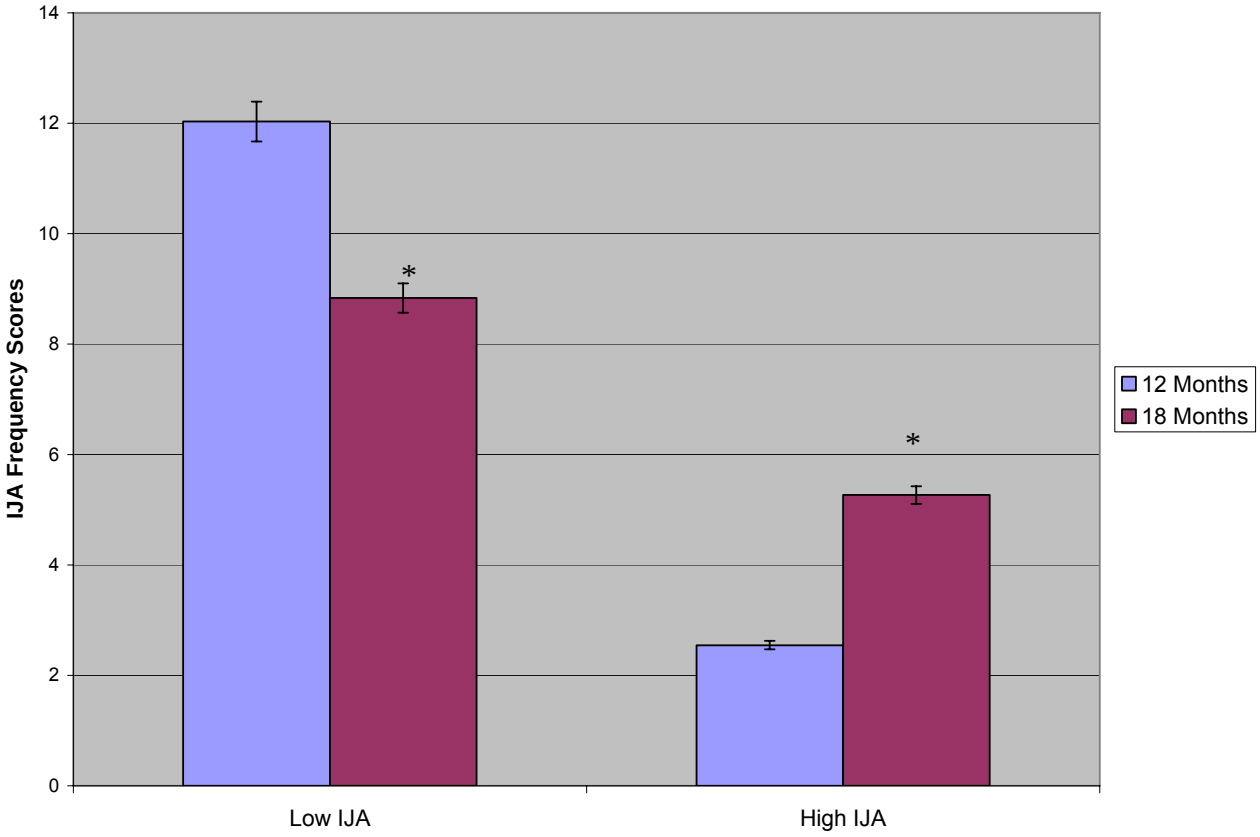

Figure 5. Scores on ESCS IJA subscales for PPICS and NPICS groups combined at 12 and 18 months of age. * $p < .001$. Error bars represent standard error of the mean (SEM). The low level IJA subscores on the ESCS significantly decreased from 12 to 18 months of age. The high level IJA subscores on the ESCS significantly increased from 12 to 18 months of age.

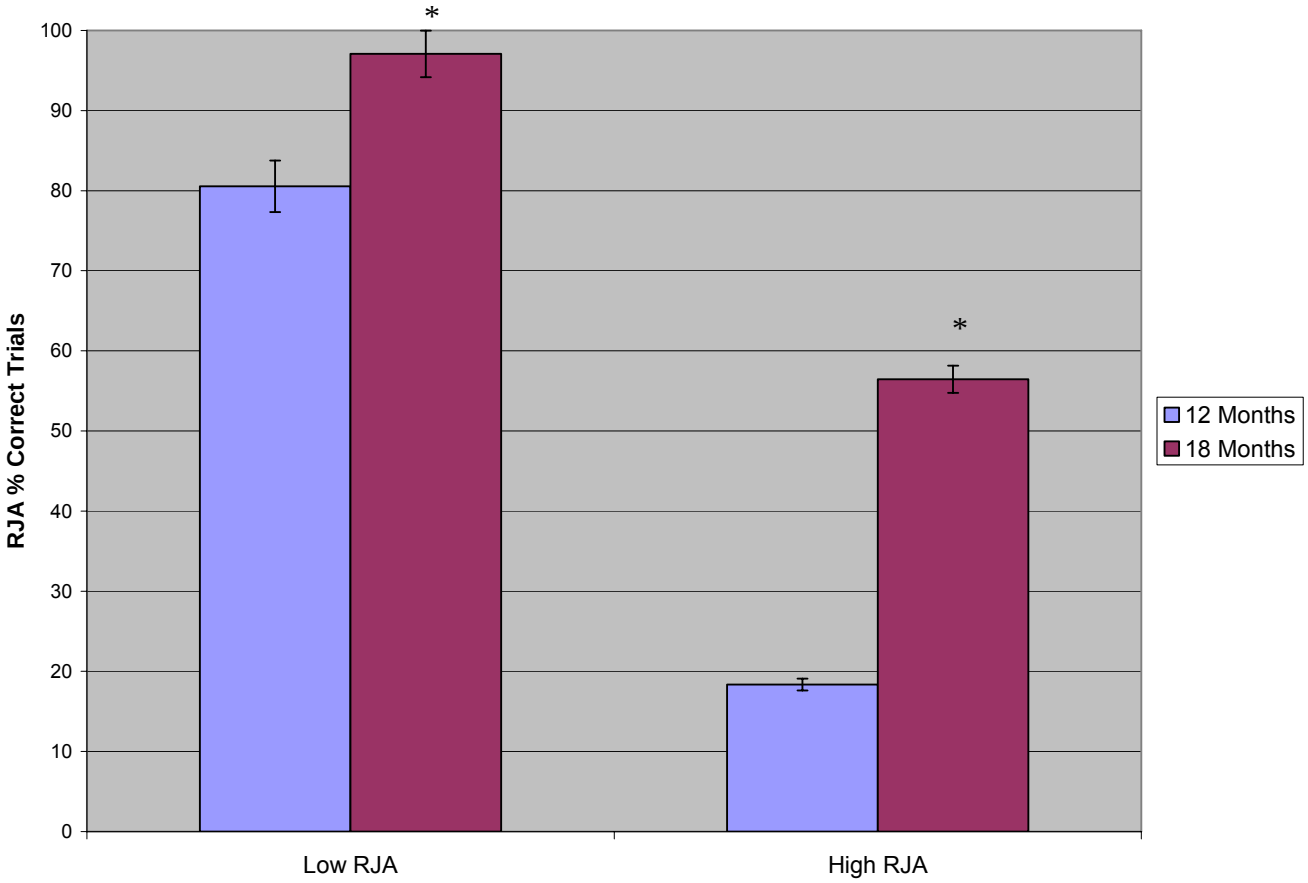

Figure 6. Scores on ESCS RJA subscales for PPICS and NPICS groups combined at 12 and 18 months of age. * $p < .001$. Error bars represent standard error of the mean (SEM). The low and high level RJA subscores on the ESCS significantly increased from 12 to 18 months of age.

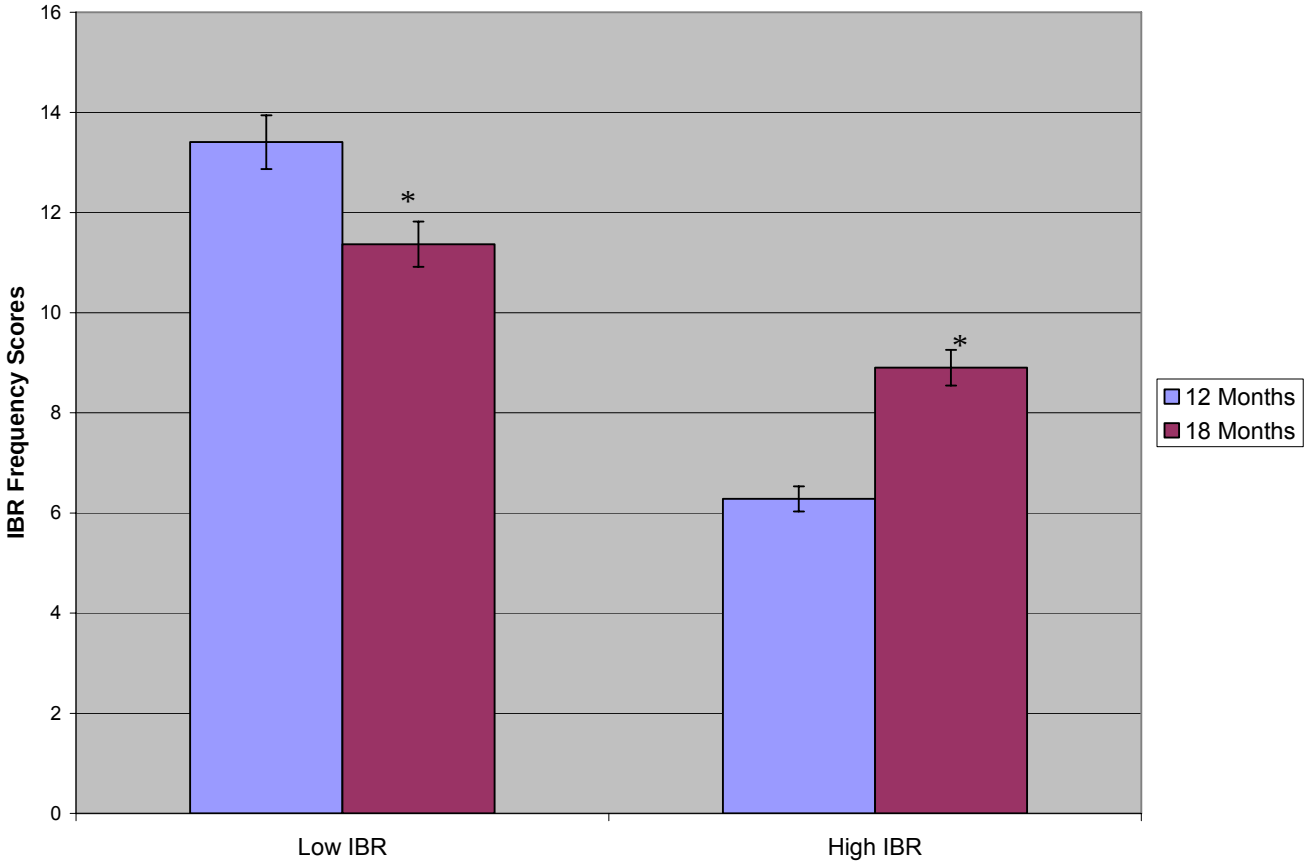

Figure 7. Scores on ESCS IBR subscales for PPICS and NPICS groups combined at 12 and 18 months of age. * $p < .001$. Error bars represent standard error of the mean (SEM). The low level IBR subscores on the ESCS significantly decreased from 12 to 18 months of age. The high level IBR subscores on the ESCS significantly increased from 12 to 18 months of age.

Are There Differences Between the PPICS and the NPICS?

The second series of analyses were conducted to examine any differences between the PPICS and the NPICS. As JA predicts language development in very young children (Markus et al., 2000; Tomasello et al., 1986), the first question that was examined was whether the JA items on the PPICS or the NPICS were more strongly correlated to concurrent and later language development. Since the ESCS is a valid measure of JA skills among infants (Guidetti & Tourrette, 1995), the second question that was examined was whether the JA items on the PPICS or the NPCIS were more strongly correlated to JA items on the ESCS.

Due to the large number of variables involved in the correlational analyses section below, only correlations significant at the .01 level or below will be considered statistically significant. However, correlations between .01 and .05 will be referred to as *trends* in the data. This conservative approach was implemented in the hope that only meaningful correlations would be taken into consideration when interpreting the data set.

Is the PPICS or NPICS More Strongly Correlated to Concurrent Language Skills?

In order to investigate whether the PPICS or NPICS is more strongly associated to concurrent language skills, we examined scores on the PPICS and NPICS at T1 and T2 to scores on the MCDI at T1 and MCDI and MSEL-Receptive and Expressive Scales at T2 (see Tables 7 and 8 respectively). At T1, the PPICS was not correlated with the MCDI. However, there was a trend in the correlation between the NPICS IBR score and the MCDI-Receptive score ($r = .390$, $p = .03$).

At T2, the PPICS IJA score was correlated with the MSEL-Expressive scores

(r = -.494, p = .006). The PPICS RJA score was correlated with the MSEL-Receptive score (r = .475, p = .008). However, the NPICS was not correlated with the language measures at T2.

Is the PPICS or NPICS More Predictive of Later Language Development?

In order to investigate the extent to which they are predictive of later language development, scores on the PPICS and NPICS at T1 and T2 were correlated to scores on the MCDI and MSEL-Receptive and Expressive scales at T2 and T3 (see Tables 9, 10 and 11 respectively). There was a trend of a correlation between the PPICS Total score at T1 and the MSEL-Receptive score at T2 (r = .404, p = .027). There was a trend of a correlation between the NPICS IBR score at T1 and the MSEL-Expressive score at T2 (r = .398, p = .029). Neither version of the PICS at T1 was correlated with the language measures at T3. There was a trend in the correlation between the NPICS IBR at T1 and the MCDI-Expressive (r = .393, p = .035) scores at T3. Neither the PPICS nor the NPICS scores at T2 were correlated to the language measures at T3.

Is the PPICS or NPICS More Strongly Associated to the ESCS?

In order to examine whether the JA items on the PPICS or the NPCIS were more strongly correlated to JA items on the ESCS, we examined the concurrent correlations between scores from the PPICS and NPICS to scores on the ESCS at T1 and T2 (see Tables 7 and 8 respectively). At T1, the PPICS Total score was correlated with ESCS High IJA (r = .635, p < .000) and High IBR (r = .512, p = .002) scores. The PPICS IJA score was correlated to the ESCS High IJA (r = .586, p < .000). The PPICS IBR score was correlated with the ESCS High IJA (r = .636, p < .000) and High IBR (r = .637,

$p < .000$) scores. There was a trend between the PPICS RJA scores and the High RJA scores on the ESCS ($r = .354$, $p = .044$). The NPICS IJA score was correlated with ESCS High IJA ($r = .553$, $p = .002$). There was a trend between the NPICS IJA score and the ESCS HIGH IBR ($r = .407$, $p = .028$) and the NPICS RJA scores and the ESCS High RJA scores ($r = .358$, $p = .05$).

At T2, scores on the PPICS did not correlate with ESCS scores. Trends between the NPICS Total score and the ESCS High IJA ($r = .407$, $p = .026$) and Low RJA scores ($r = .405$, $p = .026$) were found. There were trends between the NPICS IJA score and both the ESCS High IJA ($r = .430$, $p = .018$) and the Low RJA scores ($r = .426$, $p = .019$). The NPICS IBR score and the ESCS High IJA score ($r = .394$, $p = .031$) and the NPICS RJA score and the ESCS Low RJA score ($r = .451$, $p = .012$) also showed a trend in the correlations.

Table 4

Time 1 Descriptive information across measures for the PPICS and NPICS group

	PPICS (n= 34)	NPICS Group (n=33)	Signif. Diff.
PICS Summary Scores		M(SD)	
Total Score	1.4 (.29)	1.5 (.28)	ns
IJA Score	1.4 (.32)	1.4 (.29)	ns
IBR Score	1.3 (.42)	1.5 (.45)	ns
RJA Score	1.4 (.52)	1.5 (.46)	ns
ESCS Summary Scores			
IJA Low	12.4 (6.1)	11.7 (7.4)	ns
IJA High	2.9 (3.4)	2.2 (3.0)	ns
IJA Total	15.2 (6.3)	13.9 (7.9)	ns
IBR Low	13.0 (5.0)	13.8 (5.7)	ns
IBR High	6.1 (6.3)	6.5 (5.8)	ns
IBR Total	19.1 (6.3)	20.3 (7.7)	ns
RJA Left/Right	28.8 (31.9)	31.2 (31.6)	ns
RJA Behind	8.3 (19.4)	4.8 (18.7)	ns
RJA Total	18.6 (21.2)	18.2 (19.0)	ns
MCDI Average Scores			
Expressive	2.7 (2.8)	3.7 (5.6)	ns
Receptive	22.5 (12.5)	29.8 (16)	ns

Note. PICS scores are calculated by averaging the scores from each item for that subscale and then divided by the total number of valid items and the maximum score is 2. ESCS scores are frequency counts, except for RJA scores which are a percentage of trials correct and MCDI scores are raw number of words.

Table 5

Time 2 Descriptive information across measures for the PPICS and NPICS group

	PPICS (n= 30)	NPICS Group (n= 31)	Signif. Diff.
PICS Summary Scores		M(SD)	
Total Score	1.7 (.21)	1.5 (.28)	ns
IJA Score	1.7 (.22)	1.6 (.25)	ns
IBR Score	1.7 (.28)	1.7 (.28)	ns
RJA Score	1.6 (.39)	1.7 (.33)	ns
ESCS Summary Scores			
IJA Low	8.2 (5.1)	9.5 (4.8)	ns
IJA High	5.4 (5.2)	5.2 (4.6)	ns
IJA Total	13.5 (6.2)	14.7 (6.8)	ns
IBR Low	11.7 (4.4)	11.0 (4.0)	ns
IBR High	8.0 (3.7)	9.8 (5.9)	ns
IBR Total	19.6 (4.8)	20.9 (4.7)	ns
RJA Left/Right	75.8 (24.9)	75.0 (32.2)	ns
RJA Behind	37.5 (39.9)	37.7 (36.9)	ns
RJA Total	56.6 (28.2)	56.2 (28.9)	ns
MCDI Average Scores			
Expressive	17.8 (13.1)	27.5 (21.5)	<.001
Mullen Language Raw Scores			
Expressive	16.7 (2.6)	17.7 (4.3)	ns
Receptive	22.0 (3.4)	22.9 (3.2)	ns

Table 6

Time 3 Descriptive information across measures for the PPICS and NPICS group

	PPICS (n= 28)	NPICS Group (n= 30)	Signif. Diff.
MCDI Average Scores		M(SD)	
Expressive	52.6 (22.4)	59.4 (27.8)	ns
Mullen Language Raw Scores			
Expressive	24.6 (4.7)	25.2 (4.7)	ns
Receptive	26.7 (4.3)	27.2 (2.8)	ns

Table 7

Time 1 Concurrent Pearson Correlation (r) values of the PICS Questionnaire, MCDI and ESCS for the PPICS and NPICS groups

	PPICS / NPICS Groups			
MCDI	PICS Questionnaire			
	PICS Total	PICS IJA	PICS IBR	PICS RJA
Receptive	.255/.339	.268/.310	.245/.390*	.041/-.056
Expressive	.102/.188	-.005/-.134	.186/.313	.088/.152
ESCS				
Low IJA	-.117/ -.223	-.082/ -.156	-.256/ -.212	.155/ -.113
High IJA	.635*/ .307	.586*/ .553*	.636*/ .181	.210/ -.028
Low RJA	-.043/ .258	-.020/ .291	.052/ .462*	.146/ -.305
High RJA	.284/ .378	.149/ .300	.217/ .200	.283/.358
Low IBR	-.234/ -.216	-.191/ -.303	-.207/ -.282	-.178/ .157
High IBR	.512*/ .352	.365/ .407*	.637*/ .212	.134/ .203

*Correlation is significant at the 0.01 level

Table 8

Time 2 Concurrent Pearson Correlation (r) values of the PICS Questionnaire, MCDI, Mullen and ESCS for the PPICS and NPICS groups

	PPICS / NPICS Groups			
MCDI	PICS Questionnaire			
	PICS Total	PICS IJA	PICS IBR	PICS RJA
Expressive	.120/ -.264	-.081/-.204	.007/ -.174	.320/ -.266
MULLEN				
Expressive	-.193/ -.302	-.494*/ -.334	-.159/ -.155	.174/ -.257
Receptive	.234/ -.267	.015/ -.201	.016/ -.223	.475*/-.232
ESCS				
Low IJA	-.039/ -.112	.084/ -.208	-.206/ -.169	.071/ .163
High IJA	-.186/ .407	-.177/ .403	-302/ .394	.107/ .110
Low RJA	.190/ .405	.337/ .426	-.074/ .144	.203/ .451
High RJA	.219/ .157	.228/ .254	.257/ .073	.008/.029
Low IBR	.184/ .004	.309/ .009	.136/ -.180	-.018/ .228
High IBR	-.104/ .145	-.091/ .168	.018/ .339	-.145/ -.257

*Correlation is significant at the 0.01 level

Table 9

Longitudinal Pearson Correlation (r) values of the PICS Questionnaire at Time 1 and MCDI and Mullen at Time 2 for the PPICS and NPICS groups

	PPICS / NPICS Groups			
MCDI	PICS Questionnaire			
	PICS Total	PICS IJA	PICS IBR	PICS RJA
Expressive	.204/ .102	.039/-.043	.319/ .197	.107/ -.014
MULLEN				
Expressive	.147/ .184	.102/ .082	.086/ .398	.249/ -.214
Receptive	.404/ .119	.288/ -.015	.343/ .311	.312/-.134

Table 10

Longitudinal Pearson Correlation (r) values of the PICS Questionnaire at Time 1 and MCDI and Mullen at Time 3 for the PPICS and NPICS groups

	PPICS / NPICS Groups			
MCDI	PICS Questionnaire			
	PICS Total	PICS IJA	PICS IBR	PICS RJA
Expressive	.266/ .308	.332/ .200	.183/ .393	.213/ -.049
MULLEN				
Expressive	.151/ .166	.220/ .341	.065/ .276	.191/ -.322
Receptive	.252/ .152	.355/ .281	.323/ .225	-.056/-.212

Table 11

Longitudinal Pearson Correlation (r) values of the PICS Questionnaire at Time 2 and MCDI and Mullen at Time 3 for the PPICS and NPICS groups

	PPICS / NPICS Groups			
MCDI	PICS Questionnaire			
	PICS Total	PICS IJA	PICS IBR	PICS RJA
Expressive	.065/ -.134	-.195/ -.253	.048/ -.035	.272/ -.041
MULLEN				
Expressive	-.155/ .026	-.338/ .075	-.122/ -.004	.102/ -.037
Receptive	-.047/ .030	-.064/ .041	.042/ -.083	-.100/ .125

Discussion

The primary aim of the present study was to examine whether the inclusion of pictures on the PICS questionnaire improves the accuracy of parental identification and reporting of their infants' joint attention behaviours. Since individual differences in joint attention skills are a significant predictor of later language development among typically developing children (Mundy et al., 1995), the joint attention items on the PPICS and NPICS were assessed in relation to scores on the MCDI and Mullen Expressive and Receptive language scales. In order to compare the joint attention items on the two versions of the PICS to a clinical measure of joint attention skills, the ESCS was administered to both groups. Data was collected with a group of 67 typically developing children and one of their parents when the children were 12, 18, and 24 months of age. In order to ensure the expected developmental trajectories on the PICS, ESCS, MCDI and Mullen were obtained and to aid in the interpretation of the correlations across the measures, developmental trends were investigated across the three time points.

Developmental Trends

The developmental trends across the measures were examined for three reasons. One reason was to ensure that the children in the study displayed the expected developmental trajectories across the three time points on all of the measures. This was important since we assumed that we were examining the PICS among a group of typically developing infants and this needed to be confirmed. The second reason was to examine whether the children in the PPICS and NPICS groups displayed the same developmental trajectories across the measures. Differences and similarities between the PPICS and the NPICS groups were used in the interpretation of the correlations. The

third reason was to compare the developmental trajectories between the clinical and parent report measures to ensure the clinical ratings advanced similarly to the parent ratings of the joint attention and language skills.

Developmental Trends for the Joint Attention Measures

The scores from both the parent report measure and clinical measure of joint attention skills suggest the children in the PPICS and NPICS groups displayed the expected developmental advancement on these skills at 12 and 18 months of age. Further, there were no significant differences between the children in the two groups on either of these measures and suggests the groups were similar in their joint attention skills. The similarity in the developmental data for the PICS and ESCS suggest that these two different measures collect similar information on joint attention skills.

Developmental trends for the PICS. The PICS Total, and the IJA, RJA and IBR subscale scores from both versions of the PICS questionnaire indicate developmental advancement in joint attention skills from 12 to 18 months of age, and extend previous findings of developmental trends with infants from 15 to 18 months of age on the PICS (Delgado, Venezia, & Mundy, 2004). The increase in the PICS IJA score indicates that the parents reported that their infants made eye contact and pointed to objects of interest to them significantly more often at 18 than at 12 months of age. The increase in the PICS RJA subscale score indicates that the parents believed that when they pointed to something to the left, right, or behind their child, the infants turned and looked at the object significantly more often at 18 than 12 months of age. The increase in the PICS IBR subscale score indicates that the parents thought that their infants made more eye

contact, pointed, and reached to obtain or get assistance with an object significantly more often at 18 than 12 months of age.

Developmental trends for the ESCS. Developmental findings from both groups on the ESCS administered at 12 and 18 months of age replicated findings of increased nonverbal social communication skills such as joint attention, from previous research with this age group (Mundy et al., 1990, 1995). Specifically, the majority of infants at 12 months of age used eye contact alone to initiate joint attention with the examiner. However, by 18 months of age, significantly more infants used coordinated eye contact and pointing to initiate bids for joint attention. Similarly, infants responded to the examiners bids for joint attention significantly more often at 18 than 12 months of age. For example, when the examiner pointed to proximal objects in a book or distal posters placed to the right, left and behind the infant, they turned and looked at the object that the examiner pointed to significantly more often at 18 than 12 months of age. When the infants requested an object out of their reach at 12 months of age, they either used eye contact or a whole hand reach, but by 18 months of age, they used their index finger to point to the object alone or coordinated with eye contact significantly more often.

Developmental Trends for the Language Measures

The scores from both the parent report and clinical measure of language skills suggest the children in the PPICS and NPICS groups displayed the expected developmental advancement on these skills at 12, 18, and 24 months of age. However, the parents of the infants in the NPICS group indicated on the MCDI that their infants spoke significantly more words at 18 months of age than the PPICS group. The larger MCDI expressive vocabulary score for the infants in the NPICS group could be an

example of over reporting by the parents, especially since the expressive scores on the MSEL were not significantly different between the two groups across the time points.

Developmental trends for the MCDI. The parents reported on the MCDI that the expressive vocabulary of their infants significantly increased from 12 to 18 months, and then to 24 months of age. The parents of the children in the PPICS group reported that the infants' expressive vocabulary consisted of an average of 3 words at 12 months of age, 18 words at 18 months of age, and 53 words at 24 months of age on average. The parents of the children in the NPICS group reported that the infants' expressive vocabulary consisted of an average of 4 words at 12 months of age, 27 words at 18 months of age, and 59 words at 24 months of age on average.

Developmental trends for the MSEL. The infants' expressive and receptive language scores on the Mullen Scales of Early Learning increased significantly from 12 to 18 months and then to 24 months of age. At 12 months of age, the majority of the infants were able to combine words with gestures, name a few common objects (e.g., ball, book and car), understand simple verbal input, identify objects, and give a toy to the examiner upon request. By 18 months of age, most of the infants used two words phrases, one or two pronouns, comprehended simple questions, and recognized their body parts. By 24 months of age, most infants could count to ten, use 3 to 4 words in a sentence, comprehend size concepts, and identify colours. The developmental findings from this study support the notion that the PICS, MCDI, ESCS and Mullen Expressive and Receptive scales measure typical development of children between one and two years of age.

The PICS and Language: Pictures May Not Quite Be Worth a Thousand Words From This Perspective

In order to examine whether the inclusion of pictures on the PICS improves the accuracy of the information parents provide, concurrent and longitudinal correlations were compared between both the PPICS and the NPICS and language measures at 12, 18 and 24 months of age. Generally, neither of the two versions of the PICS significantly correlated with the MCDI or Mullen. One exception was at 18 months of age, when the RJA subscale score on the PPICS was significantly correlated to the Mullen Receptive score and suggests that the pictures on the PICS assisted parents reporting of this specific construct. There was also an overall trend for the PPICS, but not the NPICS, administered at 12 months of age to be correlated to language development at 18 months of age. This may indicate that the pictures on the PICS assisted parents in reporting on the subtle joint attention behaviours found among one year old infants. There is a chance that the verbal descriptions alone on the NPICS may be misinterpreted by parents and leading to inaccurate information about their children's joint attention skills.

The failure to find consistent differences between the PICS and MCDI are similar to Delgado et al.'s (2004) findings of significant correlations between the PICS and MCDI at 15 months of age that were not maintained with the PICS administration at 18 months of age. The verbal descriptions and pictures on the PICS may not be representative of the joint attention behaviours displayed by the average 18 or 24 month old child, and may lead to parents' misinterpretation of the items and inaccurate responding at these time point. The PICS may be a tool most useful among 12-15 month

old children and further investigation of the PICS at this point in development would help to support this claim.

In both the present study and the study by Delgado et al. (2004) the short version of the MCDI was used to collect parent report data on the children's language skills. This short version was chosen in the present study because it is brief and easy to complete for parents, although the limited information gathered with the MCDI may explain the failure to find significant correlations with the PICS. In all of the short versions of the MCDI at the different time points, the parents were asked to simply indicate the number of words that their child said or understood and yielded an expressive and receptive vocabulary score. The longer MCDI Words and Gestures and MCDI Words and Sentences versions collect information about language comprehension and production, use of gestures and assess sentence complexity and are the versions typically used in studies examining joint attention and language (Calandrella & Wilcox, 2000; Morales et al., 2000). These longer versions of the MCDI may add to the time and resources that are required to complete the measure, but they may be informative about the various aspects of the child's language development that correlate with the joint attention items on the PICS.

The PICS and ESCS: Pictures Seem to be Worth a Thousand Words for Parents of One Year Olds

In order to further examine whether the inclusion of pictures on the PICS improves the accuracy of parental identification and reporting of their infants' joint attention behaviours the concurrent correlations between the PPICS and the ESCS were compared to the correlations between the NPICS and ESCS. The overall findings revealed that the PPICS was more strongly correlated to the ESCS than the NPICS at 12

months of age. Specifically, the High IJA and High IBR subscores, but not the Low IJA and Low IBR subscores on the ESCS, significantly correlated with the PPICS. The more complex skills captured by the High IJA and High IBR subscores on the ESCS may be the behaviours that are measured more accurately with pictures. Furthermore, the pictures on the PICS may be most helpful for parents to answer questions related to High IJA and High IBR behaviours in their one year old infants, since by the time that their infants are 18 months of age, their parents may be more familiar with these behaviours and may no longer require pictures to clarify the concepts. The RJA subscores for both versions of the PICS at 12 and 18 months of age correlated with the RJA subscores on the ESCS, suggesting that the verbal descriptions alone and combined with pictures both assist parents to interpret and accurately report upon their child's RJA behaviours.

Although both the PPICS and NPICS correlated with the ESCS at 12 months of age, this relationship was lost completely at 18 months of age. One possible reason for the inconsistency in the results is that the same items are used on the PICS to describe the different stages in development of joint attention skills in the second year of life. Since the joint attention skills of a 12 month old infant are considerably different from an 18 month old infant, items on screening tools may be improved by creating different versions for infants at these different ages.

Strengths and Limitations

A common goal among researchers examining screening measures for autism is to develop a tool to identify children at the youngest age possible, although the majority of screening tools are examined among older children between 2-4 years of age (Charman, 2003). Therefore, the inclusion of infants as young as 12 months of age in the present

study was an attempt to examine whether early screening measures can be helpful at such an early age. Another strength of the present study was that the measures were administered among a group of infants at 12, 18 and 24 months of age. Collecting data between the first and second years of life was optimal since the initial assessment was at an age when joint attention skills begin to emerge and the latest at an age when they become mastered by most children.

Recruitment for the present study was complicated because parents indicated reluctance to participate in a study measuring behaviours associated to a diagnosis of autism. Many parents indicated that they would be interested in participating in the study, although they were fearful of learning of an autism diagnosis and preferred not to participate. The reluctance from parents to enroll in this study highlights the need for professionals to educate parents about the benefits of early diagnosis of autism.

Clinical Implications and Further Research

In the present study, the PPICS showed to slightly improve the accuracy of the information parents provide about their infants' joint attention behaviours. Incorporating pictures may be particularly helpful for parents when their child is around 12 months of age. Since the main goals in the development of screening tools for autism is to identify children at the youngest age possible while limiting the amount of time and resources required (Baird et al., 2000; Baron-Cohen, 1996), the PICS would be an ideal tool for clinicians to use with infants at the population level. Further development of the PICS is warranted and examining its properties among younger siblings of children already diagnosed with autism could be the next steps. Similarly, the extent to which the use of pictures improve the accuracy of the information parents provide of other well developed

screening tools with pictures incorporated may be beneficial since this may improve their psychometric properties without increasing the time and resources that are needed.

Extending the same principle of incorporating a visual representation of joint attention behaviours to improve the accuracy of the information parents provide and used to develop the PICS, a computerized parent-report screening instrument that incorporates video clips to depict the behaviours about which the parents report may further enhance such an assessment. A parent would be able to watch multiple video clips of specific behaviours to ensure they have understand the construct. Since joint attention behaviours vary between one to two years of age, parents could watch videos reflecting the behaviours representative of the specific age of their own child. For example, parents with children who are 12 months of age could view video clips of other children at the same chronological age depicting the developmentally appropriate skills associated with the relevant behaviours. Computerized versions of screening instruments could be available on compact disk or the internet and could be completed by parents in a variety of settings, such as the doctors' office or at home. This would make assessments easier to access and complete by parents. Simple statistical programs could be used to summarize and score the results, thereby reducing costs and resource consumption.

Conclusions

In conclusion, the pictures on the PICS slightly improved the information that parents provided about their children's joint attention skills. The joint attention items on the PPICS were more strongly correlated to the ESCS than the NPICS at 12 months of age. There was also an overall trend for the PPICS, but not NPICS, administered at 12 months of age to be correlated to language development at 18 months of age. However,

the PPICS was not consistently more strongly correlated to the language measures or ESCS across the three time points. The inclusion of pictures on screening tools does not increase the amount of time or resource consumption on the screening process, therefore examination of the PICS to identify children at higher genetic risk for autism is warranted.

Original Contributions to Science

In the present study, the properties of the PICS were examined among children beginning at 12 months of age, the youngest age at which the PICS has been studied. The findings that the PICS displays developmental trends between 12, 18 and 24 months of age are novel and contribute to the development of this new tool. The comparison of the joint attention items on the PICS, to joint attention items on the ESCS, is also novel and provides a unique comparison between parent report and clinical measurement of joint attention skills.

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Appendix A

Pictorial Infant Communication Scale Version with Pictures

Pictorial Infant Communication Scale (PICS)

Christine Delgado, Peter Mundy, Meg Venezia & Jessica Block, University of Miami, 2003

(Version 2.2)

Child's name: _____

DOB: _____

Completed by: _____

Date completed: _____

Relationship to child: _____

Age: _____

We are interested in the ways that your child communicates without using words. Please use the pictures to help you answer each question.

Please answer the questions based on your child's behavior during the last two weeks.

1. How often does your child show objects to you without giving them to you?

Circle One:

Not Sure Never Sometimes Frequently

---

2. If you point to something behind your child that is interesting to see, how often does your child turn his/her head and look behind?

Circle One:

Not Sure Never Sometimes Frequently

3. How often does your child let you know that he/she wants an object by looking at you and reaching for the object at the same time?

Circle One:

Not Sure Never Sometimes Frequently



4. How often does your child look at you when he/she sees an interesting object?

Circle One: Not Sure Never Sometimes Frequently

5. How often does your child give an object to you to get help operating or opening it?

Circle One:

Not Sure Never Sometimes Frequently

6. How often does your child point to an object to enlist your aid in obtaining the object?

Circle One:

Not Sure Never Sometimes Frequently

7. When you point and look at something how often does your child look at the same object or event?

Circle One:

Not Sure Never Sometimes Frequently

8. How often does your child point to indicate his/her interest in an object or an event?

Circle One:

Not Sure Never Sometimes Frequently

9. How often does your child show you an object but not let you take the object from him/her?

Circle One:

Not Sure Never Sometimes Frequently

10. How often does your child use reaching as a sign to you to help him/her get an object?

Circle One:

Not Sure Never Sometimes Frequently

11. When you look at and point to a toy how often does your child turn and look at the same toy?

Circle One:

Not Sure Never Sometimes Frequently

12. How often does your child point to draw your attention to something?

Circle One:

Not Sure Never Sometimes Frequently

13. How often does your child hand (or push) an object to you in order to give it to you?

Circle One:

Not Sure Never Sometimes Frequently

14. When you point and look at something how often does your child look at the same object, even if that object is behind him/her?

Circle One:

Not Sure Never Sometimes Frequently

15. How often does your child point to let you know that he/she wants something else?

Circle One:

Not Sure Never Sometimes Frequently

16. When your child sees something interesting how often does he/she make eye contact with you to share his or her interest?

Circle One: Not Sure Never Sometimes Frequently

Appendix B

Pictorial Infant Communication Scale - Version without Pictures

Pictorial Infant Communication Scale (PICS)

Christine Delgado, Peter Mundy, Meg Venezia & Jessica Block, University of Miami, 2003

(Version 2.1)

Child's name: _____ DOB: _____

Completed by: _____ Date completed: _____

Relationship to child: _____ Age: _____

We are interested in the ways that your child communicates without using words.

Please answer the questions based on your child's behavior during the last two weeks.

---

1. How often does your child show objects to you without giving them to you?

Circle One: Not Sure Never Sometimes Frequently

---

2. If you point to something behind your child that is interesting to see, how often does your child turn his/her head and look behind?

Circle One: Not Sure Never Sometimes Frequently

---

3. How often does your child let you know that he/she wants an object by looking at you and reaching for the object at the same time?

Circle One: Not Sure Never Sometimes Frequently

---

4. How often does your child look at you when he/she sees an interesting object?

Circle One: Not Sure Never Sometimes Frequently

---

5. How often does your child give an object to you to get help operating or opening it?

Circle One: Not Sure Never Sometimes Frequently

---

6. How often does your child point to an object to enlist your aid in obtaining the object?

Circle One: Not Sure Never Sometimes Frequently

---

7. When you point and look at something how often does your child look at the same object or event?

Circle One: Not Sure Never Sometimes Frequently

---

8. How often does your child point to indicate his/her interest in an object or an event?

Circle One: Not Sure Never Sometimes Frequently

---

9. How often does your child show you an object but not let you take the object from him/her?

Circle One: Not Sure Never Sometimes Frequently

---

10. How often does your child use reaching as a sign to you to help him/her get an object?

Circle One: Not Sure Never Sometimes Frequently

---

11. When you look at and point to a toy how often does your child turn and look at the same toy?

Circle One: Not Sure Never Sometimes Frequently

---

12. How often does your child point to draw your attention to something?

Circle One: Not Sure Never Sometimes Frequently

---

13. How often does your child hand (or push) an object to you in order to give it to you?

Circle One: Not Sure Never Sometimes Frequently

---

14. When you point and look at something how often does your child look at the same object, even if that object is behind him/her?

Circle One: Not Sure Never Sometimes Frequently

---

15. How often does your child point to let you know that he/she wants something else?

Circle One: Not Sure Never Sometimes Frequently

---

16. When your child sees something interesting how often does he/she make eye contact with you to share his or her interest?

Circle One: Not Sure Never Sometimes Frequently

Appendix C

Checklist for Autism in Toddlers (CHAT)

Section A - Ask Parent:

Yes or No?

____ 1) Does your child enjoy being swung, bounced on your knee, etc?

____ 2) Does your child take an interest in other children?

____ 3) Does your child like climbing on things, such as up stairs?

____ 4) Does your child enjoy playing peek-a-boo/hide-and-seek?

____ *5) Does your child ever pretend, for example, to make a cup of tea using a toy cup and teapot, or pretend other things?

____ 6) Does your child ever use his/her index finger to point, to ask for something?

____ *7) Does your child ever use his/her index finger to point, to indicate interest in something?

____ 8) Can your child play properly with small toys (e.g. cars or bricks) without just mouthing, fiddling, or dropping them?

____ 9) Does your child ever bring objects over to you, to show you something?

Section B - GP's observation

Yes or No?

____ i) During the appointment, has the child made eye contact with you?

____ *ii) Get child's attention, then point across the room at an interesting object and say "Oh look! There's a (name a toy)!" Watch child's face. Does the child look across to see what you are pointing at?

NOTE - to record yes on this item, ensure the child has not simply looked at your hand, but has actually looked at the object you are pointing at.

____ *iii) Get the child's attention, then give child a miniature toy cup and teapot and say "Can you make a cup of tea?" Does the child pretend to pour out the tea, drink it etc?

NOTE - if you can elicit an example of pretending in some other game, score a yes on this item

____ *iv) Say to the child "Where's the light?" or "Show me the light". Does the child point with his/her index finger at the light?

NOTE - Repeat this with "Where's the teddy?" or some other unreachable object, if child does not understand the word "light". To record yes on this item, the child must have looked up at your face around the time of pointing.

____ v) Can the child build a tower of bricks? (If so, how many?) (Number of bricks...)

* Indicates critical question most indicative of autistic characteristics

Appendix D

Modified Checklist for Autism in Toddlers (M-CHAT)

Please fill out the following about how your child **usually** is. Please try to answer every question. If the behavior is rare (e.g., you've seen it once or twice), please answer as if the child does not do it.

1.	Does your child enjoy being swung, bounced on your knee, etc.?	Yes	No
2.	Does your child take an interest in other children?	Yes	No
3.	Does your child like climbing on things, such as up stairs?	Yes	No
4.	Does your child enjoy playing peek-a-boo/hide-and-seek?	Yes	No
5.	Does your child ever pretend, for example, to talk on the phone or take care of dolls, or pretend other things?	Yes	No
6.	Does your child ever use his/her index finger to point, to ask for something?	Yes	No
7.	Does your child ever use his/her index finger to point, to indicate interest in something?	Yes	No
8.	Can your child play properly with small toys (e.g. cars or bricks) without just mouthing, fiddling, or dropping them?	Yes	No
9.	Does your child ever bring objects over to you (parent) to show you something?	Yes	No
10.	Does your child look you in the eye for more than a second or two?	Yes	No
11.	Does your child ever seem oversensitive to noise? (e.g., plugging ears)	Yes	No
12.	Does your child smile in response to your face or your smile?	Yes	No
13.	Does your child imitate you? (e.g., you make a face-will your child imitate it?)	Yes	No
14.	Does your child respond to his/her name when you call?	Yes	No
15.	If you point at a toy across the room, does your child look at it?	Yes	No
16.	Does your child walk?	Yes	No
17.	Does your child look at things you are looking at?	Yes	No
18.	Does your child make unusual finger movements near his/her face?	Yes	No
19.	Does your child try to attract your attention to his/her own activity?	Yes	No
20.	Have you ever wondered if your child is deaf?	Yes	No
21.	Does your child understand what people say?	Yes	No
21.	Does your child sometimes stare at nothing or wander with no purpose?	Yes	No
23.	Does your child look at your face to check your reaction when faced with something unfamiliar?	Yes	No

Appendix E

Quantitative Checklist for Autism in Toddlers (Q-CHAT)

Section 1. Please answer the following questions about your child. Try to answer every question if you can.

1. Does your child look at you when you call his/her name?

• always • usually • sometimes • rarely • never

2. How easy is it for you to get eye contact with your child?

• very easy • quite easy • quite difficult • very difficult • impossible

3. When your child is playing alone, does s/he line objects up?

• always • usually • sometimes • rarely • never

4. Can other people easily understand your child's speech?

• always • usually • sometimes • rarely • never • my child does not speak

5. Does your child point to indicate that s/he wants something (e.g. a toy that is out of reach)

• many times a day • a few times a day • a few times a week • less than once a week • never

6. Does your child point to share interest with you (e.g. pointing at an interesting sight)?

• many times a day • a few times a day • a few times a week • less than once a week • never

7. How long can your child's interest be maintained by a spinning object (e.g. washing machine, electric fan, toy car wheels)?

• several hours • half an hour • 10 min • a couple of minutes • less than a minute

8. How many words can your child say?

• none—s/he has not started speaking yet • less than 10 words • 10–50 words • 51–100 words • over 100 words

9. Does your child pretend (e.g. care for dolls, talk on a toy phone)?

• many times a day • a few times a day • a few times a week • less than once a week • never

10. Does your child follow where you're looking?

• many times a day • a few times a day • a few times a week • less than once a week • never

11. How often does your child sniff or lick unusual objects?

• many times a day • a few times a day • a few times a week • less than once a week • never

12. Does your child place your hand on an object when s/he wants you to use it (e.g. on a door handle when s/he wants you to open the door, on a toy when s/he wants you to activate it)?

• many times a day • a few times a day • a few times a week • less than once a week • never

13. Does your child walk on tiptoe?

• always • usually • sometimes • rarely • never

14. How easy is it for your child to adapt when his/her routine changes or when things are out of their usual place?

• very easy • quite easy • quite difficult • very difficult • impossible

15. If you or someone else in the family is visibly upset, does your child show signs of wanting to comfort them? (e.g. stroking their hair, hugging them)?

• always • usually • sometimes • rarely • never

16. Does your child do the same thing over and over again (e.g. running the tap, turning the light switch on and off, opening and closing doors)?

• many times a day • a few times a day • a few times a week • less than once a week • never

17. Would you describe your child's first words as:

• very typical • quite typical • slightly unusual • very unusual • my child doesn't speak

18. Does your child echo things s/he hears (e.g. things that you say, lines from songs or movies, sounds)?

• many times a day • a few times a day • a few times a week • less than once a week • never

19. Does your child use simple gestures (e.g. wave goodbye)?

• many times a day • a few times a day • a few times a week • less than once a week • never

20. Does your child make unusual finger movements near his/her eyes?

• many times a day • a few times a day • a few times a week • less than once a week • never

21. Does your child spontaneously look at your face to check your reaction when faced with something unfamiliar?

• always • usually • sometimes • rarely • never

22. How long can your child's interest be maintained by just one or two objects?

• most of the day • several hours • half an hour • ten minutes • a couple of minutes

23. Does your child twiddle objects repetitively (e.g. pieces of string)?

• many times a day • a few times a day • a few times a week • less than once a week • never

24. Does your child seem oversensitive to noise?

• always • usually • sometimes • rarely • never

25. Does your child stare at nothing with no apparent purpose?

• many times a day • a few times a day • a few times a week • less than once a week • never

Appendix F

First Year Inventory (FYI)

Each of the following questions below are followed by never, seldom, sometimes or often as possible responses.

1. Looks when name is called
2. Bothered by loud sounds
3. Overly sensitive to touch
4. Excited when knows what will happen next
5. Trouble hearing
6. Avoids looking at you
7. Looks at your face for comfort
8. Ignores loud or startling sounds
9. Spits out certain textures of foods
10. Turns to look at pointed out object
11. Plays alone for an hour or more
12. Looks at people when they talk
13. Rocks body back and forth over and over
14. Looks up from play when shown new toy
15. Upset when switching activities
16. Easy to understand baby's expressions
17. Presses against things
18. Smiles when looking at you
19. Tries to get your attention to show things
20. Tries to get your attention for interactive games
21. Tries to get your attention to obtain toy
22. Tries to get your attention for physical games
23. Body feels loose or floppy
24. Imitates mouth sounds
25. Imitates body movements
26. Imitates activities with objects
27. Difficult to calm when upset
28. Sleeping and waking patterns are regular
29. Tries to get attention by sound and gaze
30. Repeats simple activity over and over
31. Seems interested in other babies
32. Babbles
33. Enjoys staring at bright lights
34. Uses communicative gestures
35. Responds to ''Where's ___?
36. Uses pincer grip
37. Gets stuck on playing with a part of a toy
38. Uses finger to point at things
39. Plays or communicates less than in the past
40. Eyes line up when looking at object
41. Regular feeding patterns
42. Enjoys rubbing or scratching objects

43. Body gets stuck in positions or postures
44. Enjoys making objects spin over and over
45. Enjoys kicking feet over and over
46. Stares at fingers while wiggling them

47. a. Uses toy in same way all the time
b. Occasionally finds new ways to play
c. Often explores new ways to play

48. a. Plays with 1 or 2 special toys per day
b. Plays with 3–5 toys
c. Plays with a large number of toys

49. a. Almost always joins in new game immediately
b. Joins with a little help
c. Joins with a lot of help
d. Not interested in new games

50. a. Looks up from playing when shown a different toy
b. Looks up if new toy moves, shakes or makes noise
c. Looks up only if current toy is removed

51. a. Doesn't seem to notice painful experience
b. Reacts a little but calms quickly
c. Very sensitive and cries for a long time

52. a. Turns toward you when you say baby's name
b. Turns when name said several times
c. Turns when name is loud or other sound is used
d. Doesn't turn when name is said

53. a. Smiles and laughs in response to smile and laugh
b. Smiles when touched or tickled
c. Smiles when swung or bounced
d. Doesn't smile or laugh

54. a. Sleeps 12+ hours per night
b. Sleeps 10–11 h
c. Sleeps 8–9 h
d. Sleeps 7 or fewer hours

55. a. Wakes up 0 times per night
b. Wakes 1–2 times
c. Wakes 3 or more times

56. a. Walks independently
b. Walks with hands held or with other aid
c. Pulls to stand but doesn't walk
d. Doesn't pull to stand

57. a. Almost never gets upset
b. Needs to be calmed 1–3 time per day
c. Needs to be calmed 4–6 times
d. Needs to be calmed 6 or more times

58. a. Doesn’t notice that sound is being imitated
b. Notices sound but doesn’t imitate it
c. Notices sound and imitates it
d. Makes the sound several times

59. a. Almost never keeps toy or object in mouth
b. Sometimes keeps toy or object in mouth
c. Often keeps toy or object in mouth
d. Almost always keeps toy or object in mouth

60. a. Almost always looks at toy being handled
b. Sometimes looks at toy being handled
c. Rarely looks at toy being handled
d. Almost never looks at toy being handled

Appendix G

Early Screening of Autistic Traits Questionnaire (ESAT)

1. Is your child interested in different sorts of objects and not for instance mainly in cars of buttons? YES/NO

2. Can your child play with toys in varied ways (not just fiddling, mouthing or dropping them)? YES/NO

3. When your child expresses his/her feelings, for instance by crying or smiling, is that mostly on expected and appropriate moments? YES/NO

4. Does your child react in a normal way to sensory stimulation, such as coldness, warmth, light, sound, pain or ticking? YES/NO

5. Can you easily tell from the face of the child how he/she feels? YES/NO

6. Is it easy to make eye-contact with your child? YES/NO

7. When your child has been left alone for some time, does he/she try to attract your attention, for instance by crying or calling? YES/NO

8. Is the behavior of your child free of stereotyped repetitive movements like banging his/her head or rocking his/her body? YES/NO

9. Does your child, on his/her own accord, ever bring objects over to you or show you something? YES/NO

10. Does your child show to be interested in other children or adults? YES/NO

11. Does your child like to be cuddled? YES/NO

12. Does your child ever smile at you or at other people? YES/NO

13. Does your child like playing games with others, such as peek-a-boo, ride on someone's knee, or to be swung? YES/NO

14. Does your child react when spoken to, for instance, by looking, listening, smiling, speaking or babbling? YES/NO

15. Does your child speak a few words or utter various babbling sounds? YES/NO

16. When you are pointing at something, does your child follow your gaze to see what you are pointing at? YES/NO

17. Does your child ever use his/her index finger to point, to indicate interest in something? YES/NO

18. Does your child ever use his/her index finger to point, to ask for something? YES/NO

19. Does your child ever pretend, for example, to make a cup of tea using a toy cup and teapot, or pretend other things? YES/NO

Appendix H

Background Information Form

Child's Birthdate_____ Today Date_____

Child's Name _____ Sex _____
FIRST MIDDLE LAST

Address
_____
STREET CITY POSTAL CODE

Child's birth order: ❒ 1st ❒ 2nd ❒ Other _____ (specify) Number of children in family_____

Name of
Mother/Guardian:_____
FIRST, LAST

Name of
Father/Guardian:_____
FIRST, LAST

EXPOSURE TO OTHER LANGUAGES

Is your child regularly exposed to a language other than English? **YES ❒ NO ❒**

If YES: What Language? _____ By whom? _____

Days per week? _____ # Hours per day?_____ Since what age (in months)_____

HEALTH

Did you experience any major pregnancy or birth complications? **YES ❒ NO ❒**
If YES: Please describe:
_____

Was your child born prematurely (i.e., before the due date)? **YES ❒ NO ❒**
If YES: How many weeks early? _____

Does your child experience chronic ear infections (5 or more)? **YES ❒ NO ❒**

If so, has your child undergone intervention (e.g., tubes)? **YES ❒ NO ❒**

If YES: Please describe: _____

Is there some reason to suspect that your child may have a hearing loss? **YES ❒ NO ❒**

Has your child had any illnesses, hospitalizations, or diagnosed disabilities? **YES ❒ NO ❒**
If YES: Please describe:
_____

Have you or any member of your extended family (e.g., child's siblings, grandmother, father, etc.) been diagnosed with any type of behavioral impairment, neurological impairment, language disability and/or learning disability?

YES ❒ NO ❒

If YES: Please specify:
_____
_____

ETHNIC BACKGROUND

For example, Asian, Black, Hispanic, White, American Indian, or other appropriate category.

_____ _____
Mother/Guardian Father/Guardian

EDUCATION

Circle highest grade completed. (12 = high school graduate, 16 = college/university graduate, 18 = advanced degree).

Mother/Guardian <5 6 7 8 9 10 11 12 13 14 15 16 17 18

Father/Guardian <5 6 7 8 9 10 11 12 13 14 15 16 17 18

OCCUPATION

Please provide a brief description of your occupation using specific terms (e.g., computer technician, accountant, dental assistant)

Mother/Guardian:_____

Father/Guardian:_____

What is your household's annual income?

< 20000 ____ 20,000-40,000____ 40,000-60000 ____ 60,000-100,000 ___ above 100000___

CONTACT INFORMATION

The best **TIME** to contact me is: _____
The best **PLACE** to contact me is: HOME ❒Ph. #_____
WORK ❒Ph. #_____

THANK YOU FOR TAKING THE TIME TO ANSWER OUR QUESTIONS!
PLEASE MAIL FORM(S) IN ACCOMPANYING ENVELOPE.
***IF YOU HAVE ANY QUESTIONS OR CONCERNS, PLEASE CONTACT* THE PRINCIPAL INVESTIGATOR: ANNA MATEJKA TEL: 514.369.8989**

Appendix I

Scoring Guidelines for the PICS

Item Scores:

0 = Never
1 = Sometimes
2 = Frequently
9 = Not Sure (excluded from analyses)

Summary Scores:

Averages are calculated for each summary score. These averages are based only on items that the parent completed and did not indicate 'Not Sure'. To determine the average scores…

1) calculate the sum of item scores for all completed items (parent responded Never, Sometimes, or Frequently)
2) divide the sum of the item scores by the number of items the parent completed

Total Score = average score of all completed items

IJA Subscore = average score of completed items 1, 4, 8, 9, 12, 16

IBR Subscore = average score of completed items 3, 5, 6, 10, 13, 15

RJA Subscore = average score of completed items 2, 7, 11, 14

Appendix J

Early Social Communication Scale (ESCS)

ESCS Summary Scores

IJA (Initiating Joint Attention)

Lower Level IJA = EC + Alt

Higher Level IJA = Pt + PtEC + Show

Total IJA = Lower Level IJA + Higher Level IJA
= (EC + Alt) + (Pt + PtEC + Show)

IJA Bids to Mom = _____

Points in Imitation = _____

RJA (Responding to Joint Attention)

Lower Level RJA = *% following proximal points (book)*

Higher Level = % following line of regard

Left/Right RJA = % following line of regard on L/R trials

Behind RJA = % following line of regard on Beh. Trials

Total RJA = % following line of regard on L/R & Beh. Trials

(IBR) Initiating Behavior Regulation

Lower Level IBR = EC + Rch + App

Higher Level IBR = Pt + PtEC + Gv + GvEc

Total IBR = Lower Level IBR + Higher Level IBR

IBR Bid to Mom = $\frac{(EC + Rch + App) + (Pt + PtEC + Gv + GvEC)}{\_\_\_\_\_}$

RBR (Responding to Behavior Regulation)

Total RBR Passes = $\frac{(\#\text{ Pass without Gesture} + \#\text{ Pass with Gesture})}{(\text{Total \# of Trials, including Pass \& Fail})}$

Total RBR Fails = $\frac{(\#\text{ Fail without Gesture} + \#\text{ Fail with Gesture})}{(\text{Total \# of Trials, including Pass \& Fail})}$

ISI (Initiating Social Interaction)

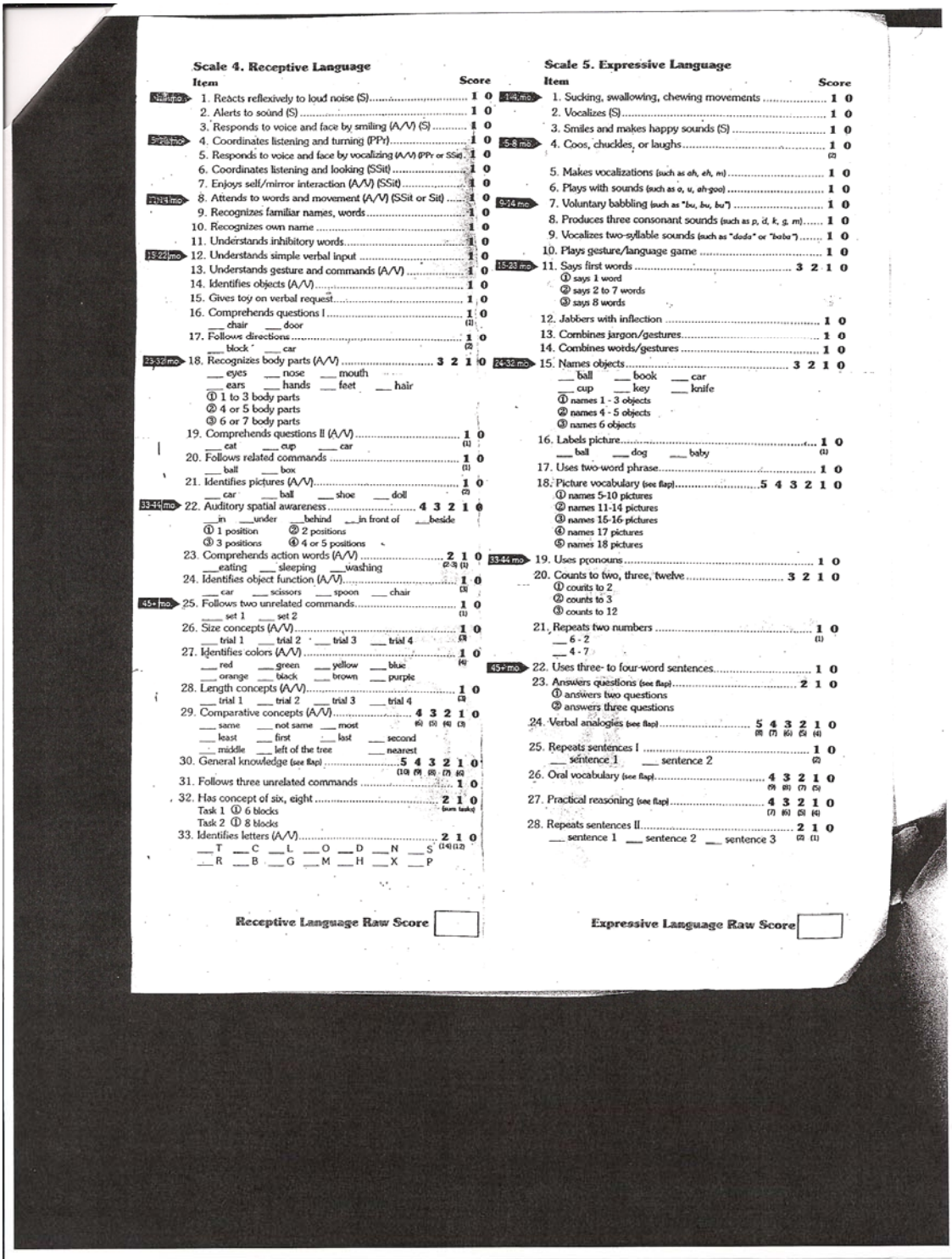
ISI = Init. TT with car/ball Total + Tease + (*Initiates Song/Tickle)*

RSI (Responding to Social Interaction)

RSI = Total Song/Tickle Resp. + Total TT Resp. + Total Resp. to Invitation
= (EC + Act + Appeal) + (car + ball resp.) + (comb + hat + glasses resp.)

Appendix K

Mullen Expressive and Receptive Protocol



Scale 4. Receptive Language

	Item	Score
0-4 mo	1. Reacts reflexively to loud noise (S)	1 0
	2. Alerts to sound (S)	1 0
	3. Responds to voice and face by smiling (A/V) (S)	1 0
5-8 mo	4. Coordinates listening and turning (PPr)	1 0
	5. Responds to voice and face by vocalizing (A/V) (PPr or SSit)	1 0
	6. Coordinates listening and looking (SSit)	1 0
	7. Enjoys self/mirror interaction (A/V) (SSit)	1 0
9-14 mo	8. Attends to words and movement (A/V) (SSit or Sit)	1 0
	9. Recognizes familiar names, words	1 0
	10. Recognizes own name	1 0
	11. Understands inhibitory words	1 0
15-22 mo	12. Understands simple verbal input	1 0
	13. Understands gesture and commands (A/V)	1 0
	14. Identifies objects (A/V)	1 0
	15. Gives toy on verbal request	1 0
	16. Comprehends questions I	1 0 (2)
	___ chair ___ door	
	17. Follows directions	1 0 (2)
	___ block ___ car	
23-32 mo	18. Recognizes body parts (A/V)	3 2 1 0
	___ eyes ___ nose ___ mouth	
	___ ears ___ hands ___ feet ___ hair	
	① 1 to 3 body parts	
	② 4 or 5 body parts	
	③ 6 or 7 body parts	
	19. Comprehends questions II (A/V)	1 0 (1)
	___ cat ___ cup ___ car	
	20. Follows related commands	1 0 (1)
	___ ball ___ box	
	21. Identifies pictures (A/V)	1 0 (2)
	___ car ___ ball ___ shoe ___ doll	
33-44 mo	22. Auditory spatial awareness	4 3 2 1 0
	___in ___under ___behind ___in front of ___beside	
	① 1 position ② 2 positions	
	③ 3 positions ④ 4 or 5 positions	
	23. Comprehends action words (A/V)	2 1 0 (2-3) (1)
	___eating ___sleeping ___washing	
	24. Identifies object function (A/V)	1 0 (3)
	___ car ___ scissors ___ spoon ___ chair	
45+ mo	25. Follows two unrelated commands	1 0 (1)
	___ set 1 ___ set 2	
	26. Size concepts (A/V)	1 0 (3)
	___ trial 1 ___ trial 2 ___ trial 3 ___ trial 4	
	27. Identifies colors (A/V)	1 0 (4)
	___ red ___ green ___ yellow ___ blue	
	___ orange ___ black ___ brown ___ purple	
	28. Length concepts (A/V)	1 0 (3)
	___ trial 1 ___ trial 2 ___ trial 3 ___ trial 4	
	29. Comparative concepts (A/V)	4 3 2 1 0 (6) (5) (4) (3)
	___ same ___ not same ___ most	
	___ least ___ first ___ last ___ second	
	___ middle ___ left of the tree ___ nearest	
	30. General knowledge (see flap)	5 4 3 2 1 0 (10) (9) (8) (7) (6)
	31. Follows three unrelated commands	1 0
	32. Has concept of six, eight	2 1 0 (num. tasks)
	Task 1 ① 6 blocks	
	Task 2 ① 8 blocks	
	33. Identifies letters (A/V)	2 1 0 (14) (12)
	___T ___C ___L ___O ___D ___N ___S	
	___R ___B ___G ___M ___H ___X ___P	

Receptive Language Raw Score ____

Scale 5. Expressive Language

	Item	Score
0-4 mo	1. Sucking, swallowing, chewing movements	1 0
	2. Vocalizes (S)	1 0
	3. Smiles and makes happy sounds (S)	1 0
5-8 mo	4. Coos, chuckles, or laughs	1 0 (2)
	5. Makes vocalizations (such as *oh, eh, m*)	1 0
	6. Plays with sounds (such as *o, u, ah-goo*)	1 0
9-14 mo	7. Voluntary babbling (such as "*bu, bu, bu*")	1 0
	8. Produces three consonant sounds (such as *p, d, k, g, m*)	1 0
	9. Vocalizes two-syllable sounds (such as "*dada*" or "*baba*")	1 0
	10. Plays gesture/language game	1 0
15-23 mo	11. Says first words	3 2 1 0
	① says 1 word	
	② says 2 to 7 words	
	③ says 8 words	
	12. Jabbers with inflection	1 0
	13. Combines jargon/gestures	1 0
	14. Combines words/gestures	1 0
24-32 mo	15. Names objects	3 2 1 0
	___ ball ___ book ___ car	
	___ cup ___ key ___ knife	
	① names 1 - 3 objects	
	② names 4 - 5 objects	
	③ names 6 objects	
	16. Labels picture	1 0 (1)
	___ ball ___ dog ___ baby	
	17. Uses two-word phrase	1 0
	18. Picture vocabulary (see flap)	5 4 3 2 1 0
	① names 5-10 pictures	
	② names 11-14 pictures	
	③ names 15-16 pictures	
	④ names 17 pictures	
	⑤ names 18 pictures	
33-44 mo	19. Uses pronouns	1 0
	20. Counts to two, three, twelve	3 2 1 0
	① counts to 2	
	② counts to 3	
	③ counts to 12	
	21. Repeats two numbers	1 0 (1)
	___ 6 - 2	
	___ 4 - 7	
45+ mo	22. Uses three- to four-word sentences	1 0
	23. Answers questions (see flap)	2 1 0
	① answers two questions	
	② answers three questions	
	24. Verbal analogies (see flap)	5 4 3 2 1 0 (8) (7) (6) (5) (4)
	25. Repeats sentences I	1 0
	___ sentence 1 ___ sentence 2	(2)
	26. Oral vocabulary (see flap)	4 3 2 1 0 (9) (8) (7) (5)
	27. Practical reasoning (see flap)	4 3 2 1 0 (7) (6) (5) (4)
	28. Repeats sentences II	2 1 0
	___ sentence 1 ___ sentence 2 ___ sentence 3	(3) (1)

Expressive Language Raw Score ____

Appendix L

Short Form MacArthur Communication Development Inventory (MCDI)

MacArthur Short Form
Vocabulary Checklist: Level I

Please circle who filled out this form:
mother father
other (specify relation to child) _____

Child's Name _____ Sex _____

Birthdate _____ Today's Date _____

VOCABULARY CHECKLIST

For words your child understands but does not yet say, mark the first column (understands). For words that your child not only understands but also says, mark the second column (understands and says). If your child uses a different pronunciation of a word, mark it anyway.

	Understands	Understands and says		Understands	Understands and says		Understands	Understands and says
choo choo	O	O	chair	O	O	wait	O	O
meow	O	O	couch	O	O	break	O	O
ouch	O	O	kitchen	O	O	feed	O	O
uh oh	O	O	table	O	O	finish	O	O
bird	O	O	television	O	O	help	O	O
dog	O	O	blanket	O	O	jump	O	O
duck	O	O	bottle	O	O	kick	O	O
kitty	O	O	cup	O	O	kiss	O	O
lion	O	O	dish	O	O	push	O	O
mouse	O	O	lamp	O	O	sing	O	O
car	O	O	radio	O	O	smile	O	O
stroller	O	O	spoon	O	O	night	O	O
ball	O	O	flower	O	O	today	O	O
book	O	O	home	O	O	all gone	O	O
doll	O	O	moon	O	O	big	O	O
bread	O	O	outside	O	O	broken	O	O
candy	O	O	plant	O	O	dark	O	O
cereal	O	O	rain	O	O	fast	O	O
cookie	O	O	rock	O	O	hurt	O	O
juice	O	O	water	O	O	pretty	O	O
toast	O	O	babysitter	O	O	soft	O	O
hat	O	O	girl	O	O	I	O	O
pants	O	O	grandma	O	O	me	O	O
shoe	O	O	mommy	O	O	how	O	O
sock	O	O	bath	O	O	who	O	O
eye	O	O	don't	O	O	away	O	O
head	O	O	hi	O	O	out	O	O
leg	O	O	night night	O	O	other	O	O
nose	O	O	patty cake	O	O	some	O	O
tooth	O	O	please	O	O		O	O

MacArthur Short Form
Vocabulary Checklist: Level II (Form A)

Please circle who filled out this form:
mother father
other (specify relation to child) _____

Child's Name _____ Sex _____

Birthdate _____ Today's Date _____

VOCABULARY CHECKLIST

Children understand many more words than they say. We are particularly interested in the words your child SAYS. Please mark the words you have heard your child use. If your child uses a different pronunciation of a word, mark it anyway.

baa baa	O	hat	O	sky	O	all gone	O
meow	O	necklace	O	party	O	cold	O
ouch	O	shoe	O	friend	O	fast	O
uh oh	O	sock	O	mommy	O	happy	O
woof woof	O	chin	O	person	O	hot	O
bear	O	ear	O	bye	O	last	O
bird	O	hand	O	hi	O	tiny	O
cat	O	leg	O	no	O	wet	O
dog	O	broom	O	shopping	O	after	O
duck	O	comb	O	thank you	O	day	O
horse	O	mop	O	carry	O	tonight	O
airplane	O	plate	O	chase	O	our	O
boat	O	trash	O	dump	O	them	O
car	O	tray	O	finish	O	this	O
ball	O	towel	O	fit	O	us	O
book	O	bed	O	hug	O	where	O
game	O	bedroom	O	listen	O	beside	O
applesauce	O	bench	O	like	O	down	O
candy	O	oven	O	pretend	O	under	O
coke	O	stairs	O	rip	O	all	O
cracker	O	flag	O	shake	O	much	O
juice	O	rain	O	taste	O	could	O
meat	O	star	O	gentle	O	need	O
milk	O	swing	O	think	O	would	O
peas	O	school	O	wish	O	if	O

Has your child begun to combine words yet, such as "nother cookie" or "doggie bite?"

O Not Yet O Sometimes O Often

MacArthur Short Form
Vocabulary Checklist: Level II (Form B)

Please circle who filled out this form:
mother father
other (specify relation to child) _____
_____

Child's Name _____ Sex _____

Birthdate _____ Today's Date _____

VOCABULARY CHECKLIST

Children understand many more words than they say. We are particularly interested in the words your child SAYS. Please mark the words you have heard your child use. If your child uses a different pronunciation of a word, mark it anyway.

baa baa	O	beads	O	store	O	big	O
moo	O	hat	O	zoo	O	black	O
ouch	O	jeans	O	baby	O	then	O
yum yum	O	shoe	O	mommy	O	careful	O
quack quack	O	feet	O	child	O	dirty	O
bird	O	nose	O	mailman	O	fine	O
duck	O	tongue	O	bath	O	mad	O
fish	O	bottle	O	bye	O	noisy	O
kitty	O	bowl	O	lunch	O	slow	O
moose	O	clock	O	night night	O	before	O
penguin	O	glass	O	no	O	today	O
boat	O	jar	O	bite	O	tomorrow	O
truck	O	keys	O	build	O	she	O
balloon	O	light	O	catch	O	their	O
present	O	telephone	O	drink	O	they	O
puzzle	O	bathtub	O	drop	O	yourself	O
cheese	O	chair	O	find	O	why	O
chicken	O	crib	O	go	O	above	O
cookie	O	porch	O	hide	O	away	O
juice	O	sofa	O	jump	O	up	O
pretzel	O	cloud	O	kick	O	none	O
salt	O	hose	O	look	O	some	O
sauce	O	sidewalk	O	pick	O	does	O
vanilla	O	sun	O	run	O	don't	O
cup	O	house	O	sit	O	were	O

Has your child begun to combine words yet, such as "nother cookie" or "doggie bite?"

O Not Yet O Sometimes O Often