EXPLORING THE USE OF NONVERBAL COMMUNICATIVE BEHAVIORS IN CHILDREN WITH WILLIAMS SYNDROME

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Brittany Myatt

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Exploring the Use of Nonverbal Communicative Behaviors in Children with Williams Syndrome

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ABSTRACT OF THE THESIS

Exploring the Use of Nonverbal Communicative Behaviors in
Children with Williams Syndrome
by
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Williams syndrome (WS) is a rare genetic disorder characterized by a deletion of about 20 genes including the elastin gene on chromosome 7. Individuals with WS have a uneven cognitive profile as adults: they are mildly to moderately retarded with significantly impaired visuo-spatial skills, however, language is a strength and they show a characteristic behavioral profile of extremely sociable and friendly personalities. In spite of the late onset of language in WS as children, they later develop a robust vocabulary similar to mentally age matched typically developing children. Interestingly, they do not appear to follow the typical path of language development. In typical development, a link has been noted between language development and earlier development of nonverbal communicative tools such as gestures, eye gaze, joint attention, and social referencing. Current research suggests that children with WS do not produce many gestures, such as those seen in typical development, until after they have acquired language. Moreover, they may have difficulties in areas of social referencing as they often become fixated with unfamiliar faces. The purpose of the present study was to examine the production of nonverbal communicative behaviors of young children with WS and their relation to vocalizations. Participants included 12 children with WS and 30 typically developing controls matched on mental ages, as calculated by the Bayley Mental Development Index. All data were previously collected via video recording by Dr. Ursula Bellugi as part of the Project in Cognitive and Neural Development at UCSD. Nonverbal communicative behaviors were measured by means of tasks from the Laboratory Temperament Assessment Battery (Lab Tab). Four questions were addressed: (1) Do toddlers with WS produce nonverbal communicative behaviors? (2) If children with WS are producing nonverbal behaviors with communicative intent, what do these behaviors look like? (3) Provided children with WS produce nonverbal communicative behaviors, will such behaviors co-occur with vocalizations? (4) Will children with WS look more at a person than an object? In exploring such questions, the present study sought to explore the overall question: Do children with WS use nonverbal forms of communication during language development similar to children of typical development? Results suggest that when including a more broad range on nonverbal behaviors, children with WS do produce nonverbal behaviors with communicative intent.

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CHAPTER 1

INTRODUCTION

Williams syndrome is a rare genetic disorder, typically occurring 1 in 7, 500 live births (Brock, 2007). This disorder is characterized by a deletion on chromosome 7 (7q11.23) of approximately 20 genes including the elastin gene (Levy, 2004; Masataka, 2001; Mervis, 2003). People with Williams syndrome (hereby referred to as WS) exhibit distinct characteristics such as "elfin" like faces, abnormal reactions to certain sounds, postnatal growth deficiency, renal and cardiovascular anomalies, and spatial cognitive deficits that exceed their levels of general cognitive impairments (Brock, 2007; Capirci, Letizia, & Volterra, 1996; Singer-Harris, Bellugi, Bates, Jones, & Rossen, 1997). Their personalities are often described as extremely sociable and friendly. The language development of WS has captivated the attention of many researchers as it appears to defy the general path of development seen in typically developing populations, and other atypically developing populations.

Past research of typical development has noted a link between gestures and language development suggesting the two systems are "tightly coupled" (Bates & Dick, 2002; Capone & McGregor, 2004; Iverson & Goldin-Meadow, 2005; Iverson & Thelen, 1999). This "coupled" gesture-speech system commences with the use of gestures in the middle of a child's first year, and first words emerge shortly thereafter. Signs of the gesture-speech system are evident early in development with signs of canonical movements (Iverson & Goldin-Meadow, 2005; Masataka, 2001). During toddlerhood, gestures become an essential mode of communication as gestures are relied on to express thoughts and ideas toddlers cannot yet express verbally (Bates & Dick, 2002; Goldin-Meadow, 2007; Iverson & Goldin-Meadow, 2005; Mervis & Bertrand, 1997).

Children developing atypically, such as those with Down syndrome, early brain injury, or autism, have demonstrated similar patterns of development as typically developing children (Brock, 2007; Bello, Caprici, & Volterra, 2004; Mervis & Becerra, 2007; Nazzi & Bertoncini, 2003; Singer-Harris et al., 1997). Gestures emerge prior to their first words,

equipping children with a non-verbal method of communicating a thought or desire pre-linguistically. Given the general delay in language development of atypical populations, this gestural development and use is of profound importance. Gestures have even appeared beneficial to such populations in the classroom; children are more likely to comprehend a task when instructed with speech and gestures (Wang, Bernas, & Eberhard, 2001). When examining the language development of the WS population, however, what is known about this "tightly coupled" system is challenged.

Faced with complications such as late diagnosis, early health complications, and small sample sizes (Mervis & Bertrand, 1997; Singer-Harris et al, 1997; Masataka, 2001; Mervis et al., 2003), few studies have examined early stages of development of WS. Such studies have proposed that children with WS produce few gestures in comparison to children of typical and atypical development. Milestones of gestural development appears to emerge later in development and occur out of the typical sequence. Furthermore, past studies have been confined to a limited definition of the term gesture.

In efforts to better understand the pathway of development of language and non-verbal behaviors in the WS population, the present study seeks to further examine this area by using a wider view of gestures, including other non-verbal communicative behaviors. The present paper seeks to evaluate past research in this area by first examining milestones of nonverbal communication during language development, contrasting development in WS to patterns seen in typical development. Second, the evolution of language and gesture use in WS as evidenced later in development will be reviewed. Lastly, the current study and its methodology will be addressed.

EARLY MILESTONES IN THE DEVELOPMENT OF NON-VERBAL COMMUNICATION

To understand the relationship between nonverbal communication and language development, it is first important to discuss milestones evidenced in typical development.

Canonical Babbling and Head Banging

The relationship between gesture and speech first appears during the period of canonical babbling. This stage of development involves the co-emergence of two milestones: (1) the production of repeated consonant-vowel segments such as 'bababa', 'yaya', or

'dadada' and (2) rhythmic head banging or rhythmic arm shaking (oscillation) (Bates & Dick, 2002; Iverson & Fagan, 2004; Masataka, 2001). Although both milestones occur outside the realm of communication, the connection between the two may foreshadow development of the gesture-speech system (Bates & Dick, 2002; Iverson & Fagan, 2004).

In typically developing children, canonical babbling and rhythmic head banging first appear at about 6-10 months of age, or generally 2 to 3 months prior to the emergence of their first words (Bates & Dick, 2002; Masataka, 2001). Given WS' general delay in reaching motor milestones, Masataka (2001) conducted a longitudinal study to determine if this phase of development was disrupted in babies with WS. Consistent with typically developing babies (Mervis & Bertrand, 1997) results in the WS group yielded significant correlations across the subjects between three categories:(1) the onset of words and canonical babbling (2) the onset of first words and head banging and (3) the onset of canonical babbling and head banging. Findings imply the WS population exhibits the same link between the onsets of canonical babbling and head banging during infancy. Results are consistent with other studies of infants with WS during this phase of development (Mervis & Bertrand, 1997). Important to note is that this milestone occurs somewhat delayed commensurate with the delayed onset of their first word.

From this study of early development, one may begin to see the development of the relationship between non-verbal communication and language. Babbling serves as a precursor to language. In the same manner, oscillated movements (i.e. head banging) serve as a precursor to gestures. This relationship is evident in typical development. The Masataka (2001) study indicates that although children with WS are delayed in this area, they demonstrate typical patterns in these early nonverbal communicative behaviors and language development during infancy.

Pointing

Through the emergence of pointing and language, we begin to see a second link between gestural and language development. Pointing is a gesture of importance with several functions from infancy to adulthood (Tomasello, Carpenter, & Liszkowski, 2007). Explicitly, the salient function of the pointing gesture is for a communicator to direct someone's attention to something, suggesting "If you look over there, you'll know what I mean"

(Tomasello et al., 2007). Comprehending the intended meaning of a pointing gesture, however, requires serious "mind reading" on behalf of the recipient (Goldin-Meadow, 2007; Tomasello et al., 2007). That is, it is the responsibility of the recipient to fully capture the intended message of the communicator.

During infancy, more functions of pointing emerge as this gesture serves its premier function of facilitating language development. Emerging prior to the first birthday (Tomasello et al., 2007), pointing predates language development and sets the foundation for the production of first words (Goldin-Meadow, 2007; Laing et al., 2002; Mervis & Bertrand, 1997). This manual behavior permits toddler's non-verbal expression of what they cannot yet express verbally, thus facilitating their transition from gestures to object naming (Bates & Dick, 2002; Goldin-Meadow, 2007; Mervis & Bertrand, 1997). When a child points to an object, the mother (or the interlocutor) directs their attention to the object and often say the object's name.

An example of this concept can be seen when considering a child playing with his or her mother. During playtime, a child might point to a ball. Provided the mother understands the intent of this gesture, she will more than likely turn her attention to the ball, look back at the child, and say the word "ball" (Mervis & Bertrand, 1997). The mother is encouraged to interpret their child's gesture into a word, introducing the child to a label. In turn, the child may be encouraged by pointing to learn a word for that particular object (Goldin-Meadow, 2007). This gesture is of such great significance during development that Goldin-Meadow (2007) proposed the pointing gesture serves as a stepping stone on the path to acquiring spoken vocabulary items; infants refer to an object by pointing, learn the name of the object, and then begin to say the word themselves. Mervis and Bertrand (1997) buttress this assertion suggesting the link from the cognitive manifestation of referential pointing to the lexical manifestation of productive language is expected to be sequential. Additionally, they explain that this sequence of development is one of the most robust findings in regard to the developmental transition from gesturing to producing language.

Laing et al. (2002) sought to explore this critical stage of development in toddlers with WS. Participants (mean CA = 31 months; mean MA= 4 months), compared to typically developing matches, displayed a lack of pointing. Toddlers with WS pointed less than children at similar cognitive levels, providing evidence that pointing is an area of significant

impairment. A second study was conducted to examine the production of the pointing gesture, including an assessment of children with WS comprehension of this gesture. Children with WS produced fewer points and were less likely to follow the experimenter's point, consistent with findings of the initial experiment. Both sets of findings support Mervis' et al. (2003) suggestion that children with WS use referential language prior to referential pointing, in reverse of the pattern of development evident in typical development.

To examine the possible influence of deficits in fine motor control in their production of pointing, Laing et al. (2002) conducted a third experiment. Utilizing a test developed by Butterworth and Morissette (Laing et al., 2002), researchers tested the development of the children's precision grip. The precision grip was defined as those in which the object is grasped between the index finger and the thumb, either at the tip, or before the last articulation of either or both the finger and the thumb (Laing et al., 2002). Although children with WS were found to produce fewer total grips, the difference was not significant ($F(1, 25) = 1.69$, $p = 0.21$). The amount of precision grips produced from this total was actually found to be significantly higher in the children with WS than the control group ($F(1, 25) = 6.9$, $p < 0.05$). The WS group did not produce pointing gestures in the first and second experiments in contrast with their high production of precision grips. In the third experiment, however, WS subjects were found to produce high measures of precision grips. Results from the three studies provide evidence that children with WS' lack of pointing is not caused by motor deficits.

Joint Attention

Typically emerging around 7-8 months, joint attention is an important element of communication which is related to pointing. Tomasello et al. (2007) refers to joint attention as a framework in which the communicator and interlocutor know and understand they are both perceptually attending to some common object. The communicator points to an object and it is the responsibility of the interlocutor to determine what is being referred to and why is it of importance. Two levels of intentionality therefore become involved in this process (Tomasello et al., 2007): (1) the communicator's referential intention of directing the recipient's attention to something and(2) the communicator's broader social motive for initially requesting her attention to that object or area. This behavior is observed with

relatively high frequency around 12 months of age (Heimann et al., 2006) and is significantly dependent on the shared understanding between the communicator and interlocutor.

The significance of joint attention on language development has been widely discussed. According to Tomasello et al., one of the primary functions of pointing is to engage the parent and child in this framework. When both the child and the mother attend to the same object, the child is better able to connect the novel words produced by the adult (Heimann et al., 2006). In the example of a child playing with his/her mother and a ball, both the child and the mother are attentive to the same task at the same time. As previously suggested, if the child looks at an object and the mother engages in joint attention, she will look to the object and provide a label, encouraging the child's language production (Mervis & Bertrand, 1997; Heimann et al., 2006). In addition to encouraging language development during infancy, joint attention during infancy aids in the comprehension of conversational rules as well as communicative intent (Tomasello et al., 2007).

Social Referencing

Pointing is an essential component of establishing joint attention between the communicator and the interlocutor. Yet, pointing is not the sole component of the joint attentional framework. Another critically important part of establishing this framework is through eye gaze. Just as with pointing, eye gaze can serve as a social mechanism of directing someone's attention.

Early in development, infants' attention remains on their partner (or an object) in a face-to-face dyadic interaction (Striano & Rochat, 2000). Towards the end of the first year, this dyadic interaction expands to include objects. Thus, looking behaviors transition in the latter part of infancy to a more referential intent; infants often use eye gaze to engage the interlocutor, seeking information about a situation (Walden & Kim, 2005). This concept of engaging an individual in a social context is commonly referred to as social referencing (Striano & Rochat, 2000; Walden & Kim, 2005).

Few studies have explored the development of eye gaze infants with WS One study, (Brown et al., 2003), examined whether children with WS and DS would demonstrate a deficit in using spatial representations to guide actions, compared to typically developing controls. Results suggested that the children with WS produced a higher proportion of looks

to other areas on the grid than the typically developing and DS children. The children with WS were also impaired on orienting to a target, signifying visuo-spatial problems. However, sustained attention was not found to be impaired. Brown's et al. (2003) study did not focus directly on eye gaze; yet, results emphasize the idea that joint attention is a challenging area of the WS population.

Given the importance of establishing joint attention skills, it could be assumed if this framework is not established, the child may experience complications in comprehending what object the mother is referencing. The likelihood the child will learn object labels will therefore be decreased. The absence of this framework may predict difficulties in word comprehension and thus word production. In regard to WS, if they are not producing points early in development as suggested by Laing's et al. (2002) study, could it be assumed this framework of joint attention is not established? There are several factors that may impede this area of development in WS.

Obstacles in joint attention skills in WS: Studies have noted that children with WS have an unusual strength with facial processing (Bellugi, Lichtenberg, Mills, Galaburda, & Korenberg, 1999; Karmiloff-Smith, Brown, Grice, & Patterson, 2003; Mervis et al., 2003; Mobbs et al., 2004). They are often drawn to faces, seeking direct eye gaze to such an extent it may seem awkward (Mobbs et al., 2004). Karmiloff-Smith et al. (2003) described this intent staring of children with WS as a sticky fixation. That is, children with WS produce longer gaze durations in facial processing in comparison to typically developing children.

Mervis et al. (2003) examined the attentional characteristics of infants and toddlers with WS in two different experimental settings. The first study was a case study in which the 10 month old subject was observed in a free play situation. This was done in two parts: First, the subject played with her mother. Second, she played with a stranger (the experimenter). Compared to typically developing controls, results suggested the infant with WS spent more time looking at her partner in both situations. She was also found to stare intently at the stranger during their play time.

To test the accuracy of this finding in a very different scenario, the second experiment took place in an examination room with a geneticist. As the geneticist conducted a physical exam with the child, the geneticist examined the child's looking behaviors. This study was conducted in a different situation than the first and also included a much larger sample of

children with WS (n=31). Consistent with the first experiment, children with WS displayed intent staring towards the stranger. Results from both situations suggest children with WS may prefer faces to other tasks. That is, WS children may be inclined to pay attention to the face of the person in front of them rather than the task in front of them. This appears to be especially true when an unfamiliar person is involved in the situation.

Facial Expressions

Aside from gestures pertaining to hand and body movements, facial expressions also serve as an important means of communication that exists prior to gestural development (Losonczy, 2004). The significance of facial expressions is evident throughout the course of life, but they are of extreme importance during infancy. As with gestures previously discussed in this paper, facial expressions allow infants to communicate pre-linguistically.

Basic facial expressions emerge within the first seven months of life (Losonczy, 2004). Through smiling, expressions of joy typically emerge within three to six weeks of age (Losonczy, 2004). Other emotions surface somewhat later; between two and four months of age, expressions of anger emerge and between three and four months, expressions of sadness and surprise appear (Losonczy, 2004). Fear expressions typically emerge within the second half of the first year (Bennet, Bendersky, & Lewis, 2005). Such developments suggest that by seven months of age, there is evidence of infants using facial expressions to display emotions of joy, anger, interest, and sadness (Bennet et al., 2005; Losonczy, 2004). These facial expressions appear to occur with greater frequency as the child develops, however it is suggested that not all emotions emerge by seven months (Bennet et al., 2005; Losonczy, 2004).

Several studies have examined facial processing in WS; however, very few researchers have explored the development of facial expression in WS. Jones et al. (2001) explored early development hypersociability in children with WS. Using the LAB TAB measure (to be discussed later in greater detail), WS children younger than 5 years old were found to produce less negative emotional facial expressions than typically developing matched controls (Jones et al., 2001). Additionally, WS subjects were found to exhibit prolonged engaging social behaviors such as smiling and eye contact. Results suggest children with WS may develop positive expressions very early in development. The onset

age of emotional expression in WS has not yet been determined, although the emergence of facial expressions in WS children does appear delayed. Results further imply that positive emotional expressions may emerge in WS prior to negative emotional expressions. Hypersociability is suggested to be a strong characteristic of WS later in development, and by examining this area of social development, we are introduced to their development of social expressions. Moreover, we are encouraged to explore this area in greater detail to understand the origin of their emotional expressions.

GESTURAL USE AND LANGUAGE EARLY IN WS DEVELOPMENT

In WS, language emerges with a suggested mean delay of two year (Bellugi, Lichtenberg, Jones & Lai, 2000; Levy, 2004; Singer-Harris et al., 1997). Mervis and Bertrand (1997) suggest toddlers with WS have general language abilities that exceed their general cognitive abilities. Singer-Harris et al. (1997) explored the language development and gestural use in children with WS, comparing their development to children with DS and using the MacArthur Communicative Development Inventory (CDI). Composed of two scales (1: The Words and Gestures scale and 2: The Words and Sentences scales), the CDI is a parental report measuring language and gesture development. Additionally, normative data from both scales provide for associations between the various dimensions of language assessed by the CDI (Singer-Harris et al., 1997, p. 349). The CDI provides researchers with the ability to look for potential dissociations between domains of language, which is of particular importance in atypical populations as they tend to have unique profiles of language development compared to typical development.

Children with WS were found to be delayed compared to typical development, although there were no significant group differences between children with WS and children with DS in regard to words comprehended or produced. When examining gestural use, children (mean age= 41 months) with WS produced significantly fewer gestures than the children with DS. What is of particular interest is that although children with WS produced fewer gestures than the DS group, children with WS were found to produce more words than DS matches. Those with WS, furthermore, appeared to eventually display a normal grammatical developmental trajectory relative to their word production. As Singer-Harris (1997), et al. point out, this finding is quite intriguing. That is, children with WS do not

produce nearly as many gestures early in development, but eventually surpass the grammatical development of children with DS.

Findings from Singer-Harris et al. (1997) suggest that children with WS may eventually begin to achieve grammatical milestones at a rate similar to those developing typically (albeit with a delay). More importantly, these findings accentuate the need for future studies to evaluate gestural and language development in children with WS in an experimental setting rather than solely through parental reports. The Singer-Harris et al. (1997) study is of particular importance as it is one of few studies with a large sample of children with WS (n= 54), thus providing researchers with robust findings in regard to their early gestural and language development.

GESTURAL USE AND LANGUAGE LATER IN WS DEVELOPMENT

Table 1 shows what is currently known regarding language development and gesture use in children with WS. Table 2 compares non-verbal behaviors evident in typical development as compared to behaviors seen in children with WS. Results from both figures would appear to foreshadow a profile of language and gestural deficits in this population. Interestingly, as development continues, behaviors later in development contradict those observed earlier. Once language is acquired, it becomes a relative strength in the cognitive profile of WS, with performance often higher than their overall cognitive abilities (Bellugi et al., 1999; Bellugi et al., 2000). Individuals with WS develop robust vocabularies and loquacious personalities despite their delayed language onset (Bellugi et al., 2000).

To understand their gestural use in later development, Bello et al. (2004) examined the spontaneous use of gestures of older children with WS in a spontaneous picture naming task. Ten children with WS (CA mean = 10.11; MA mean= 5.11), matched with typically developing children based on MA and CA (mean = 6.0 and 10.8, respectively), participated. Gesture coding included pointing as well as additional types of gestures that are evident in typically developing older children and adults (McNeil, 1992; Goldin-Meadow, 2003), as in the following:

- **Iconic gestures:** the pictographic representation of the target picture often depicting the action performed with object. For example, moving two fingers together to indicate cutting a piece of paper with scissors.

Table 1. Early Milestones of Development of Gestures and Language in WS

	Ages Studied	n=	Results
Masataka (2001)	6-30 months	8	- Infants with WS show evidence of the link of canonical babbling - Consistent with Mervis and Bertrand (1997)
Singer Harris et al., (1997)	12-76 months (longitudinal)	54	- Children with WS showed a grammatical advantage and noted as 'agestural'
Mervis & Bertrand (1997)	13-26; 36-44 (longitudinal)	6	- Evidence links onsets of rhythmic babbling and rhythmic head banging - The onset of referential pointing occurs after the onset of referential word production
Laing, (2002)	17-55 months (CA) 6-23 months (MA)	13	- WS children point less than TD children at similar levels of cognitive development - WS produced fewer points and were less able to follow the experimenters' points - (measuring motor activity) although they produced fewer total grips, there was no significant difference between WS and TD children
Pirchio, Caselli, & Volterra (2003)	2-4 years old	4	- Children with WS produce more words and fewer gestures than children with DS - WS subjects did produce more gestures than typically developing children

Table 2. Development of Nonverbal Behaviors in Typical Development and in WS

	TD	WS
Head Banging	Generally emerges 2-3 months prior to first words	Emerges in same path as typical development, but is delayed
Pointing	Emerges prior to first birthday and predates language development	Not evident until later in development and after language development
Joint Attention	Typically emerges around 7-8 months	Area of difficulty and age of onset has not yet been identified
Eye Gaze or Social Referencing	Develops towards latter part of first year and often includes objects and other people	Age of onset has yet to be determined and children with WMS typically demonstrate a intense fixation on faces
Facial Expressions	Typically emerge during first seven months	Very few studies in this area. However it appears positive facial expressions develop very early in development

- **Conventional interactive:** culturally defined and used primarily for regulating interaction. The most common form of this gesture is nodding the head ‘yes’ or ‘no’.
- **Beat gestures:** a simple, repetitive movement that does not present a discernable meaning. For example, the child moved their hand along with the rhythmical pulsation of speech.
- **Other category:** gestures that occur while thinking or trying to remember something. For example, supporting the head in their hand while thinking.

In contrast to studies during toddlerhood, children with WS were found to produce more gestures than their typically developing controls. More interestingly, in comparison to their typically developing matches, WS subjects displayed a richer gesture repertoire than typically developing children. They produced a high number of conventional-interactive and iconic gestures, and lexical abilities were found to be consistent with their MA matches. Results are at odds with studies of early language and gesture use in WS (Laing et al., 2002), and thus pose questions about how the speech-gesture system emerges in WS.

CHAPTER 2

PURPOSE

Few studies have examined language and gesture use in WS early in development. Such studies are generally limited to parental reports and/or focused primarily on the pointing gesture. Results suggest children with WS do not produce gestures early on, which serve as a factor in their language delay. Studies of later development, however, have found that children with WS mature to develop loquacious personalities with large vocabularies. Additionally, children with WS do produce gestures later in development (Bello et al., 2004), implicating a link between their language and gestural use that is not apparent during infancy and toddlerhood.

In regard to nonverbal behaviors, children with WS were found to produce high levels of intensive staring, and show positive emotional expressions early in development (Jones et al., 2001). Evaluating the Singer-Harris et al. (1997) study is of particular importance in this regard as it highlights the need to confirm her findings in experimental situations and expand them to include assessments of WS' eye gaze, facial expressions, and other nonverbal behaviors. No studies have yet integrated areas of non-verbal communication in WS development (as examined by Singer-Harris, 1997) with what is known about their gestural development to address one essential question: Do children with WS use nonverbal forms of communication during language development similar to children of typical development?

The present study seeks to explore this question by expanding our view of early communication to include both verbal/vocal and non-verbal behaviors with communicative intent. Nonverbal behaviors were defined as bodily movements directed to a person or object such as eye contact/gazing, smiling, reaching, showing, pointing etc. To lessen the degree of "mind reading", or guessing what behaviors are communicative, (Goldin-Meadow, 2007; Tomasello et al., 2007), behaviors considered as communicative were those related to the task and/or involve the parent or experimenter. For example, if a child extended his/her hand towards the experimenter in efforts to take a toy from the experimenter or looked at his/her parent during a task in social referencing (Straino & Rochat, 2000; Walden & Kim, 2005),

these were considered to be communicative. In contrast, if a child started dancing during a task, this was not considered as a communicative behavior. In the two former examples, behaviors were related to the task, whereas in the latter example, the behavior does not appear related to the task. Nor does the last example appear to express a thought, idea, or desire. Under this operational definition, different nonverbal behaviors were examined in a battery of tasks designed to elicit responses.

Verbal production was also an area of concern. As previously stated, the primary intent of this study was to examine whether children with WS produce non-verbal behaviors with communicative intent. Therefore the co-occurrence of vocalizations with nonverbal behaviors was assessed. Given the ages of the children from our sample, verbal productions included all vocalizations. Vocalizations were defined as English words (e.g. “ball”, “bear”, “blanket”) or patterns of speech sounds that are consistently used to refer to a specific object or event (e.g., [ba] for “bottle”) (Iverson & Goldin-Meadow, 2005). This also included non-linguistic sounds such as whimpers, cries and laughs.

The overall question of the present paper was: Do children with WS use nonverbal forms of communication during language development similar to children of typical development?

In efforts to answer our overall question, four sub-questions will be addressed:

Question 1: Do toddlers with WS produce nonverbal communicative behaviors?

Typically and other atypically developing children use of gestures emerges prior to their first words, granting them a method of expression and communication. Children with WS contrast with this path of development, producing their first words prior to their first gestures. Such evidence suggests children with WS do not produce many pre-linguistic behaviors, such as gestures, early in development. Children with WS, however, are noted to exhibit some use of pointing, although less than typically developing matches (Laing et al., 2002; Pirchio, Caselli, & Volterra, 2003). Later in development, older children with WS produce many gestures that are often paired with speech (Bello et al., 2004).

Hypothesis 1: It is hypothesized that WS subjects will produce fewer non-verbal communicative behaviors than typically developing controls.

Question 2: If children with WS are producing non-verbal behaviors with communicative intent, what do these behaviors look like?

Jones et al. (2001) suggest that children with WS display relatively more positive emotional expressions early in development than typically developing children. In her study, children with WS were found to produce less negative emotional expressions than typically developing children. Furthermore, Jones et al. (2001) found that WS subjects exhibited prolonged engaging social behaviors such as smiling and eye contact.

Hypothesis 2: Assessing a wide range of nonverbal possibilities in an infant-caregiver dyad, it is hypothesized that toddlers with WS will exhibit more nonverbal communicative behaviors on positive tasks than typically developing controls. However, under this assumption, it is further hypothesized WS subjects will display fewer nonverbal behaviors with communicative intent overall than their typically developing matched controls.

Question 3: Provided children with WS produce nonverbal communicative behaviors, will such behaviors co-occur with speech?

Review of the literature provides evidence that children with WS display a mean delay of language development of about two years (Singer-Harris et al, 1997; Bellugi et al., 2000; Levy, 2004; Losh, Bellugi, Reilly, & Anderson, 1998). Given the WS subjects in the present study are still fairly young (MA age range: 11 months – 30 months), it could be suggested that our subjects are not yet of age to produce many vocalizations.

Hypothesis 3: It is hypothesized that children with WS will not co-produce vocalizations with their nonverbal behaviors.

Question 4: Will children with WS focus more on a person (parent or experimenter) rather than the task?

Children with WS show similar patterns of delayed development when examining other areas of pre-linguistic non-verbal behaviors. Joint attention, eye gaze, and social referencing are areas of difficulty in this population, especially in the presence of strangers. Often children with WS are described as having sticky attention (Karmiloff-Smith et al., 2003) as they appear hypnotized by unfamiliar faces, staring absorbedly.

Hypothesis 4: It is hypothesized that children with WS will look more frequently at the parent or experimenter rather than the object.

METHODOLOGY

This chapter discusses the method used in this study, including participants, procedures, and results.

Participants

A total of 12 children with Williams syndrome (WS) were (CA range =15 to 57 months) included. Using the Bayley Mental Development Index (MDI), mental ages were calculated to be a mean of 24.41 months (MA range = 11 to months). All data were previously collected by Dr. Ursula Bellugi and her research team at the Laboratory of Cognitive Neuroscience at the Salk Institute for Biological Studies. Data were collected by means of video recordings as part of the Project in Cognitive and Neural Development, centered at UCSD.

Important to note is original data included 18 WS subjects. Two children of the original group have been excluded from the current project due to a later dual diagnosis of WS and Autism. An additional four children have been excluded from the sample as their age exceeded the age limitations for the measure analyzed. Thirty typically developing controls (CA range= 9 to 30 months) spanning the mental ages of WS subjects will serve as controls.

Measures

Communicative nonverbal behaviors and vocalizations were examined in the context of tasks taken from the Laboratory Temperament Assessment Battery (Lab Tab). This battery was designed by Dr. H. Goldsmith, with the original intent to assess child temperament and emotional expression. Although, the current study is not focused on aspects of temperament, social emotional responses are of interest. Five tasks were chosen from the battery as they provide opportunities for a child to produce nonverbal communicative behaviors. The five tasks are: Puppet Game, the modified version of peek-a-boo, the brief maternal separation, the barrier situation, and the gentle arm restraint task.

A trained experimenter administered all tasks to the child in established setting. Tasks involved a medium-sized table (82 cm x 137 cm) and took place in an experimental room. Videotaping activity took place in a control room with a window suitable for videotaping. Parents were asked to remain in the room for all tasks except for the maternal separation task when the parent and the experimenter left the room for a short time.

Procedure and Coding

Nonverbal communicative behaviors and vocalizations were coded for each task (See appendix A).

Nonverbal behaviors: To avoid bias toward the intent of a produced behavior, all data was viewed first without sound. In doing this, coders listen separately to vocalizations co-produced with the behavior and can therefore code behaviors more objectively. Length or duration and frequencies of occurrences will be coded for each behavior. Nonverbal communicative behaviors will be divided into five categories (See Appendix A): Facial expressions, eye gaze, hand movements, body posture, and other.

TASKS TO ELICIT POSITIVE RESPONSES

Puppet Game: This task was designed as a pleasure episode in efforts to measure the child in a social situation that encouraged the child's interaction with the puppets. During this task, the child was placed in a chair securely positioned on one side of a table. On the other side of the table, the experimenter put both hands under the table and placed one puppet on one hand and another puppet on the other hand. The experimenter then emerged with the puppets on their hands, introducing the puppets to the child. They then proceeded to act out the provided script using the puppets in a 90 second dialog. This task involved 3 'tickles' by the puppets that lasted approximately 3 seconds each.

Once the experimenter completed the provided dialogue, they placed their hands under the table again, this time removing the puppets from their hands. The child was then permitted to play with the toys for 30 seconds as the experimenter withdrew silently.

Modified Peek-a-Boo: In this task, children engaged in modified version of the childhood game of peek-a-boo. The child was placed in a chair securely positioned on one side of the table. The experimenter then placed a large plywood screen with 4 small hinged "doors" in front of the child. On the back of each door was a small pad of tissue paper with an X indicating where the parent should place his/her nose. Additionally, there were numbers on the back of each door indicating the sequence of doors the parent should hide behind. The experimenter was able to follow the same sequence by referring at a 3" x 5" card taped to the table.

Once the mother moved behind the plywood screen and out of the child's site, the experimenter playfully asked the child "_____, where is Mommy/Daddy?" After a 3 second pause, the experimenter opened the correct door to reveal mother/father's smiling face to their child. Once the door was opened, the experimenter exclaimed, "There she/he is!" The experimenter then closed the door after 2 seconds and repeated this procedure two more times, opening a different door for each trail. On the fourth and fifth trial, the experimenter opens the wrong door, saying, "No, she/he's not there. Where's Mommy/Daddy?" before opening the correct door. On the sixth and final trail, the child is asked, "Where's Mommy/Daddy?" Once the experimenter opened the door and exclaimed, "There he/she is!" the session was terminated.

In few instances, this game is played between the mother and child with a blanket rather than the plywood screen with doors.

TASKS TO ELICIT NEGATIVE RESPONSES

Maternal Separation: This task was designed to provide the child with an opportunity to express anger. Parents were asked to inform their child they were leaving the room saying, "Stay here and play; I'll be right back". Once the experimenter and parent left the room, they remained outside of the room.

The parent was then directed to the control room where he/she could watch their child on the monitor. It was up to the discretion of the parent as to whether the session should be terminated immediately, based on their observance of their child. If the parent felt comfortable with their child's reaction to the situation, the child remained in the room alone for 30 seconds. Once the allotted time period passes, the mother and the experimenter re-entered the room.

Barrier: The barrier task is a measure of frustration and anger and serves as a measure of the child's level of persistence. During this task, the experimenter gave the child an attractive toy to play with for 15 seconds. After the child plays with the toy for the allotted time frame, a Plexiglas barrier (31.25 cm x 40 cm) was then placed on the table, approximately 9 cm in front of the child. The experimenter then gently took the toy from the child and placed it directly behind the barrier. The barrier remained between the child and the toy for 30 seconds. The barrier was then removed, permitting the child to play with the toy again. This

procedure was repeated for two more trials. To alleviate any possible distress caused to the child, the child was able to play with the toy once all three trails have been administered.

Gentle Arm Restraint by Parent: Similar to the barrier task, the gentle arm restraint task was designed to elicit anger. The child was securely positioned on one side of the table facing the camera. The toy used, Perpetual Motion, is a toy that consists of a small metal wheel and 10 inch plastic tracks that run parallel. The wheel is placed on the tracks and spins continuously once pushed. Perpetual Motion was positioned 20 cm in front of the child.

Prior to placing the toy in front of the child, the parent was instructed to hold down their child's arm, reaching from behind and gently placing their hands on their child's forearms. The parent is to then move their child's arms to his/her side and to hold them firmly, but gently, for 30 seconds once cued by the experimenter. The action of restraining their child was only to happen as cued by the experimenter.

Once the parent was instructed, the experimenter first played with the toy to demonstrate how it works and then allowed the child to play with the toy. After playing with the toy for 15-30 seconds, the parent gently restrained their child's arms as instructed. In doing so, the child was able to watch as the experimenter played with the toy, but was not able to actually play with the toy themselves. After 30 seconds, the parent was asked to release their child's arms, and the child was free to play with the toy again. This situation was repeated for two more trials, with the next trial beginning once the mother released their child's arms. If the child did not respond well to the task, the experimenter ended the task immediately. Provided the child completed all three trials, the child was able to play with the toy to reduce any distress caused during the session. .

Vocalizations: After coding for behaviors without sound, data will be viewed with sound in efforts to code for vocalizations. Content, frequency, and duration of occurrences will be coded for each vocalization. The primary intent of this study is to examine use of non-verbal behaviors by toddlers with WS. By including vocalizations in the coding, we will be able to examine whether the vocal channel is used in relation to non-vocalizations.

Analysis Tool

To successfully examine non-verbal behaviors and vocalizations, the present study used a behavioral data collection and analysis tool called the Observer (5.0 Version). This

tool was created by Noldus Information and Technology and was designed to track behaviors such as facial expressions, gestures, postures, movements and other social interactive behaviors. This highly innovative system allowed us to capture targeted non-verbal behaviors and vocalizations, their frequency, duration, and co-occurrences with greater accuracy.

Prior to coding subjects, a configuration was developed and used for each individual subject (Appendix B). The configuration included subject information, variables, as well as behavioral class and behaviors (with corresponding codes) from our ethogram (Appendix A). Behavioral classes included our 5 non-verbal communicative categories (Eye Gaze, Hand Movements, Facial Expressions, Head Movements, Body Postures, and Full Body Movement), as well as vocalizations. Behaviors from each class were defined as either state or event behaviors. According to the Observer 5.0 system, state behaviors were defined as an event or combination of events sustained for a certain period of time. All behaviors within our nonverbal communicative classes and vocalization were defined as state behaviors. In doing this, we were able to examine the frequency and duration of each individual behavior across the tasks (Figure 1). State behaviors allowed us to also consider co-occurrences within each task.

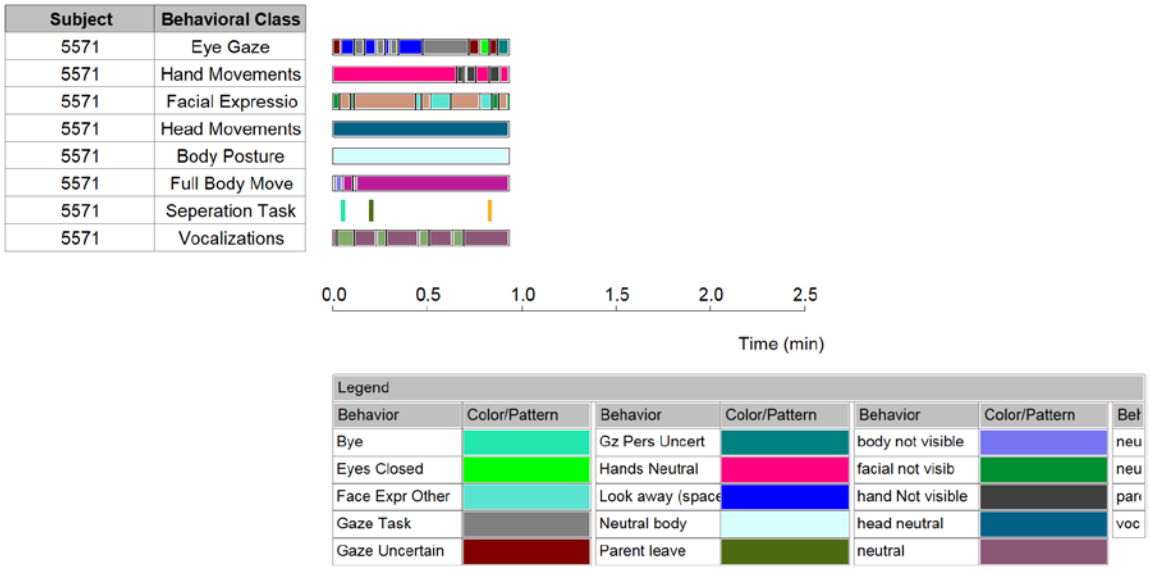

Figure 1. Results table taken from observer 5.0. Note: Denotes behaviors in each behavioral class.

Events behaviors, in contrast, were defined as behaviors that are often instantaneous and do not require a certain duration for their occurrence to be scored (Figure 1; separation

task). Since event behaviors do not take frequency and duration into account, the only behaviors that were defined as event behaviors were those that fell in the behavioral classes that were specifically designed for the negative tasks. With the three negative tasks, it was important to consider when the situation was introduced in comparison to when the child was playing (i.e. when the barrier was placed between the child and the toy). Therefore, our behavioral classes included three additional categories which were coded as event behaviors: barrier task, separation task, and arm restraint task. In the same manner, in the puppet task, it was important to consider when the child was tickled by the puppets (experimenter). An additional behavioral task, puppet task, was thus included and coded as event behaviors.

As shown in Figure 1, the observer not only tracked behaviors, but also allowed us to examine any behaviors that co-occur with other behaviors and or vocalizations. Results from the Observer were exported into SPSS for statistical analysis.

Reliability: To examine the accuracy for coding behaviors and vocalizations, two individuals were trained to code for reliability for all subjects, tasks, and behaviors; reliability was 85% across all measures.

CHAPTER 3

ANALYSIS

To test the hypotheses proposed in this thesis, several Pearson chi-square tests were conducted across behaviors, with one test for each task. These tests compare the frequency with which the two groups of children demonstrated the behaviors of interest. The results are given in Table 3.

Table 3. Observed Frequencies of Nonverbal Communicative Behaviors Across Tasks

		Eye Gaze	*Hand Movements*	*Facial Expressions*	*Head Movements*	*Body Posture*	*Full Body Movements*
Arm Restraint	WS	210	314	154	186	145	23
	TD	292	369	200	305	278	21
Maternal Separation	WS	129	145	87	141	101	42
	TD	107	88	72	105	51	57
Barrier	WS	412	495	219	411	242	16
	TD	435	435	152	317	197	19
Puppets	WS	403	366	265	258	252	18
	TD	805	333	198	192	126	23
Peek-A-Boo	WS	110	63	98	89	64	13
	TD	140	44	91	64	48	38

Next, to further understand any significant differences, additional chi-square tests were run for each individual category across each task. If the observations coded did not yield a significant number of behaviors for a category, the category was not included in the chi-square analysis. The null hypothesis in all tests was that children with WS do not differ from TD children.

ANALYSIS 1: NONVERBAL COMMUNICATIVE BEHAVIORS

Table 3 displays observed behaviors for both children with WS and the TD children. According to the null hypothesis, children with WS would use nonverbal communicative behaviors with the same frequency as TD children. With a chi-square level of significance of 14.067 ($df= 7$; $p>.05$), group differences of nonverbal communicative behaviors were significant across all tasks.

ANALYSIS 2: TYPES OF NONVERBAL COMMUNICATIVE BEHAVIORS USED

To explore the types of nonverbal communicative behaviors produced by our WS subjects, a chi-square test of association was carried out. Unlike the omnibus test over all behaviors used for Analysis 1, this analysis was designed to isolate a specific behavior and make comparisons to the totality of other behaviors. For example, Eye behaviors are compared against all other nonverbal communicative behaviors.

Arm Restraint: On this task, WS children produced the most hand movements out of all nonverbal communicative behaviors (Table 3). The TD group similarly produced more hand movements as compared to other behaviors (Table 3). Results from the chi-square analysis (isolating one behavioral category against other categories) indicated that the highest group differences were found when examining Head Movements and Hand Movements (Table 4). Full Body Movements, however, was not significant ($X^2(1)= 1.744$), nor were behavioral categories that related to the facial region; Eye Movements and Facial Expressions produced a chi-square of $X^2(1)= .111$ and $X^2(1)= .164$ respectively.

Table 4. Chi-Square Test of Independence Across Tasks

	Eye Gaze	*Hand Movements*	*Facial Expressions*	*Head Movements*	*Body Posture*	*Full Body Movements*
Arm Restraint	.111	4.381**	0.164	5.149**	13.670**	1.744
Maternal Separation	0.875	2.692	0.529	.001	5.737**	9.793**
Barrier	15.709**	0.987	3.186	1.190	.047	1.135
Puppets	212.297**	1.094	9.376**	9.346**	43.573**	0.739
Peek-A-Boo	5.061**	3.654	0.270	4.653**	2.469	13.080**

Barrier: On this task, children with WS produced the most hand movements with 495 behaviors. They produced the least amount of behaviors in regard to full body movements with Facial Expressions as the second lowest observed behaviors (Table 3). Similar to the WS group, TD children produced the least amount of Full Body Behaviors and Face. They also produced the highest amount of behaviors in both Eye Gaze and Hand Movements (Table 3). On this task, Eye Behaviors were the only behavior found to be of statistical significance with a chi-square of $X^2 (1)= 15.709$ (Table 4).

Maternal Separation: Maternal Separation was the only task in which subjects' full bodies could be observed with clarity. Results, however, suggested that Full Body behaviors were observed with the lowest frequency among the WS children (Table 3). In contrast, the TD

produced the least amount of behaviors in the Body Posture category. The behaviors with the most observed behaviors differed between the groups as well. The children with WS produced Hand Movements the most, as compared to the TD children who produced more Eye Movements. On Maternal Separation a chi-square analysis indicated that Body Posture (X^2 (1)= 5.737) and Full Body (X^2 (1)= 9.793) were statistically significant.

Peek-A-Boo: Both WS and TD groups performed alike on the Peek-A-Boo task. Although they did not produce the same number of behaviors across any category, (i.e., WS children produced 110 eye behaviors in comparison to the 140 eye behaviors produced by TD children) both groups produced the most behaviors on Eye Movements, and the least on Full Body Movements and Hand Movements (Table 3). The WS group, however, did approach the same number of Facial Expressions as the TD group (x= 98 and 91 respectively). Chi-square analysis yielded three nonverbal communicative behavior categories of statistical significance: Eye Movements Head Movements, and Full Body Movements (Table 4).

Puppet: Similar to Peek-A-Boo, WS and TD subjects performed highest and lowest in the same behavioral categories. Both groups were observed to use more Eye Movements than other nonverbal communicative behaviors. The least number of behaviors was in regard to Full Body movements and Body Posture. Of all the tasks, results from a chi square analysis indicated the most nonverbal communicative behavioral categories of significant values on the Puppet task. Four categories (Eye Movements, Facial Expressions, Head Movements, and Body Posture) were significant with only two categories that were not (Hand Movements and Full Body movements).

Functioning of Behaviors for Barrier and Peek-a-Boo: To understand the functioning of hand movements between the groups, proportions of hand movements from each subject's total time per task was calculated. Figure 2 displays the hand movements for each group on a positive task (Peek-A-Boo) and a negative task (Barrier). Behaviors listed on each graph denote the types of hand movements that emerged within each group from the coded behaviors (Appendix A).

ANALYSIS 3: CO-OCCURRENCE OF NONVERBAL COMMUNICATIVE BEHAVIORS AND SPEECH?

Vocalizations were examined by exploring frequency of use as compared to use of nonverbal communicative behaviors. Of the five tasks, the WS group produced less

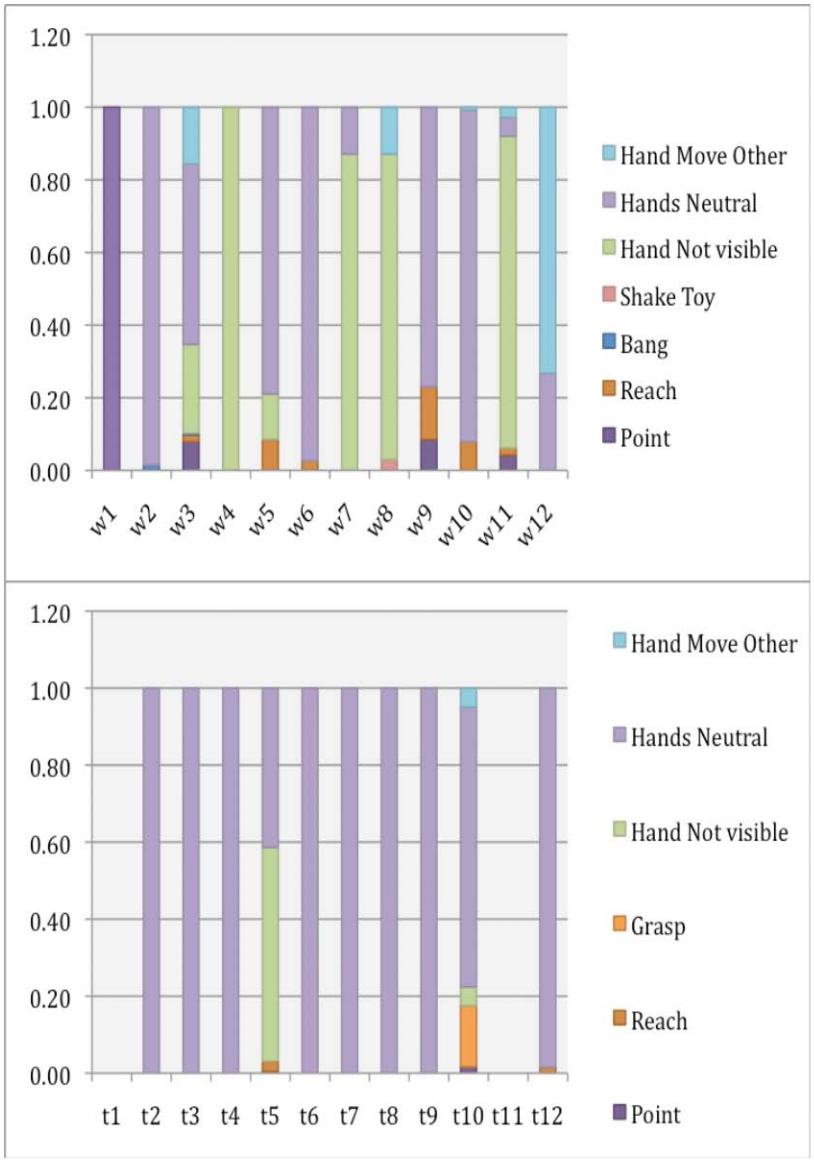

Figure 2. Hand movements produced per group on peek-a-boo. Note: Displays most frequently used hand movements per group (Appendix A). Proportions of each hand movement were based on total time from that task. Missing subjects for this task: t1 and t11.

vocalizations than the TD group on two tasks, Arm Restraint and Peek-A-Boo (Table 5).

In contrast, on the other three tasks the WS groups produced more vocalizations as compared to the TD group. A chi-square analysis was used to measure vocalizations against nonverbal communicative behaviors (Table 6). The group differences on Arm Restraint, Puppet, and Barrier were found to be significant.

Table 5. Observed Frequencies of Vocalizations as Compared to Total Nonverbal Behaviors Across Tasks

		Total Behaviors	*Vocalizations*
Arm Restraint	WS	1032	145
	TD	1465	156
Maternal Separation	WS	645	96
	TD	480	65
Barrier	WS	1795	222
	TD	1555	117
Puppets	WS	1562	236
	TD	1677	92
Peek-A-Boo	WS	437	60
	TD	425	69

Table 6.Chi-Square Test of Independence for Vocalizations as Compared to Nonverbal Behaviors Across Tasks

	Vocalizations
Arm Restraint	4.409**
Maternal Separation	0.372
Barrier	17.621**
Puppets	65.742**
Peek-A-Boo	0.786

Note. ** Chi-square level of significance of 3.841 (df= 1; p>.05)

ANALYSIS 4: DIRECTION OF EYE GAZE BEHAVIORS

Consistent with previous analysis, a chi-square test of association was used to examine Eye Gaze behaviors of both the children with WS and the TD group. Eye Gaze for each task were separated and examined across three separate categories: Eye Gaze Parent, Eye Gaze Experimenter, and Eye Gaze Task. Across the tasks, group differences between children with WS and TD children were found to be significant only on Puppet with a chi-square of $X^2(2)= 7.289$ ($p>.05$) (Table 7).

Table 7. Chi-Square Tests of Independence for Eye Gaze Behaviors Across Tasks

	Eye Gaze
Arm Restraint	5.434
Maternal Separation	0.011
Barrier	3.763
Puppets	7.289**
Peek-A-Boo	3.539

To understand the functions of the eye gaze behaviors, proportions of gazes towards a person (parent or experimenter) or the task were calculated. Proportions were calculated across tasks and displayed group differences (Figures 3, 4, 5, 6, 7).

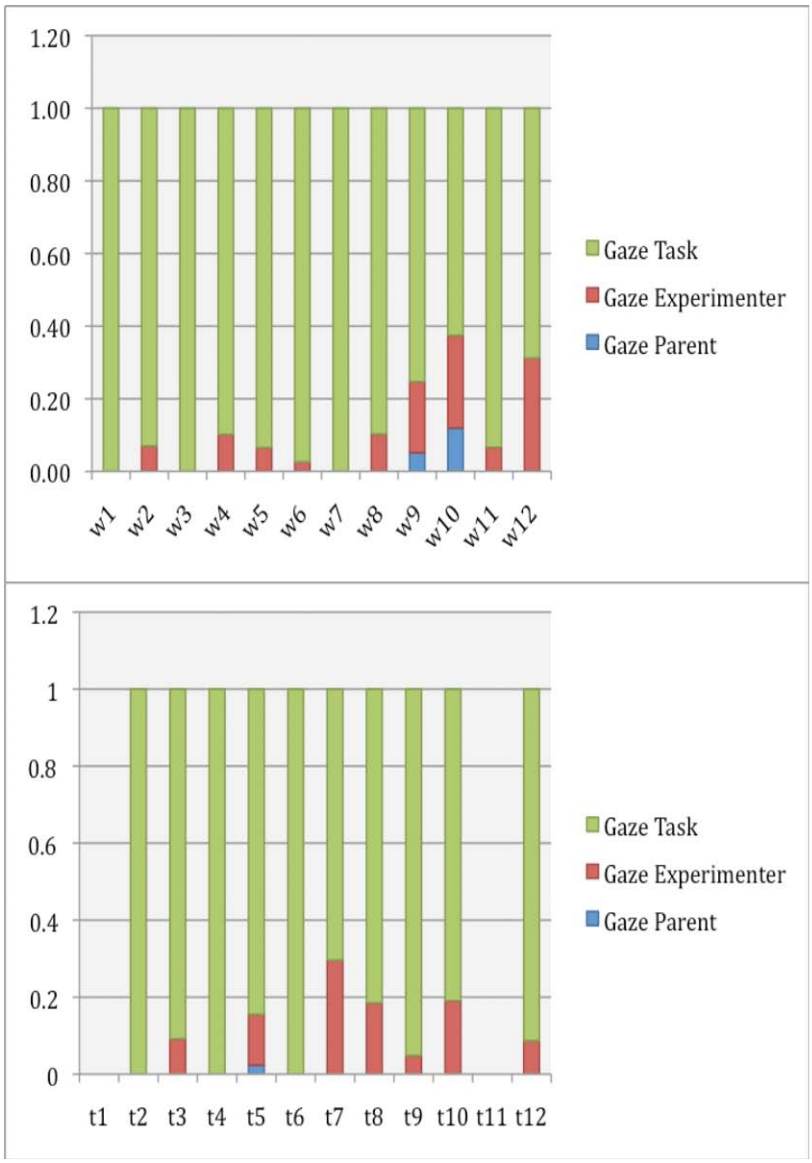

Figure 3. Eye gaze behaviors: Peek-a-boo. Note: Subject missing data for this task: t1 and t11.

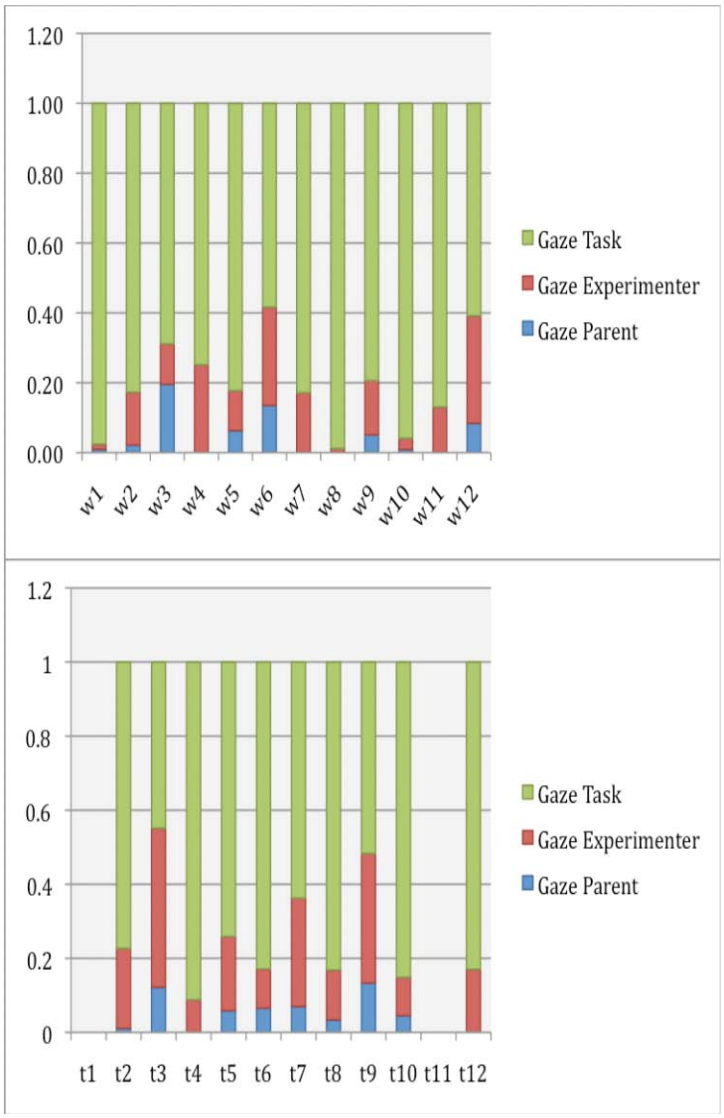

Figure 4. Eye gaze behaviors: Barrier task. Note: Subject missing data for this task: t1 and t11.

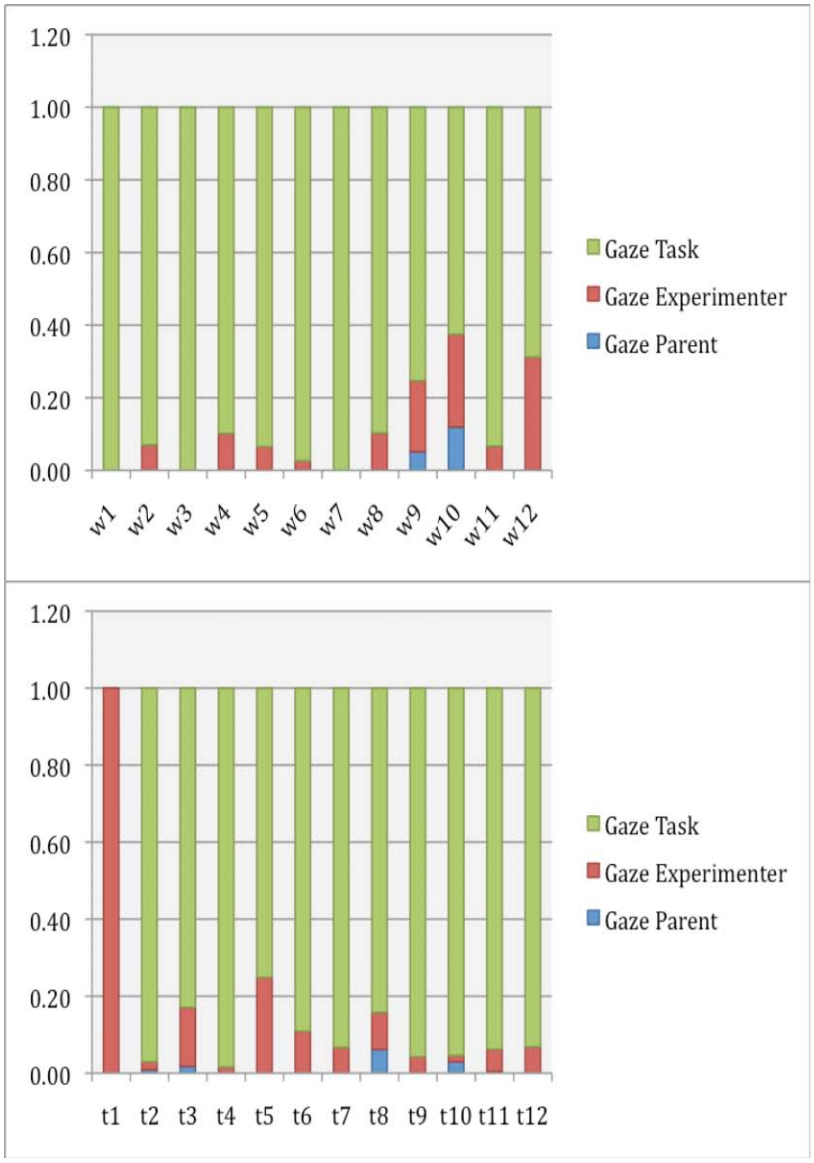

Figure 5. Eye gaze behaviors: Arm restraint.

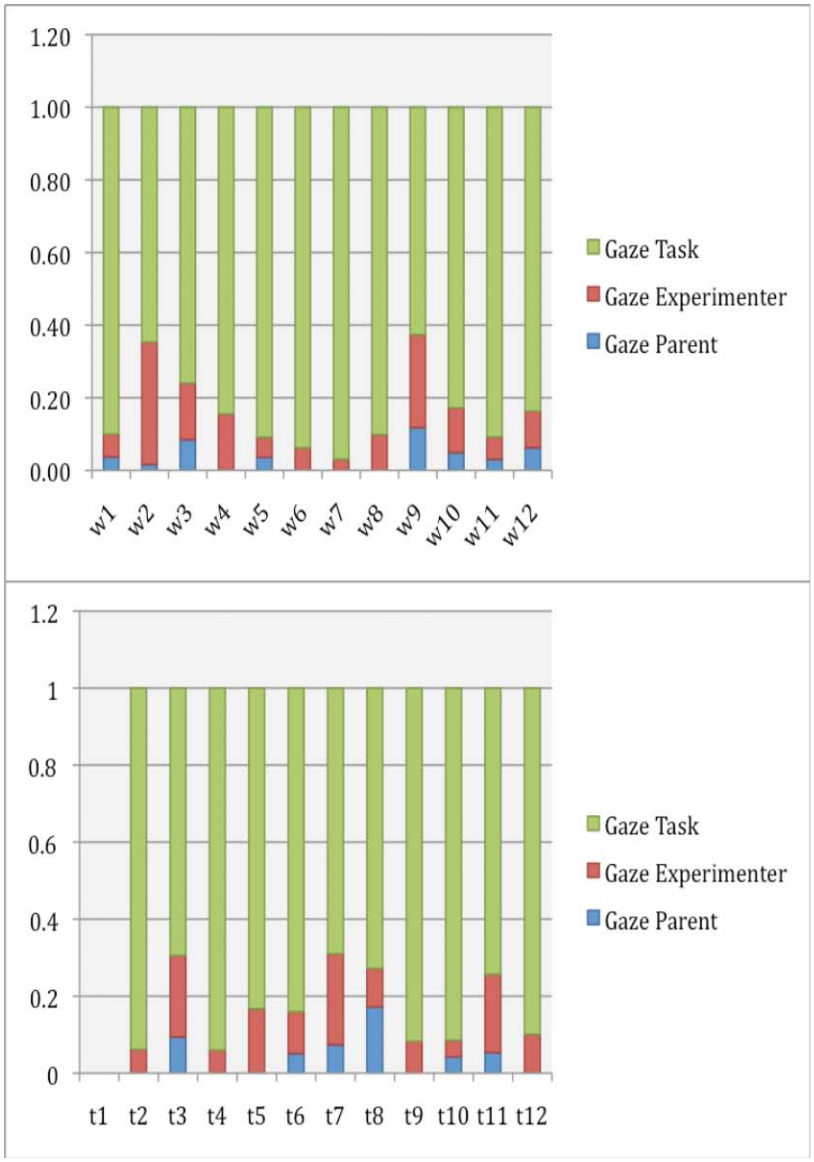

Figure 6. Eye gaze behaviors: Puppet. Note: Subject missing data for this task: t1.

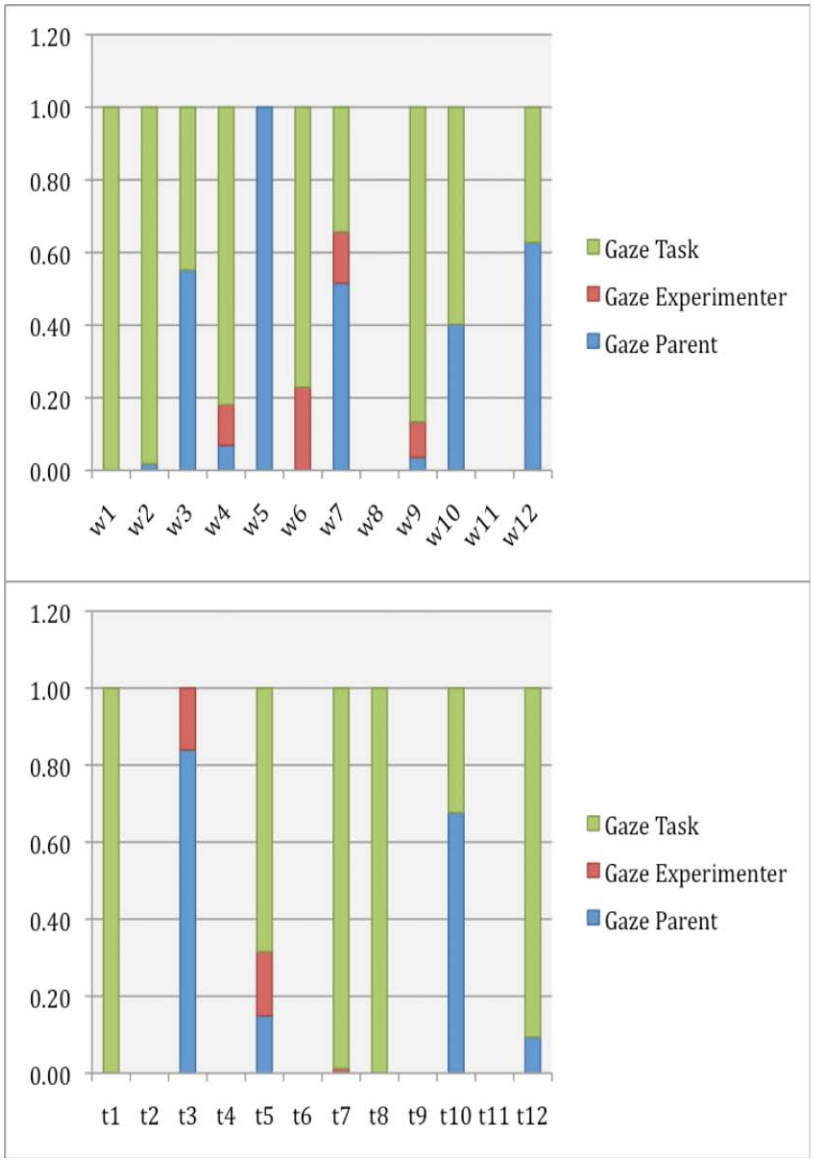

Figure 7. Eye gaze behaviors: Maternal separation. Note. Missing subjects for this task: w8 and t11. Other subjects without data indicated that the subject looked elsewhere rather than a person or the task (Appendix A).

CHAPTER 4

DISCUSSION

Previous studies focusing on specific nonverbal behaviors (i.e. pointing) have found that children with WS do not use gestures during stages of language development. Later in development, studies have found that this population eventually follows patterns of typical development using gestures and broad vocabularies. The present study sought to explain this gap in children with WS from an atypical path of development to a more typical path. Using five tasks to elicit communicative behaviors, the overall question addressed was: Do children with WS use nonverbal forms of communication during language acquisition similar to children of typical development? This was examined by four sub-questions and consequent hypothesis.

Question 1: Do toddlers with WS produce nonverbal communicative behaviors?

Hypothesis 1: WS subjects will produce fewer nonverbal communicative behaviors than typically developing controls

Table 3 demonstrates the frequencies of each nonverbal communicative behavior across tasks. Evidenced by the frequencies, children with WS produced nonverbal communicative behaviors. When considering individual behavioral categories, there was variability in regard to whether the WS group produced more or less behaviors than the TD group across all tasks (Table 3). For example, on Arm Restraint, WS subjects produced less nonverbal behaviors in all categories except for Full Body Movements. On Barrier, in contrast, the WS group produced more behaviors in all categories except Eye Gaze and Full Body Movements. By examining behavioral categories, results do support the hypothesis that children with WS produce fewer nonverbal communicative behaviors than TD children. However, this is only in regard to some categories and was dependent on the task. Facial Expressions, for example, were produced less than TD controls on Arm Restraint but more than TD controls on all other tasks.

A more clearly defined response to this hypothesis may be found by means of a second approach to this analysis, looking at total behaviors. When comparing total nonverbal communicative behaviors across tasks, results indicated that the hypothesis was supported on

two tasks: Arm Restraint and Puppets. In contrast, on Maternal Separation, Barrier, and Peek-A-Boo children with WS contradicted the hypothesis, producing more behaviors than the control groups. Interesting to note is that on the Peek-A-Boo task, both groups produced totals of close resemblance (x= 437 and 425, respectively).

Despite variability across tasks and behavioral categories, overall results contradict the hypothesis, demonstrating that children with WS do produce nonverbal communicative behaviors. This contradiction to our hypothesis specifically relating to results from Peek-A-Boo provide this area of research with a great wealth of information; in a controlled task children with WS may use nonverbal behaviors with communicative intent with similar frequency as typically developing children. Results suggest that when considering a broader array of behaviors, children with WS may mirror patterns of typical development.

A Pearson chi-square test revealed significant values on all tasks indicating that although nonverbal behaviors were observed in the WS group, they differed from those produced by controls. More insight to the use of these behaviors was addressed in greater detail in the assessment of the second question.

Question 2: If children with WS are producing nonverbal communicative behaviors, what do these behaviors look like?

Hypothesis 2: Toddlers with WS children will produce nonverbal behaviors with communicative intent. It is further hypothesized that the WS group will exhibit more nonverbal communicative behaviors on positive tasks than TD controls.

All behaviors were coded as serving communicative functions; if nonverbal behaviors were not related to the task, they were not included in the data. Table 3 indicates that children with WS do use nonverbal behaviors as a mean of communicating, whether with the experimenter or the parent. More important to this hypothesis is what do their communicative behaviors look like and how do they differ from the control group

Overall, Figure 2 suggests that similar types of hand movements emerged between the two groups. To answer this sub-question in greater detail, however, it may be best addressed by discussing the results in a threefold process. First, frequencies of behaviors were examined by separating the positive tasks from the negative tasks. As previously discussed, positive (Peek-A-Boo and Puppet) and negative tasks (Arm Restraint, Maternal Separation, and Barrier) were all found to have a chi-square of significant value. This

suggests that despite the emotional design of the task, there were group differences found between WS and controls. That is, nonverbal communicative behaviors did not align with particular emotions elicited by the task; behaviors were produced in both positive and negative tasks.

Once this was addressed, differences across the behavioral categories were assessed. A chi-square test of independence across tasks revealed which behaviors produced group differences on specifics tasks. Again, there was some variability as there was not one behavioral category that was consistently found to be significantly different. Such variance implies that although nonverbal communicative behaviors were not aligned with the type of emotion elicited by a task, behaviors did depend on the task itself. For example, the amount of Head Movements produced by both groups differed on 3 tasks, Arm Restraint, Puppets, and Peek-A-Boo. On Maternal Separation and Barrier however, group differences were not found.

Two behavioral categories, Hand Movements and Facial Expressions, are worth mentioning, as differences were only significant on one task. Hand Movements yielded a chi-square of significance on Arm Restraint alone. For this task, the child was placed in front of toy as their parents gently held down their arms. Generally, children react to this task with great discomfort often trying to release their arms. Significance of Hand Movements on this particular task implied that differences in emotional response towards the task might have existed between the groups. This was also evidenced in regard to Facial Expressions. Puppets, a positive task that engaged children in a script using two hand puppets, yielded group differences in the amount of facial expressions produced. Additional research is needed to explore the emotional reactions of children with WS in understand how it relates to the number or nonverbal communicative behaviors produced.

Full Body Movements were only accurately captured on Maternal Separation, which may explain why this category was only significant on two tasks. That is, this was the only task of which the camera was positioned so that the child's full body could be examined at all times. This category was still coded on other tasks as the child often got up and moved during the activities. Bearing this in mind, significant chi-square results on Puppets (a task that generally generates a great deal of positive interest from children) implies that children with WS reacted differently to this task and may have become more engaged with the task

than TD children. Moreover, it is interesting that the WS group differed from the TD controls in this regard on Maternal Separation. TD children often were observed to run towards the door as their parents left the room. Results suggest that children with WS may have been more calm or indifferent when their parents departed.

Question 3: Will nonverbal behaviors co-occur with speech?

Hypothesis: Children with WS will not produce vocalizations with their nonverbal behaviors.

Although the Observer did not allow this question to be answered as intended, results did yield findings worth mentioning. As displayed on Table 5 children with WS were observed to produce vocalizations. Moreover, children from both groups produced both vocalizations and nonverbal communicative behaviors. Observed frequencies suggest that on Maternal Separation, Barrier, and Puppets not only did children with WS produce vocalizations, but they were found to produce more than children of typical development.

A chi-square test of independence for vocalizations and nonverbal behaviors examined observed frequencies in greater detail (Table 5). Vocalizations produced differed between TD and WS subjects indicating that differences were specific to the task. Given group differences found when assessing nonverbal behaviors on Maternal Separation (Question 2), it is interesting that chi-square analysis of vocalizations was not significant as well.

A surprising finding surfaced in regard to coding vocalizations. There was a great deal of difficulty in establishing reliability between coders with facial expressions solely due to vocalizations. When behaviors were coded with the sound off, coders often coded an expression as positive or negative. When data was recoded with the sound on, however, it appeared that the facial expressions might not have been as the coder originally considered. Reliability was reached only after viewing and examining the data in great detail and arriving at a joint decision. The present paper did not aim to understand in detail the types of nonverbal behaviors produced and the vocalizations connected to them. However, future research should explore this issue as it may explain a relationship between language development and emotion in children with WS or a disconnect in this system.

Question 4: Will children with WS focus more on a person rather than the task?

Hypothesis: Children with WS will look more frequently at the parent or experimenter rather than the task.

Karmiloff-Smith et al. (2003) described children with WS as having sticky fixation, staring at unfamiliar faces. Findings from the present study contradict both this label and the hypothesis. As displayed in Figure 8 children from both groups tended to look more at the task than a person across all tasks. On Maternal Separation, moreover, children with WS looked at the task (toys) more than TD controls. More interesting is that a chi-square analysis revealed group differences on only one task, Puppets. Eye gaze behaviors did not differ on other tasks between groups. This assertion is bolstered by proportional distributions of eye gaze behaviors (Figure 8), which demonstrate similar gaze patterns between the two groups.

These finding interpreted in light of past research might suggest that in a controlled environment, children with WS may display use of eye gaze behaviors that mirror that seen in typically developing children when participating in highly engaging activities (Table 7).

Limitations: A few limitations to the present studies should be taken into account when considering results. The most salient limitation is that since the data was collected for reason different from the purpose of the present study, images of the child were limited. That is, in some instances the individual who recorded the sessions only focused on the child's face. This created a complication to the present task as coders were not able to see the task itself, nor the full body of the subject. This hindered results in two primary ways: (1) Full Body Movements were not fully captured except in the Maternal Separation and (2) coders were not able to see the task way that fully captured what a subject might have been responding to or, more importantly, the child's direction of eye gaze at all times.

Another limitation was that in some cases, children did not respond well to the task. Therefore, the experimenter had to end the task and the length of each task was not consistent across the subjects. For example, in the arm restraint task, if a child exhibited extreme discomfort, the third trial was not administered. Lastly, data used included a small sample size, and of the small sample, some subjects that were missing data on a specific tasks. All limitations should be considered in future studies.

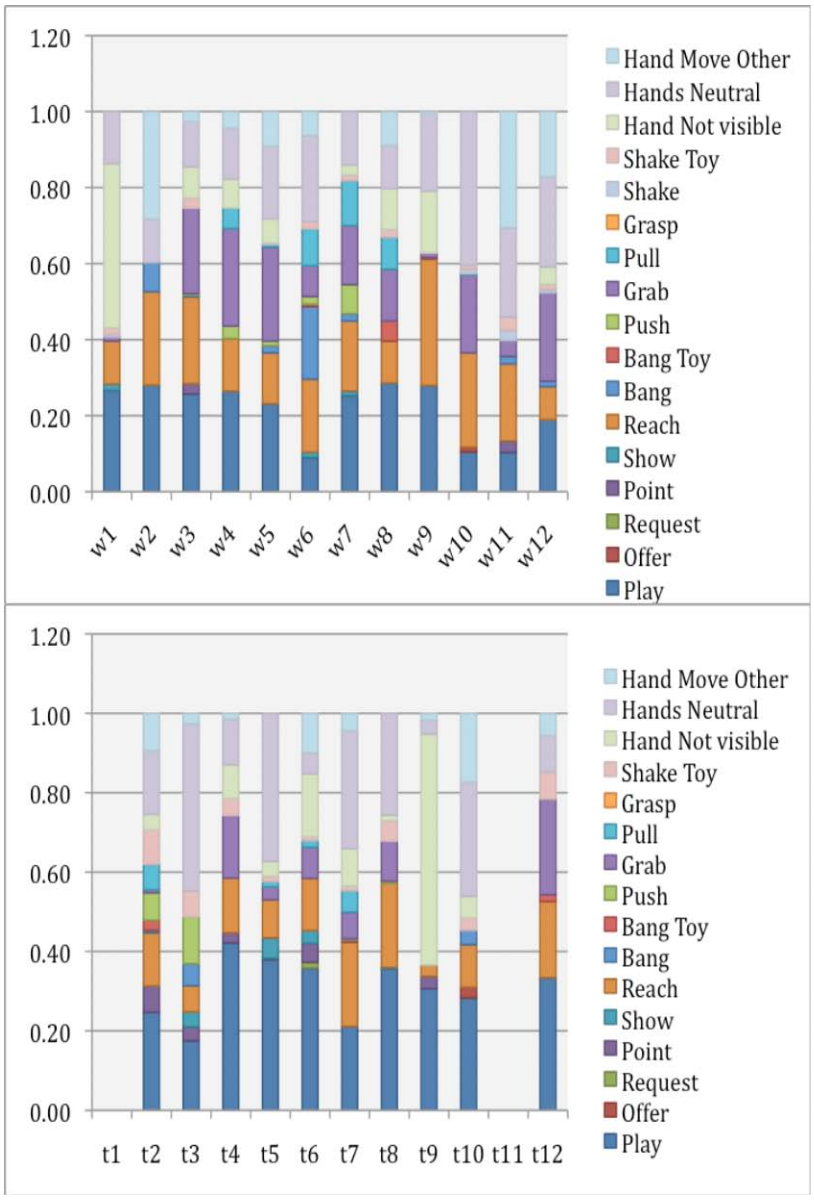

Figure 8. Hand movements produced per group on barrier. Note: Displays most frequently used hand movements per group (Appendix A). Proportions of each hand movement were based on total time from that task. Missing subjects for this task: t1 and t11.

RECOMMENDATIONS

Recommendations from the present study fall into two categories: (1) need for replication of study, (2) need to understand emotional and cognitive contributions to findings and (3) additional use of collected data. Results found indicated that the production of nonverbal behaviors might have been contingent on the tasks used to measure these behaviors. It would be interesting to replicate the design of the present study and assess

children during free play. Would children with WS be observed to produce the suggested range of behaviors in a less controlled environment? Future studies should also examine if group differences between WS and TD subjects follow those found in the present paper.

Discussion of the results and findings provide some evidence that in children with WS, there may be some emotional attributes attached to their use of nonverbal behaviors. For example, did Full Body Movements differ between the two groups on Maternal Separation because children with WS were indifferent to the absence of their parent? This is also an important concern in regard to facial expressions and vocalizations. Future studies should explore possibilities of this populations incongruent use of facial expressions and vocalizations (i.e. a positive facial expression with a negative expression). In doing so, researchers may develop a better understanding of the relationship between emotions and language development in individuals with Williams syndrome.

There may also be some underlying cognitive differences worth future research. As displayed in Figure 2, differences in the functioning of hand movements indicated group differences in the types of behaviors that were used on similar tasks. This suggests that children with WS may have a different cognitive approach to tasks than that of TD children. Future research should explore this issue in greater detail to understand the cognitive basis that children with WS understand and approach situations.

Lastly, data from the present study should be used to explore areas in greater detail. It would be interesting to study each nonverbal behavioral category in-depth. For example, what types of hand movements were used and what can be learned from the group differences. This data should also be used to examine length of time associated with the use of nonverbal behaviors (i.e. how long do a child with WS look at the task in comparison to an individual). Facial expressions can also be explored comparing positive or negative expressions to type of vocalizations produced. All data can be assessed across tasks, or specific tasks may be selected and assessed.

CONCLUSION

The overall question was to examine the possibility of children with WS producing nonverbal communicative behaviors. Results indicate that if a broader range of nonverbal behaviors is examined in a controlled situation, the answer to this question supports the

notion that they do communicate using nonverbal behaviors. Children with WS were found to not only produce behaviors, but they do so in ways that aspects mirror those seen in typical development. Additionally, children produced vocalizations and did so with fewer differences from the typically developing group than predicted.

By examining nonverbal communicative behaviors of toddlers with WS, researchers of language development in children with WS now have some evidence that these children do use nonverbal behaviors in frequencies not dissimilar to typically developing children. Although some group differences exist, results indicate that individuals with WS may develop language following more milestones of typical language acquisition than expected. This finding will aid in developing a better understanding of how this population communicates pre-linguistically, as well providing more insight into how their language develops in general. As with studying any atypical population, these findings overall will enhance literature's global understanding of language development.

REFERENCES

Bates, E., & Dick, F. (2002). Language, gesture, and the developing brain. *Developmental Psychobiology, 40*, 293-310.

Bello, A., Capirci, O., & Volterra, V. (2004). Lexical production in children with Williams syndrome: Spontaneous use of gesture in a naming task. *Neuropsychologia*, *42*(2), 201-214.

Bellugi, U., Lichtenberger, L., Jones, W., & Lai, Z. (2000). The Neurocognitive profile of Williams Syndrome: A complex pattern of strengths and weaknesses. *Journal of Cognitive Neuroscience*, *12*, 7-29.

Bellugi, U., Lichtenberger, L., Mills, D., Galaburda, A., & Korenberg J. R. (1999). Bridging cognition, the brain and molecular genetics: Evidence from Williams syndrome. *Trends in Neuroscience*, *22*(5), 197-207.

Bennet, D. S., Bendersky, M., & Lewis, M. (2005). Does the organization of emotional expression change over time? Facial expressivity from 4 to 12 months. *Infancy*, *8*(2), 167-187.

Brock, J. (2007). Language abilities in Williams syndrome: A critical review. *Development and Psychpathology*, *19*, 97-127.

Brown, J. H., Johnson, M. H., Paterson, S. J., Gilmore, R., Longhi, E., & Karmiloff-Smith, A. (2003). Spatial representation and attention in toddlers with Williams syndrome and Down syndrome. *Neuropsychologia*, *41*(8), 1037-1046.

Capirci, O., Letizia, S., & Volterra, V. (1996). Language development in Williams syndrome: A case study. *Cognitive Neuropsychology, 13*(7), 1017-1039.

Capone, N. C., & McGregor, K. K. (2004). Gesture development: A review for clinical and research practices. *Journal of Speech, Language, and Hearing Research*, *47*, 173-186.

Goldin-Meadow, S. (2003). *Hearing gesture: How our hands help us think*. Cambridge, MA: The Belknap Press of Harvard University Press.

Goldin-Meadow, S. (2007). Pointing sets the stage for learning language- and creating language. *Child Development*, *78*(3), 741-745.

Heimann, M., Strid, K., Smith, L., Tjus, T., Ulvund, S. E., & Meltzoff, A. N. (2006). Exploring the relation between memory, gestural communication, and the emergence of language in infancy: A longitudinal study. *Infant and Child Development*, *15*, 233-249.

Iverson, J. M., & Fagan, M. K. (2004). Infant vocal-motor coordination: Precursor to the gesture-speech system? *Child Development*, *75*(4), 1053-1066.

Iverson, J. M., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. *Psychological Science, 16*(5), 367-371.

Iverson, J. M., & Thelen, E. (1999). Hand, mouth, and brain: The dynamic emergence of speech and gesture. *Journal of Consciousness Studies*, *6*(11-12), 19-40.

Jones, W., Bellugi, U., Lai, Z., Chiles, M., Reilly, J., Lincoln, A., & Adolphs, R. (2001). Hypersociability: the social and affective phenotype of Williams syndrome. In U. B. M. S. George (Ed.), *Journey from cognition to brain to gene: Perspectives from Williams syndrome* (pp. 43-71). Cambridge, MA: The MIT Press.

Karmiloff-Smith, A., Brown, J.H., Grice, S., & Paterson, S. (2003). Dethroning the myth: Cognitive dissociations and innate modularity in Williams syndrome. *Developmental Nueropsychology*, *23*(1 & 2), 227-242.

Laing, E., Butterworth, G., Ansari, D., Gsodl, M., Longhi, E., Panagiotaki, G., … Karmiloff-Smith, A. (2002). Atypical development of language and social communication in toddlers with Williams syndrome. *Developmental Science*, *5*(2), 233-246.

Levy, Y. (2004). A longitudinal study of language development in two children with Williams syndrome. *Journal of Child Language*, *31*, 287-310.

Losh, M., Bellugi, U., Reilly, J., & Anderson, D. (1998). Excessive use of linguistically encoded affect: Stories from young Williams syndrome children. *Brain and Language*, *88*(2), 1-26.

Losonczy, M. E. (2004). Infants' emotional expressions in response to social and non-social stimuli. *International Social Science Review*, *79*(3/4), 124-130.

Masataka, N. (2001). Why early linguistic milestones are delayed in children with Williams syndrome: Late onset of head-banging as a possible rate-limiting constraint in emergence of canonical babbling. *Developmental Science*, *4*(2), 158-164.

McNeil, D. (1992). *Hand and mind; What gestures reveal about thought*. Chicago, IL: The University of Chicago Press.

Mervis, C. B. (2003). Williams Syndrome: 15 years of Psychological Research. *Developmental Neuropsychology*, *23*(1 and 2), 1-12.

Mervis, C. B., & Bercerra, A. M. (2007). Language and communication development in Williams syndrome. *Mental Retardation and Developmental Disabilities Research Reviews*, *13*, 3-15.

Mervis, C. B., & Bertrand, J. (1997). Developmental relations between cognition and language. In L. B. A. M. A. Romski (Ed.), *Communication and language acquisition: Discoveries from atypical development*. Baltimore, MD: Paul Brookes.

Mervis, C. B., Morris, C. A., Klein-Tasmas, B. P., Bertrand, J., Kwitney S., Appelbaum, L. G., & Rice, C. (2003). Attentional characteristics of infants and toddlers with Williams syndrome. *Developmental Nueropsychology*, *23*(1 and 2), 243-268.

Mobbs, D., Garrett, A. S., Menon, V., Rose, F. E., Bellugi, U., Reiss, A. L. (2004). Anomalous brain activation during face and gaze processing in Williams syndrome. *Neurology*, *62*(1), 2070-2076.

Nazzi, T., and Bertoncini, J.(2003). Before and after the vocabulary spurt: Two modes of word aquisition? *Developmental Science*, *6*(2), 136-142.

Pirchio, S., Caselli, M. C., & Volterra, V. (2003). Communication in children with genetic disorders: Comparing children with Williams syndrome and children with Down syndrome. *Enfrance, 53*(3), 251-264.

Singer Harris, N. G., Bellugi, U., Bates, E., Jones, W., & Rossen, M. . (1997). Contrasting profiles of language development in children with Williams and Down syndrome. *Developmental Neuropsychology 13*(3), 345-370.

Striano, T., & Rochat, P. (2000). Emergence of selective social referencing in infancy. *Infancy, 1*(2), 253-264.

Tomasello, M., Carpenter, M., & Liszkowski, U. (2007). A new look at infant pointing. *Child Development, 78*(3), 705-722.

Walden, T. A., & Kim, G. (2005). Infants' social looking toward mothers and strangers. *International journal of Behavioral Development, 29*(5), 356-360.

Wang, X-L., Bernas, R., & Eberhard, P. (2001). Effects of teachers' verbal and non-verbal scaffolding on everyday classroom performances on students with Down Syndrome. *International Journal of Early Years Education, 9*(1), 71-80.

APPENDIX A

CODING OF TODDLER BEHAVIOR

(Adapted from Doyle, Bellugi, and Korenberg, 2004)

All testing sessions were video taped allowing behavioral coding at a later time point. The ethogram was used to record behaviors produced by the participants during the task. Only behaviors performed by the child or directed toward the child were scored. Behavioral categories were all coded as STATES or EVENTS. (A state is an event or combination of events sustained for a certain period of time. Events are often instantaneous and do not require a certain duration for their occurrence to be scored.).

****Note: In all classes, there is an 'other' category. This category will be used to describe any non-verbal behavior that a child does that does not have a pre-existing code. A description of each 'other' behavior will be written. Trial

State (Code)	Definition
	Eye Gaze
Eye Contact (c)	Looks coordinated between the eyes of the child and the adult
Gaze Parent (prt)	Instances of sustained looking or eye contact toward the parent
Gaze Experimenter (exp)	Instances of sustained looking or eye contact toward the experimenter
Gaze Task (ta)	Instances of sustained looking or eye contact toward the task
Gaze Object 1 (o1)	**ONLY FOR THE PUPPET TASK** Instances of sustained looking or eye contact toward the first puppet that 'talks' to the child
Gaze Object 2 (o2)	**ONLY FOR THE PUPPET TASK** Instances of sustained looking or eye contact toward the second puppet that 'talks' to the child
Gaze Person -Uncertain (unp)	Instances of sustained looking or eye contact toward an unknown person
Eyes Closed (ec)	Instances when both eyes are closed
Look Away (space) (la)	Instances of the subject turning away from the stimulus
Gaze Uncertain (gu)	Children's eyes cannot be seen
Gaze Other (go)	Child produces a form of eye gaze that does not fit a pre-existing category

Hand Movements

Play (pp)	Child is playing with the toy
Offering (of)	An object is shown, offered, or given to the other person
Requesting (rq)	Use of gestures or eye contact to direct attention and elicit aid in obtaining an object
Pointing (pg)	Use of the extended index finger or similar gesture to initiate referential looking
Showing (sh)	Object presented to the other person
Reaching (re)	Extended arm or hand towards an object
Banging (bg)	Hitting an object with flat hands, fists, or fingers
Banging toy (bt)	Using the toy to hit another object in the room (i.e the table)
Pushing (us)	Attempting to move an object away from body using force
Grabbing (ab)	Child maintains a grip on an object so that they are holding the object
Pull (ul)	Attempting to move an object by grabbing object and pulling it towards body
Grasping (gr)	An object is requested by an opening and closing of hand with palm facing up (towards ceiling)
Shake (sk)	shaking or bouncing of the hand/arm without the toy
Shake toy (st)	shaking or bouncing of the hand/arm with the toy
Hands not visible (hno)	The child's hands cannot be seen
Hands Neutral (hnu)	No hand movement
Hand Movement Other (ho)	Child produces a hand movement that does not fit into a pre-existing category

Facial Expressions

Positive expressions (x)	Any degree of smiling, pleasure, or excitement **Modifier:** Initiate (facial expression); Respond
Negative Expressions (nx)	Any degree of anger, distress, discomfort, or frowning **Modifier:** Initiate; Respond
Facial not visible (fv)	The child's face cannot be seen
Neutral face (fn)	No facial expressions
Face expression Other (fo)	Facial expression that does not fit in a pre-existing category
	<u>Head Movements</u>
Head Nod (hh)	Up and down movement of the head
Head Shake (ss)	Left to right, or right to left, movement of the head
Head Tilt (tt)	Leaning head towards shoulder; ear either touches or almost touches shoulder
Head turn (uu)	turning head away from the task
Head down (dd)	child puts their head down so that their chin is either touching their chest, or going towards their chest
Head not visible (vv)	The child's head movement cannot be seen
Head Neutral (nn)	No head movement
Head Movement Other (oo)	Child produces head movement that does not fit in a pre-existing category
	<u>Body Posture</u>
Raising Shoulders (rs)	Raising shoulders and bringing shoulders closer to head
Turning body (tb)	Change in body positioning, turning their body away or towards the task. For example, the child alters body so that they are not facing the experiment.
Attempt to Raise Arms (ra)	Attempt to release arms from restraint of the parent

Sit forward (sf)	Changing body position to lean towards the task
Sit back (sb)	Changing body position to lean away from the task
Bounce (nc)	Up and down repetitive movement of the body
Body posture not visible (pn)	The child cannot be seen to determine body posture
Neutral body (nb)	No change in body posture
Body posture other (ob)	Change in body posture that does not fit a preexisting category

Full Body Movement:

Only in the parental separation task

Stands up (su)	child changes from a sitting position to a standing position
Follow walking (fw)	Child walks or crawls behind parent towards the door
Follow running (fr)	Child runs behind the parent towards the door
Standing in Front of Door (fd)	Child stands in front of the closed door and looking at the door
Open Door (od)	Child makes an attempt to open the closed door
Stomp (st)	Any degree of stomping or kicking in reaction to parent leaving the room
Body not visible (bno)	Child cannot be seen to determine their full body response
Neutral Body Movement (nm)	Child plays with toys
Unsuccessful (bnv)	Parent was not able to leave the room
Full body other (fbo)	child produces a full body movement that does not fit a pre-existing category

Vocalizations

Positive (vp)	Non-linguistic vocalization including laughing, gurgling **Modifier:** Initiate (vocalization); Respond

Negative (vn)	Non-linguistic vocalization: whimpering, sobbing, crying **Modifier:** Initiate (vocalization); Respond
Vocal Ambiguous (va)	Non-linguistic vocalization: valence is unclear **Modifier:** Initiate (vocalization); Respond
Lexical Utterance (lu)	Vocalization with words (To be transcribed: CHILDES) **Modifier:** Initiate (vocalization); Respond
Neutral (no)	No vocalization **Modifier:** Initiate (vocalization); Respond
Other (vo)	child produces a vocalization that does not fit a pre-existing category **Modifier:** Initiate (vocalization); Respond

********** Event Behaviors**********

Barrier Task

Free Play (by)	Child is introduced to an attractive toy that they are permitted to play with
Barrier introduced (bi)	Toy is taken from the child and a barrier is placed between the child and the toy
Barrier removed (br)	Barrier is removed from between the child and the toy

Separation Task

Bye (bb)	Parent tells the child she is leaving
Parent leaves (ll)	Door closes: Parent and experimenter leave the room
Parent returns (rr)	Parent and experimenter return to the room

Arm Restraint Task

Play toy (ap)	Child is introduced to an attractive toy that they are permitted to play with
Arms restrained (rt)	Parent gently restrains the child's arms

Arms released (ar)	Parent releases the child's arms
	Puppet Task
Tickle start (ts)	Experimenter starts to tickle the child with the puppets
Tickle end (te)	Experimenter stops tickling the child with the puppets
Toys (gt)	Child is given the puppets so that they can play with them
	Bear Task
Start tickle (ti)	Parent starts to tickle the child with the bear
End tickle (op)	Parent stops tickling the child with the bear

**********Modifiers**********

Missing stimulus (?)	Used when initializing channels. May also be used if the modifier is unknown
Initiate (i)	Child initiates a facial expression or vocalization without stimulus from the parent or experimenter
Respond (r)	Child produces a facial expression or vocalization in response to a stimulus from the parent or experimenter (i.e. the experimenter gives the child a toy and the child smiles)

APPENDIX B

CONFIGURATION REVIEW

Configuration Review

Location : C:\Documents and Settings\All Users\Noldus\The Observer\Workspaces\Projects\TD 2(1).opp,.ocp,.opd
Observation recorder: PC

Description

Non-verbal communication of TD control, ZM-12

Settings

Setting	Value
Recording method	Continuous
Automatically generate key codes	No
Case sensitive	Yes
Duration of Observation	Open Ended

Independent Variables

Number of Independent Variables: 2

Independent Variable Name	Type	Values
Group	Nominal	TD (...Add while scoring)
Task	Nominal	Bear Puppet Puppet Peek a boo Arm restraint Barrier Maternal Separation (...Add while scoring)

Subjects

Number of Subjects: 2

Subject Name	Code
Missing subject	?
XX-XX	t2

Element Descriptions:

Subject Name	Description
Missing subject	
XX-XX	TD, CA 12 months

Behaviors

Number of behavioral classes: 10

Behavioral Class 1: Eye Gaze
Type: Nominal

Number of Elements: 11

Behavior Name	Code	Type	Modifier Class 1	Modifier Class 2
Eye Contact	c	State	(None)	(None)
Gaze Parent	prt	State	(None)	(None)
Gaze Experimente	exp	State	(None)	(None)
Gaze Task	ta	State	(None)	(None)
Gaze Object 1	o1	State	(None)	(None)
Gaze Object 2	o2	State	(None)	(None)
Gz Pers Uncert	unp	State	(None)	(None)
Eyes Closed	ec	State	(None)	(None)
Look away (space	la	State	(None)	(None)
Gaze Uncertain	gu	State	(None)	(None)
Gaze other	go	State	(None)	(None)

Element Descriptions:

Behavior Name	Description
Eye Contact	Looks coordinated between the eyes of the child and the adult
Gaze Parent	Instances of sustained looking or eye contact toward the parent
Gaze Experimente	Instances of sustained looking or eye contact toward the experimenter
Gaze Task	Instances of sustained looking or eye contact toward the task
Gaze Object 1	ONLY USED FOR THE PUPPET TASK: Instances of sustained looking or eye contact toward the first puppet that 'talks' to the child
Gaze Object 2	ONLY USED FOR THE PUPPET TASK: Instances of sustained looking or eye contact toward the second puppet that 'talks' to the child
Gz Pers Uncert	Instances of sustained looking or eye gaze toward an unknown person (it cannot be determined if the child is looking at the experimenter or parent)
Eyes Closed	Instances where both eyes are closed (not blinks)
Look away (space	Instances of the subject truning away from stimulus
Gaze Uncertain	Children's eyes cannot be seen
Gaze other	Child produces a form of eye gaze that does not fit a pre-existing category

Behavioral Class 2: Hand Movements
Type: Nominal
Number of Elements: 17

Behavior Name	Code	Type	Modifier Class 1	Modifier Class 2
Play	pp	State	(None)	(None)
Offering	of	State	(None)	(None)
Requesting	rq	State	(None)	(None)
Pointing	pg	State	(None)	(None)
showing	sh	State	(None)	(None)
reaching	re	State	(None)	(None)

banging	bg	State (None)	(None)	
banging toy	bt	State (None)	(None)	
pushing	us	State (None)	(None)	
Grabing	ab	State (None)	(None)	
pull	ul	State (None)	(None)	
grasping	gr	State (None)	(None)	
shake	sk	State (None)	(None)	
shake toy	st	State (None)	(None)	
hand Not visible	hno	State (None)	(None)	
Hands Neutral	hnu	State (None)	(None)	
hand move other	ho	State (None)	(None)	

Element Descriptions:

Behavior Name	**Description**
Play	Child is playing with the toy
Offering	An object is shown, offered, or given to the other person
Requesting	use of gestures or eye contact to direct attention and elicit aid in obtaining an object
Pointing	Use of the extended index finger or similar gesture to initiate referential looking
showing	Object presented to the other person
reaching	extended are or hand toward an object
banging	hitting an object with flat hands, fists, or fingers
banging toy	using the toy to hit another object in the room (i.e. the table)
pushing	attempting to move an object away from body using forces
Grabing	Child maintains a grip on a object so that they are holding the object
pull	attempting to move an object by grabbing it and pulling it towards the body
grasping	an object is requested by an opening and closing of hand, with palm facing up (toward ceiling)
shake	shaking or bouncing of the hand without the toy
shake toy	shaking or bouncing of the hand with the toy
hand Not visible	child's hands cannot be seen
Hands Neutral	no hand movement
hand move other	child produces a hand movement that does not fit into a preexisting category

Behavioral Class 3: Facial Expressio
Type: Nominal
Number of Elements: 5

Behavior Name	**Code**	**Type**	**Modifier Class 1**	**Modifier Class 2**
Positive express	x	State	stimulus	(None)
negative express	nx	State	stimulus	(None)
facial not visib	fv	State	(None)	(None)
neutral face	fn	State	(None)	(None)

Face Expr Other	fo	State (None)	(None)	

Element Descriptions:

Behavior Name	Description
Positive express	any degree of smiling, pleasure, or excitement
negative express	any degree of anger, distress, discomfort, or frowning
facial not visib	child's face cannot be seen
neutral face	no facial expression
Face Expr Other	Facial expression that does not fit as either positive or negative

Behavioral Class 4: Head Movements
Type: Nominal
Number of Elements: 8

Behavior Name	Code Type	Modifier Class 1	Modifier Class 2
Head nod	hh	State (None)	(None)
head shake	ss	State (None)	(None)
head tilt	tt	State (None)	(None)
head turn	uu	State (None)	(None)
head down	dd	State (None)	(None)
head not visible	vv	State (None)	(None)
head neutral	nn	State (None)	(None)
head move other	oo	State (None)	(None)

Element Descriptions:

Behavior Name	Description
Head nod	up and down movement of the head
head shake	left to right, or right to left, movement of the head
head tilt	leaning head towards shoulder; ear either touches or almost touches shoulder
head turn	turning head away from the task
head down	child puts head down so that their chin is either touching their chest, or going towards their chest
head not visible	the child's head movement cannot be seen
head neutral	no head movement
head move other	child produces a head movement that does not fit in a preexisting category

Behavioral Class 5: Body Posture
Type: Nominal
Number of Elements: 9

Behavior Name	Code Type	Modifier Class 1	Modifier Class 2
raising shoulder	rs	State (None)	(None)
turning body	tb	State (None)	(None)
raise arms	ra	State (None)	(None)
sit forward	sf	State (None)	(None)
sit back	sb	State (None)	(None)

bounce	nc	State (None)	(None)	
post not visible	pn	State (None)	(None)	
Neutral body	nb	State (None)	(None)	
body post other	ob	State (None)	(None)	

Element Descriptions:

Behavior Name	Description
raising shoulder	raising shoulders and bringing shoulders closer to head
turning body	change in body positioning, turning their body away from the task. For example, the child alters body so that they are not facing the experiment
raise arms	attempt to release arms from restraint of the parent
sit forward	changing in body positioning to lean towards the task
sit back	changing in body positioning to lean away from the task
bounce	up and down repetitive movement of the body
post not visible	child cannot be seen to determine their body positioning
Neutral body	no change in body posture
body post other	Change of body position that does not fit an pre-existing category. For example, a twist or squirm of the upper torso

Behavioral Class 6: Full Body Move
Type: Nominal
Number of Elements: 10

Behavior Name	Code Type	Modifier Class 1	Modifier Class 2
stands up	su	State (None)	(None)
follow walking	fw	State (None)	(None)
follow running	fr	State (None)	(None)
front of door	fd	State (None)	(None)
open door	od	State (None)	(None)
stomp	sp	State (None)	(None)
body not visible	bno	State (None)	(None)
neutral body mov	nm	State (None)	(None)
unsuccessful	bnv	State (None)	(None)
full body other	fbo	State (None)	(None)

Element Descriptions:

Behavior Name	Description
stands up	child changes from a sitting position to a standing position
follow walking	child walks or crawls behind the parent towards the door
follow running	child runs behind the parent toward the door
front of door	child stands in front of the closed door
open door	child makes an attempt to open the closed door

stomp any degree of stomping or kicking in reaction to parent leaving the room
body not visible child cannot be seen to determine full body movement
neutral body mov child plays with toys
unsuccessful parent was not able to leave the room
full body other child produces a full body movement that does not fit in a preexisting category

Behavioral Class 7: Barrier Task
Type: Nominal
Number of Elements: 3

Behavior Name	**Code**	**Type**	**Modifier Class 1**	**Modifier Class 2**
Free Play	by	Event	(None)	(None)
Barrier introduc	bi	Event	(None)	(None)
barrier removed	br	Event	(None)	(None)

Element Descriptions:

Behavior Name	**Description**
Free Play	Child is given toy to play with
Barrier introduc	Barrier is placed between child and toy
barrier removed	barrier is removed and the child regains access to the toy

Behavioral Class 8: Separation Task
Type: Nominal
Number of Elements: 3

Behavior Name	**Code**	**Type**	**Modifier Class 1**	**Modifier Class 2**
Bye	bb	Event	(None)	(None)
Parent leave	ll	Event	(None)	(None)
parent returns	rr	Event	(None)	(None)

Element Descriptions:

Behavior Name	**Description**
Bye	Mom informs child that she is leaving
Parent leave	Door closes: Parent and experimenter have left the room
parent returns	parent and experimenter come back into the room

Behavioral Class 9: Arm restraint
Type: Nominal
Number of Elements: 3

Behavior Name	**Code**	**Type**	**Modifier Class 1**	**Modifier Class 2**
play	ap	Event	(None)	(None)
restraint	rt	Event	(None)	(None)
arms released	ar	Event	(None)	(None)

Element Descriptions:

Behavior Name	Description
play	child is introduced to an attractive toy and is allowed to play with the toy
restraint	parent gently restrains the child's arms
arms released	parent releases the child's arms

Behavioral Class 10: Vocalizations
Type: Nominal
Number of Elements: 6

Behavior Name	Code	Type	Modifier Class 1	Modifier Class 2
Positive	vp	State	stimulus	(None)
Negative	vn	State	stimulus	(None)
vocal ambiguous	va	State	stimulus	(None)
lexical utteranc	lu	State	stimulus	(None)
neutral	no	State	stimulus	(None)
other	vo	State	stimulus	(None)

Element Descriptions:

Behavior Name	Description
Positive	Non-linguistic vocalizations including laughing and gurgling
Negative	Non-linguistic vocalizations: whimpering, sobing, crying
vocal ambiguous	Non-linguistic vocalization: valence is unclear
lexical utteranc	vocalization with words
neutral	no vocalization
other	child produces a vocalization that does not fit a pre-existing category

Modifiers

Number of modifier classes: 1

Modifier Class 1: stimulus
Type: Nominal
Number of Elements: 3

Modifier Name	Code
Missing stimulus	?
initiate	i
respond	r

Element Descriptions:

Modifier Name	Description
Missing stimulus	
initiate	child initiates a facial expression or vocalization without stimulus from parent or experimenter

respond	child produces a facial expression or vocalization in response to a stimulus