Social Learning and Social Motivation: Examining Parent-Child Interactions

by

Hilary Aime

Bachelor of Arts (Honours with Distinction), Simon Fraser University, 2014

Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Arts

in the
Department of Psychology
Faculty of Arts and Social Sciences

SIMON FRASER UNIVERSITY
Fall 2017

Approval

Name: **Hilary Aime**

Degree: **Master of Arts (Psychology)**

Title: **Social Learning and Social Motivation: Examining Parent-Child Interactions**

Examining Committee: **Chair: Timothy Racine**
Professor

Tanya Broesch
Senior Supervisor
Associate Professor

Grace Iarocci
Supervisor
Professor

Maureen Hoskyn
External Examiner
Associate Professor
Faculty of Education
Simon Fraser University

Date Defended/Approved: December 7, 2017

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Abstract

Humans are unique in our ability to learn from one another. Our sensitivity to non-verbal communicative cues has been argued to facilitate the learning process, drawing attention to critical information in the learning context. However, it is unclear whether these behaviours derive from children's motivation to learn, or the motivation to interact and affiliate with others. I examined the use of non-verbal communicative cues in a social learning context in 50 parent-child dyads, with children varying in their desire to interact with others (range = 7-12 years): 26 typically developing (TD) children and 24 children diagnosed with Autism Spectrum Disorder (ASD). When instructed to teach their child a new skill, parents of TD and ASD children produced similar amounts of non-verbal communicative cues. However, children with ASD appeared to use these cues to adjust their behaviour less than their same-age TD peers. Although children with ASD took longer to learn a novel skill, both when learning from a parent and on their own, children's learning efficiency (speed of learning) was not related to their use of communicative cues from their parent. Finally, children's parent-reported social responsiveness (as measured by the Multidimensional Social Competence Scale) was positively related to their use of communicative cues.

Keywords: social learning; autism spectrum disorders; non-verbal communication; imitation; social responsiveness; social motivation

Acknowledgements

This research was funded by the Joseph-Armand Bombardier Canada Graduate Scholarship (Social Sciences and Humanities Research Council of Canada), as well as Graduate Fellowships and research support through Simon Fraser University. I thank all of the parents and children who participated in this study, as well as Mandeep Gurm for assistance with reliability coding.

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Chapter 1.

Introduction

Humans are unique in our capacity to learn from others and accumulate knowledge from previous generations (Boyd & Richerson, 1985; Henrich, 2015). One way to understand this unique capacity of human culture is to understand how information is transmitted through social learning. Indeed, psychologists have suggested that learning from others, rather than innate intelligence, underlies our capacity for human culture (Henrich, 2015; Richerson & Boyd, 2005; Tomasello, 2014). Several theories of human social learning exist, such as observation, imitation, and teaching. For example, some theories suggest that humans use specific social learning strategies that drive them to selectively attend to, imitate, and learn from skilled others, and the responsibility for learning rests primarily on the learner (e.g., Tomasello, 2016). Others have suggested that our ability to engage in specific forms of non-verbal communication facilitates the learning process, enabling a more knowledgeable other to focus the attention of the learner to the relevant and important information (Csibra & Gergely, 2006; Gergley & Csibra, 2005). This kind of communication is thought to enable the transmission of complex forms of knowledge across generations.

1.1. Communicative Cues

According to one theory, referred to as the theory of natural pedagogy, humans produce ‘ostensive cues’, which are subtle non-verbal communicative signals that draw the learner’s attention to the relevant features or critical moments of a skill or knowledge (Csibra & Gergely, 2009). Under this theory, humans are proficient teachers with a specialized system for producing non-verbal communicative cues to guide the attention and behaviour of the learner and that learners are receptive to these cues, attend to them, and use them to facilitate their learning (Csibra & Gergely, 2006). ‘Ostensive cues’ refer to a suite of non-verbal communicative behaviours (such as gaze and tone of voice, among others) that draw attention to relevant features of an interaction. Other non-verbal behaviours that are clear and exaggerated (such as gestures) also have pedagogical importance, particularly those that direct attention and behaviour in a learning context. As postulated by Strauss and Ziv (2012), teaching and learning becomes more sophisticated as children age. Thus, children must learn to combine different kinds of non-verbal communicative cues within interactions in order to become efficient learners. For this reason, children's use of traditional ostensive signals as well as general communicative cues become important in understanding their natural receptivity to teaching.

Empirical support for the theory of natural pedagogy comes from infancy research, as well as cross-cultural studies on social learning. Infants' sensitivity to eye contact, contingencies, and infant-directed speech make it more likely that they will learn by observing the adult's behaviours (Csibra & Gergely, 2006; Farroni, Mansfield, Lai & Johnson, 2003; Senju & Csibra, 2008). In the presence of ostensive or communicative cues (i.e., when the adult is making eye contact, responding contingently, or using infant-directed speech), infants tend to shift their attention in the direction indicated by the adult's gaze – thus altering their attention following these behavioural cues (Csibra & Gergely, 2006). Infants as young as four months of age have a tendency to follow others' gaze – to respond to movements of an adult's head and/or eyes by shifting their gaze in the same direction as the movement (Farroni, Mansfield, Lai, & Johnson, 2003). Infants are more likely to follow an adult's gaze when it is preceded by an ostensive cue, such as direct eye contact or infant-directed speech, rather than an attention-grabbing stimulus control (Senju & Csibra, 2008). This finding has also been replicated across diverse social-cultural environments. Using eye-tracking methodology, Hernik and Broesch (under review) report that infants were more likely to follow an adults' gaze after infant directed speech in a society where parent-infant communicative strategies differ from those in Western or urban societies. Additionally, there is evidence that adults from diverse cultural contexts produce these cues (Broesch & Bryant, 2014; 2017; Broesch et al., in prep; Boyette & Hewlett, 2017; Kline, Henrich & Boyd, 2013, Lew-Levy, Reckin, Lavi, Cristobal-Azkarate, Ellis-Davis, 2017) and adjust their non-verbal behaviour in teaching situations, including in interactions with infants (Hewlett & Roulette, 2016; Broesch & Bryant, 2014; 2017), children (Broesch & Ceblioglu, in prep), and other adults (Broesch et al., in prep).

1.2. Communicative Cues and Autism Spectrum Disorders

Despite the robust literature demonstrating the use of communicative cues in typically developing (TD) individuals, research demonstrates that children with Autism Spectrum Disorders (ASD) are often less inclined to attend to this type of non-verbal communication (Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Mundy & Neal, 2000). ASD is a spectrum of disorders characterized by deficits in social communication and behavioural flexibility (American Psychiatric Association, 2013), affecting approximately one in 68 children in the United States (Christensen et al., 2016). Children with ASD generally have difficulty responding to social cues and displaying reciprocity in social interactions, both of which are characteristic of the disorder and have implications for social learning.

Research demonstrates that children with ASD do not preferentially attend to faces (Magrelli et al., 2013; Osterling & Dawson, 1994) and the eyes (Klin et al., 2002) to the same extent as TD children. However, findings regarding the tendency for children with ASD to follow an adults gaze are mixed: whereas many researchers have found intact gaze-following in ASD (Birmingham, Johnston, & Iarocci, 2017; Chawarska, Klin, & Volkmar, 2003; DeJong, VanEngeland, & Kemner, 2008; Kuhn et al. 2010; Kylliäinen & Hietanen 2004; Okada et al. 2003; Rombough & Iarocci, 2012; Rutherford & Krysko 2008; Swettenham et al. 2003; Uono et al. 2009), others have reported absent or diminished gaze-following in children with ASD (Goldberg et al., 2008; Johnson et al., 2005; Senju, Tojo, Dairoku, & Hasegawa, 2004). Lack of social orienting involving obvious movement of the eyes or head is considered among the most salient and specific features of individuals with ASD, yet covert orienting may be intact or even superior (Chawarska et al., 2016; Gernsbacher, Stevenson, Khandakar, & Goldsmith, 2008; Magrelli et al., 2013). Additionally, children with ASD are less likely to orient to their name being called (Werner et al., 2000; Baranek et al., 1999; Osterling & Dawson, 1994; Osterling et al., 2002) and often do not preferentially attend to infant-directed speech compared to adult-directed speech (Kuhl, Coffey-Corina, Padden, & Dawson, 2005).

Although the empirical findings are mixed, clinical data suggest that children with ASD are less sensitive to communicative behaviours – which poses a challenge for understanding human social learning and the theory of natural pedagogy, specifically.

The theory of natural pedagogy proposes that we have psychological adaptations that make us receptive to teaching (Csibra & Gergely, 2006), yet a relatively large subgroup within the population appear significantly less sensitive to these communicative cues. A key argument levied against this theory and other theories of social learning is that the evidence cited as support for social learning mechanisms may demonstrate adaptations for human social bonding – not specific to teaching (Heyes, 2016). Social learning mechanisms may serve to establish and maintain social relationships, as well as promote the efficient development of skills and knowledge. Aligning with these arguments, several influential accounts have proposed that reduced social orienting or social motivation during early development could underlie many of the deficits seen in ASD (Chevallier, Grèzes, Molesworth, Berthoz, & Happé, 2012; Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Mundy & Neal, 2000). Although social motivation is not uniformly low among all individuals with ASD, many children with ASD show limitations in their social motivation (Chevallier et al., 2012). Theories of reduced social motivation (Chevallier et al., 2012) and social orienting (Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Mundy & Neal, 2000) among children with ASD may lend support to theories explaining human receptivity to teaching as founded on nonspecific genetic adaptations for social bonding rather than learning, specifically (Heyes, 2016).

1.3. Imitation and Autism Spectrum Disorders

Much of the responsibility for learning rests on the teacher to modify his or her behaviour in the presence of a learner, allowing the learner to identify relevant and critical information with ease (Csibra & Gergely, 2006). As part of this theory, the teacher draws the learner's attention to specific features of a skill, enabling the learner to *only* copy the necessary information and ignore functionally irrelevant information (e.g., behaviours that do not achieve the desired outcome). However, the literature on early imitation presents an apparent paradox: whereas children sometimes copy selectively (e.g., copying intentional actions, but not mistakes or failed attempts), at other times, they copy surprisingly faithfully. In fact, children sometimes copy so faithfully that they reproduce actions that are irrelevant to achieving the task at hand, referred to as *overimitation* (Lyons, Young, & Keil, 2007). Although most previous accounts of imitation focus on imitation as a way to learn from others (e.g., Whiten, McGuigan, Marshall-

Pescini, & Hopper, 2009), theories have recently begun to focus on the social side of imitation – where imitation is intimately linked to children's need to belong to a group and their drive to affiliate with those around them (Over & Carpenter, 2013). The relationship between social motivation, the presence of ostensive cues, and overimitation has yet to be explored.

According to the social motivation hypothesis (Uzgiris, 1981), children will prioritize copying the actions of the demonstrator over achieving the outcome(s) of those actions as a way to fulfill social motivations – to identify and affiliate with the demonstrator (see Carpenter, 2010; Over & Carpenter, 2013). Indeed, children will copy all of the actions used by an adult when solving a novel, object-directed task – including actions that are causally unrelated to the outcome (e.g., Horner & Whiten, 2005; Nielsen, 2006). There is evidence that by 18 to 24 months of age, infants and toddlers often go out of their way to copy others' actions on objects closely, and do so more often in social than non-social situations (e.g., Nielson, 2006; Nielsen, Simcock, & Jenkins, 2008). This overimitation has commonly been described in terms of learning about the object, but it may also reflect social processes such as the child's social motivation or motivation to affiliate with the demonstrator (Over & Carpenter, 2012) or conform to perceived social and cultural norms (Kenward, Karlsson, & Persson, 2011).

Children with ASD demonstrate significant impairments in object imitation, imitation of facial and body movements, and deferred imitation of actions on objects (Dawson et al., 1998; Edwards, 2014; Rogers, Bennetto, McEvoy, & Pennington, 1996; Rogers, Hepburn, Stackhouse, & Wehner, 2003; Sigman & Ungerer, 1984; Stone, Ousley, & Littleford, 1997; Vivanti, Trembath, & Dissanayake, 2014; Williams, Whiten, & Singh, 2004). However, the nature of such imitative difficulties remains poorly understood. In a recent meta-analysis, Edwards (2014) demonstrated that children with ASD showed a significant deficit compared to children without ASD when imitation is defined as the reproduction of both the *form* of an action as well as the attainment of an instrumental goal or skill. However, children with ASD showed no deficit when imitation was defined as the attainment of an instrumental goal only. Children with ASD display a significant deficit in imitating behaviours not casually related to an outcome, although their ability to imitate instrumental or goal-oriented behaviours remains relatively intact (Edwards, 2014).

Additionally, recent research suggests that children with ASD may *overimitate* when imitation is motivated by learning (Nielsen, Slaughter, & Dissanayake, 2013), but not when imitation is socially motivated (Marsh, Pearson, Ropar, & Hamilton, 2013). Indeed, while children with ASD have been shown to engage in overimitation when performing tasks with novel, causally opaque objects (Nielsen, Slaughter, & Dissanayake, 2013), they tend not to engage in overimitation with familiar, causally transparent objects (Marsh, Ropar, & Hamilton, 2014). The contrast in these findings may be explained due to the desire to learn about the object when it is unfamiliar and causally opaque, and lack of motivation to engage in imitation for affiliative benefits – thus aligning with characterizations of diminished social motivation among children with autism (Chevallier et al., 2012). Recent research demonstrating decreased overimitation in children with ASD compared to TD children and children with William syndrome provides further evidence that overimitation of causally opaque actions fulfills social affiliation motives (Vivanti, Hocking, Fanning, & Dissanayake, 2017). This evidence is compelling given that children with William syndrome have similar impairments in social-cognition as children with ASD, but are characterized by enhanced, rather than reduced, social motivation. In addition, recent evidence suggests that individuals with ASD may be less susceptible to social pressure: for example, they do not take the presence of an audience into account when deciding how much money to donate to charity (Izuma, Matsumoto, Camerer, & Adophs, 2011). This pattern of imitative behaviour and reduced sensitivity to social pressures suggests that whereas children with ASD possess the capacity to engage in imitation, their motivations for doing so may be different than those of typically developing children.

1.4. Present Study

There are three untested assumptions underlying this proposed social learning mechanism. First, these theories assume that the production of these social communicative cues by a teacher, will result in more efficient learning by the learner. Second, they assume that the motivation for engaging in social learning behaviours rests on the output (i.e., the learned information, skill or product) instead of an intrinsic desire to be social. Third, they assume that children's overimitation is similarly related to their desire to learn, rather than their desire to be social. The goal of the current research is to examine these three assumptions to better understand mechanisms supporting social learning.

1.4.1. Research Question #1: Efficiency

Do ostensive cues facilitate more efficient learning in children? To investigate the assumption that pedagogical cues are functional for more efficient and rapid transfer of knowledge, I examined children's learning efficiency in a social learning versus individual learning context. I also examined the production of cues by parents (the experts) and the subsequent use of cues by children (the learners) to determine whether cue use was related to children's learning efficiency (i.e., the duration of time it takes to learn the skill). Given differences in the social communicative skills of children with and without ASD, I examined these relationships in these groups together as well as separately. I expected that children who used more ostensive cues would learn more efficiently (hypothesis one).

1.4.2. Research Question #2: Social Motivation

Is the use of ostensive cues motivated by a desire to learn or a desire to be social? To investigate this, I examined the correlation between children's social motivation and responsiveness, as measured by the social responsiveness subscale of the Multidimensional Social Competence Scale (Yager & Iarocci, 2013), and their use of ostensive cues to guide behaviour. I expected that if the use of ostensive cues rests on a motivation to learn and not a motivation to affiliate, then use of ostensive cues and social responsiveness will not be correlated (hypothesis two).

1.4.3. Research Question #3: Overimitation

Do children overimitate due to a desire to learn or a desire to be social? Does this explain the lower rates of overimitation found in children with ASD? In order to test this, I examined whether children's social responsiveness, as measured by the social responsiveness subscale of the Multidimensional Social Competence Scale (Yager & Iarocci, 2013), was correlated with the number of overimitative behaviours they engaged in. I expected that children with higher scores on the measure of social responsiveness will engage in more overimitation than children with lower scores (hypothesis three).

Chapter 2.

Method

2.1. Participants

I recruited fifty parent-child dyads (*N* = 50; 33 male children; 4 fathers) for this study (age range = 7-12 years). The dyads included 30 mother-son pairs, 16 mother-daughter pairs, 3 father-son pairs, and 1 father-daughter pair. In order to test children varying in their degree of motivation for social interaction, I recruited children with autism spectrum disorders (ASD; *n* = 24, 18 male children; 2 fathers) and typically developing children (TD; *n* = 26, 15 male children; 2 fathers). Two additional children with ASD (*n* = 2; 1 male child) began the study but chose to discontinue before completing the tasks. Children were on average 9.5 years of age (*SD* = 1.8), ranging from 7 to 12 years. I selected this age range given evidence that children learn the complexities of their culture and their skills begin to resemble that of adults' during middle childhood (House et al., 2013; Lancy, 1996), and because a similar task that has been used previously with children aged 6 to 10 years (Broesch & Cebioglu, in prep).

Parent-child dyads were recruited through lab databases (the Autism and Developmental Disorders Lab and the Culture and Development Lab at Simon Fraser University), as well as online advertisements through various Facebook pages and local agencies serving families of children with ASD (Autism Community Training, Families for Early Autism Treatment of British Columbia, PALS Autism Society). I compensated the dyads by entering them into a draw for an iPad upon completion of data collection, which was awarded to one family.

For the children with ASD, parents confirmed their child's clinical diagnosis and that their child is receiving government funding for ASD. In order to qualify for funding from the Ministry of Children and Family Development Autism Funding Program in British Columbia (where the data was collected), children must be assessed by a pediatrician, psychologist, or psychiatrist trained to administer the Autism Diagnostic Interview-Revised (ADI-R; Le Couteur et al., 1989) and Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2012). As well, each child must fulfill the Diagnostic and

Statistical Manual of Mental Disorders criteria for ASD (DSM-5; American Psychiatric Association, 2013). All children in the ASD sample met these criteria.

2.2. Measures

Parents completed three questionnaires, described in detail below: a family demographics questionnaire, a measure of their child's social competence and social responsiveness (Multidimensional Scale of Social Competence – Parent Version; MSCS – Parent Version; Yager & Iarocci, 2013), and a measure of their child's ASD features (Autism Spectrum Quotient – Children's Version, AQ-Child; Auyueng, Baron-Cohen, Wheelwright, Allison, 2008). See Appendix A for all materials.

2.2.1. Family Demographics Questionnaire

Parents provided basic background information regarding their family and child on the demographics questionnaire. Parents answered 23 questions regarding topics such as their child's name, birthdate, gender, cultural background, language exposure, intervention exposure, type of schooling, and co-morbid and diagnostic information. Within this questionnaire, parents were asked to identify if their child participates in the general classroom at school, or if they have any type of special assistance or education. This was used as a proxy for cognitive ability as cognitive ability assessment information was not available for this study. Parents also reported their child's estimated experience with origami, as experience with this specific skill may have influenced children's performance. Parents reported whether their child had made origami figures "never", "rarely (up to 5 times before)", "sometimes (over 5 times before)", or "regularly (many times before)".

2.2.2. Autism Quotient – Children's Version (AQ-Child)

The AQ-Child was administered in order to measure key symptoms of ASD in children with and without ASD (Auyueng, Baron-Cohen, Wheelwright, & Allison, 2008). The AQ-Child is a parent-report questionnaire quantifying the symptoms or features of ASD in children and includes 50 items to be rated on a scale ranging from 1 ("definitely disagree) to 4 ("definitely agree"). Items were coded such that higher scores reflect greater levels of ASD features.

2.2.3. Multidimensional Social Competence Scale (MSCS)

In order to assess children's social motivation, parents provided data on their children using the Multidimensional Social Competence Scale (MSCS parent version; Yager & Iarocci, 2013). The MSCS is a parent-report questionnaire designed to assess several dimensions of children's social competence and includes 77 items to be rated on a scale ranging from 1 ("not true or almost never true") to 5 ("very true or almost always true"). Items were coded such that higher scores reflected higher levels of social competence. Specific domains of functioning measured within the MSCS included social motivation (e.g., "avoids talking to people when possible"), which reflects one's level of comfort, interest, and enjoyment in interacting with others (Yager & Iarocci, 2013). However, I analyzed the subscale referred to collectively as "social responsiveness" for the purposes of this study. This subscale consisted of three domains including social motivation, demonstrating empathic concern, and nonverbal sending skills, and overall appears to assess the extent to which individuals demonstrate an awareness of and connection with others.

2.3. Procedure

First, parents provided informed consent and completed the questionnaire measures online using the Qualtrics survey platform. Subsequently, parents completed three tasks with their child. I began data collection with parents completing all three of these tasks at home by following instructions provided online, video-recording themselves, and submitting their videos using a link I provided to a secure Canadian server (sync.com). However, due to low participation, I collected additional data by visiting families' homes to provide instructions for these three tasks and video-record the procedure. Of the 50 families who participated in the study, 19 families (10 with a child with ASD, 9 with a TD child) completed the study online, and 31 families (14 with a child with ASD, 17 with a TD child) completed the study in person (i.e., were visited by the PI). Mode of data collection was not found to impact any of the key study variables (see Results). All parents completed the questionnaires online. The three study tasks, described in detail below, included a brief imitation battery (the motor imitation scale), an activity where the child had to learn from their parent (the social learning task), and an activity where the child had to learn by themselves (the individual learning task). The imitation battery was always administered first, and then the order of the social learning and individual learning tasks was counter-balanced across participants.

2.3.1. Motor Imitation Scale

In order to assess the child's baseline imitation abilities, parent-child dyads completed a shortened version of the Motor Imitation Scale (MIS; Stone, Ousley, & Littleford, 1997). The purpose of this measure was to ensure that there were no group differences in children's baseline imitative abilities that would explain any differences found in children's overimitation or social learning. The MIS is an assessment measure of motor imitation abilities in children with and those without ASD. It consists of 16 single-step actions that are modeled by an adult within a structured interaction. Half of the items require imitation of actions with objects, and the other half require imitation of body movements. The object actions are further divided into those involving "meaningful" or "non-meaningful" actions. For example, making a toy dog 'walk' across the table is considered a meaning action, whereas making a fork 'walk' across the table is not. I provided parents with brief instructions regarding the procedure for the MIS and then the parent administered the measure and demonstrated the actions to their child. Specifically, the parents said, "[Child's name], watch me", demonstrated the action, and said, "Do this". The actions of the MIS included in this study were: pushing a car across the table, waving one's hand, making a hairbrush 'walk' across the table, clapping one's hand, pushing a cup across the table, opening and closing one's fist, making a figurine 'walk' across the table, and pulling on one's earlobe.

2.3.2. Social Learning Task

In order to elicit ostensive cues from the parents in a social learning context, all parents independently watched a video to learn how to create an origami fox and then taught this skill to their child without talking. The frame of the video the parent learnt from only included the hands of the demonstrator and was void of any ostensive signals, as to avoid individuals producing ostensive cues due to imitation of the demonstrator. The video contained two unnecessary steps as a measure of overimitation – that is, the production of steps that were causally unnecessary for the outcome. One unnecessary step was causally opaque (i.e., an unnecessary fold in the paper), and one was more clearly unrelated to the outcome of the task (i.e., tapping the paper). The parent was not video-recorded while they watched the video and learned the skill, and I informed them that they may watch the video as many times as necessary in order for them to master the skill. Once the parent had mastered the skill, I instructed the parent to share this new skill with their child without referring to the video. Because I was interested in the use of non-verbal communication, I instructed parent-child dyads not to speak to one another during this phase of the study. I video-recorded the parent-child dyad while the parent taught the child how to make the origami fox. The dyads continued practicing making the origami fox until the child created one origami figure.

2.3.3. Individual Learning Task

To measure the child's baseline ability to learn this type of skill individually, the child also learned how to make a different origami figure of equal number of steps (an origami dog) from a video, without any assistance from their parent. I presented the child with a video demonstrating how to make the origami dog. Again, the video frame only included the hands of the demonstrator, was void of any ostensive cues, and contained two unnecessary steps to provide a measure of children's overimitation (i.e., an unnecessary fold and tapping the paper). I instructed the child how to use the video and informed them that they may practice making the origami figure and watch the video for as long as necessary for them to master the skill. I video-recorded the entire process of the child learning to make the origami dog from the video until the child had completed one origami figure.

2.4. Coding

All videos (N = 50) were coded by me and a subset of videos (n = 13) were coded by a second coder, blind to the hypotheses. The individual learning task required one pass to code, whereas the social learning videos required three passes (parent behaviour, child behaviour, overimitation). The main variables of interest were the duration of time it took children to make one origami figure, the production and use of ostensive cues (social learning task only), and the presence of overimitation. See Appendices B and C for the detailed coding procedure and coding manual, respectively.

2.4.1. Duration

I operationally defined duration as the duration of time (in seconds) it took children to complete one origami fox or dog for each the social and individual learning tasks, respectively. To measure this, I timed children from when they first touched the origami paper until the final step of the figure has been completed. I coded duration in both the social learning and individual learning tasks. Higher values indicate a longer duration of time to learn how to make the origami figure, and I am considering this as reflecting less efficient learning.

2.4.2. Cues

I operationally defined attention to and use of ostensive cues as changes to the child's attention or behaviour following a nonverbal communicative cue from the parent, respectively. I coded ostensive cues in the social learning task only. First, I coded the parent's production of ostensive cues: gestures, direct eye gaze with the child, and pausing. Because the length of the interaction varied across the dyads, I calculated a per minute frequency count of the parents' production of cues. That is, I calculated cues produced as the total cues produced divided by total length of interaction in minutes. Next, I coded the child's responses to the cues – their attention to the cues as measured by their eye gaze, and their behaviour. Because the number of opportunities for each child to attend or respond to cues varied across the dyads, I calculated a proportion value based on the total number of cues they were presented. I used total rather than per minute frequency scores for this calculation. That is, I calculated the proportion of total cues used as the frequency of total cues used divided by the frequency of total cues produced by the parent.

Gestures

I coded gestures as any movement of the parent's body directing the attention or behaviour of the child. I identified and recorded the frequency of gestures produced by the parent such as pointing at the origami fox, nodding or shaking one's head, holding up and showing the child the origami fox and gesturing actions such as flipping over the paper. The frequency count of the gestures produced by the parent was divided by the number of minutes in the interaction in order to obtain the per minute score. After a parent gestured, I coded whether the child attended to the cue – that is, whether they gazed in the direction of the gesture during or immediately following its presentation. The frequency count of the gestures attended to by the child was divided by the total frequency count of gestures produced by the parent to calculate the proportion of gestures attended to by the child. Then, I coded the child's behavioural response to the cue. The child either "used" the cue or "ignored" the cue. I considered a child as having "used" the cue if they either adjusted their behaviour, acknowledged the cue (e.g., nodded their head), or continued their behaviour appropriately. I defined "ignoring" the cue as the child did not adjust their behaviour or continued their behaviour inappropriately. For example, if a parent gestured to the child to flip over their paper, and the child gazed towards the gesture and flipped over their paper, that would be coded as both attending to and using a cue. The frequency count of the gesture used by the child was divided by the total frequency count of gestures produced by the parent to calculate the proportion of gestures used by the child.

Eye Gaze

I identified and recorded the frequency of times the parent looked towards the child's head, regardless of where the child was looking. Again, the frequency count of gaze cues produced by the parent was divided by the number of minutes in the interaction in order to obtain the per minute score. I also identified and recorded the number of these gaze attempts attended to by the child. I coded that a child attended to a gaze cue when the child met the gaze of their parent or looked in the direction of the parent's head during or immediately following the parent looking at them. The frequency count of gaze cues attended to by the child was divided by the total frequency count of gaze cues produced by the parent to calculate the proportion of gaze cues attended to by the child.

Pausing

Finally, I identified and recorded pausing anytime the parent stopped manipulating their own origami fox and waited for their child. The frequency count of pauses produced by the parent was divided by the number of minutes in the interaction in order to obtain the per minute score. I did not code any child responses to parents' pausing.

2.4.3. Overimitation

I defined children's overimitation as the reproduction of one or more of the causally unnecessary steps presented either by the parent or in the video (in the social and individual learning tasks, respectively). In the social learning task, many parents omitted at least one of the causally unnecessary steps when transmitting the skill to their child. Thus, I coded the presence or absence of whether each of these steps were first produced by the parent and then imitated by the child. Because no parent produced both unnecessary steps for their child to imitate, I coded children whose parents produced at least one unnecessary step as either "ignored" or "imitated" (i.e., scored as either 0 or 1). For the individual learning task, I coded the presence or absence of whether the child imitated each of the two unnecessary steps (i.e., scored as either 0, 1, or 2).

2.4.4. Inter-rater Reliability

Inter-rater reliability was achieved by two independent coders who watched and scored 25% of the videos (n=13) for reliability. They first coded videos together (*n* = 4) for training on the ethogram. Following the training, each coder scored additional videos (*n* = 3) separately and resolved all disagreements through discussion. Finally, they independently coded 25% of the total videos (*n* = 13). The coders achieved a high degree of reliability for all of the variables, with intra-class correlation coefficient values at or above 0.8 (see Table 2.1).

Table 2.1 Intra-Class Correlation Coefficients for Study Variables

Variable	Intra-Class Correlation Coefficients *(95% CI)*
Duration (social learning task)	.99 *(.96 - 1.0)*
Duration (individual learning task)	1.0 *(.99 - 1.0)*
Parents' Codes	
Eye Gaze (frequency per minute)	.96 *(.90 - .99)*
Pausing (frequency per minute)	.93 *(.87 - .99)*
Gestures (frequency per minute)	.88 *(.84 - .89)*
Overimitation in social learning task (frequency)	1.0 *(.99 - 1.0)*
Children's Codes	
Attending to Eye Gaze (proportion)	1.0 *(.99 - 1.0)*
Attending to Gestures (proportion)	.84 *(.8 - .88)*
Using Gestures (proportion)	.88 *(.84-.92)*
Overimitation in social learning task (frequency)	1.0 *(.99 - 1.0)*
Overimitation in individual learning task (frequency)	1.0 *(.99 - 1.0)*

Chapter 3.

Results

3.1. Descriptive Data

I tested 50 parent-child dyads from two groups: those with a child with ASD (*n* = 24) and those with a TD child (*n* = 26). The ASD sample consisted of 16 mother-son pairs, six mother-daughter and two father-son pairs. The TD sample consisted of 14 mother-son pairs, 10 mother-daughter pairs, 1 father-son pair, and 1 father-daughter pair. There was no significant difference in children's age between the ASD (*M* = 9.6 years, *SD* = 1.7 years) and TD (*M* = 9.4 years, *SD* = 1.9 years) groups, as indicated by an independent samples T-test, $t(48) = -.4$, $p = .69$. There was also no significant association between children's reported gender and group (ASD = 18 males, 6 females; TD = 15 males, 11 females), as indicated by a chi-square test of association, $\chi(1) = 1.66$, $p = .2$. A preliminary multivariate analysis of variance indicated that the mode of data collection (i.e., online versus in person) was not significantly related to any key variables ($p > .2$ for all), and thus it was not included in analyses. I also included children's age in years as a covariate in all subsequent analyses and removed it only when found to not be significantly related to the variables of interest.

3.1.1. Questionnaires

Scores on the AQ-Child indicated that parents of children in the ASD group rated their children as possessing significantly more key features of ASD (*M* = 30.25, *SD* = 6.98) than those in the TD group (*M* = 11.35, *SD* = 5.17), as indicated by an independent samples t-test, $t(48) = -10.94$, $p = .00$ (see Table 3.1). Similarly, scores on the MSCS indicated that parents of children with ASD (*M* = 230.5, *SD* = 33.98) rated their children as significantly lower on social competence than TD children's parents (*M* = 303.77, *SD* = 34.39), $t(48) = 7.57$, $p = .00$. Further, parents of children with ASD rated their children as significantly lower on the domain of social motivation than their TD counterparts, $t(48) = 4.86$, $p = .00$ (see Figure 3.1), as well as the subscale of social responsiveness, $t(48) = 6.43$, $p = .00$ (see Figure 3.2). On average, parents of children with ASD rated their children's social motivation as 32.17 (*SD* = 7.35) and social responsiveness as 109.96 (*SD* = 15.45), whereas parents of TD children rated their children's social motivation as 42.23 (*SD* = 7.28) and social responsiveness as 139.62 (*SD* = 17.16). These results indicate that children in the TD and ASD group do indeed differ along the key dimensions of interest: social motivation and ASD symptomology.

Table 3.1 Descriptive Statistics and t-Test Results of Questionnaire Data

Variable	ASD (*n* = 24)		TD (*n* = 26)		T-test results	
	M	***SD***	***M***	***SD***	***t*(48)**	***Cohen's d***
Age (years)	9.6	1.7	9.4	1.9	-.4	.11
AQ-Child ASD features	30.2	6.9	11.3	5.2	-10.9	3.09*
MSCS social competence total score	230.5	33.9	303.7	34.4	7.57	2.14*
MSCS social responsiveness subscale score	109.9	17.2	139.6	15.4	6.43	1.82*
MSCS social motivation domain score	32.2	7.3	42.3	7.3	4.86	1.38*

Note. Independent samples t-test results. *p < .001.

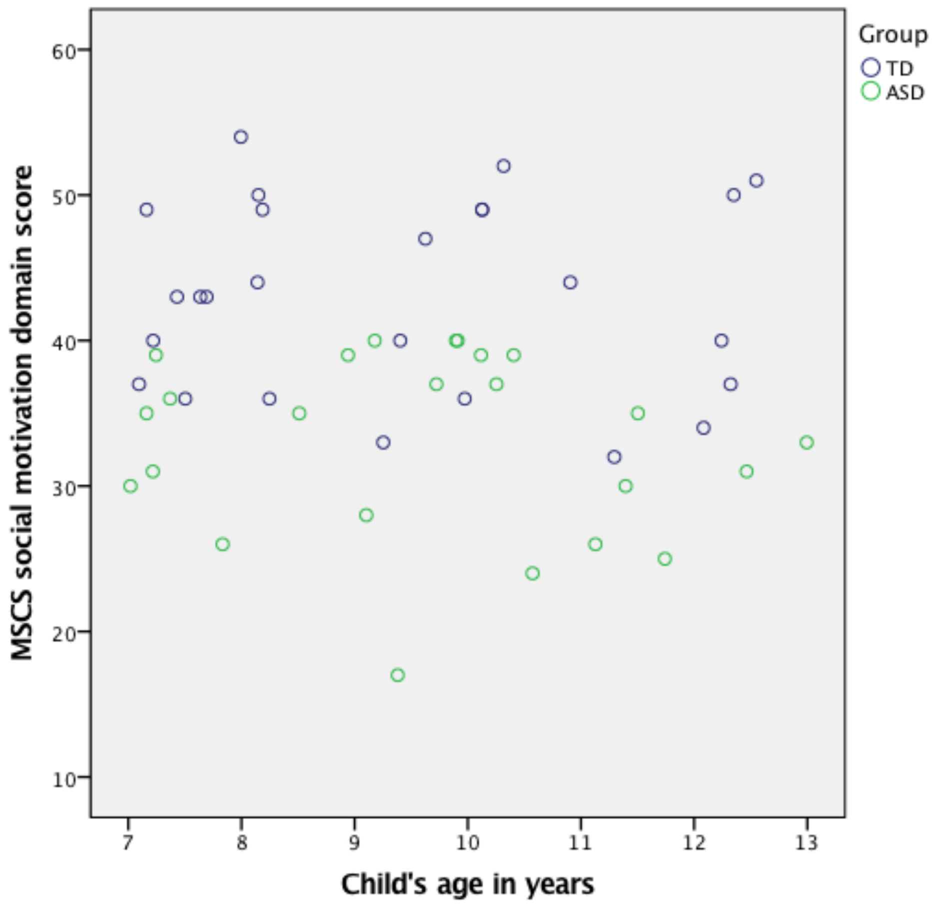

Figure 3.1 Children's Parent-Reported MSCS Social Motivation Domain Scores by Age and Group.

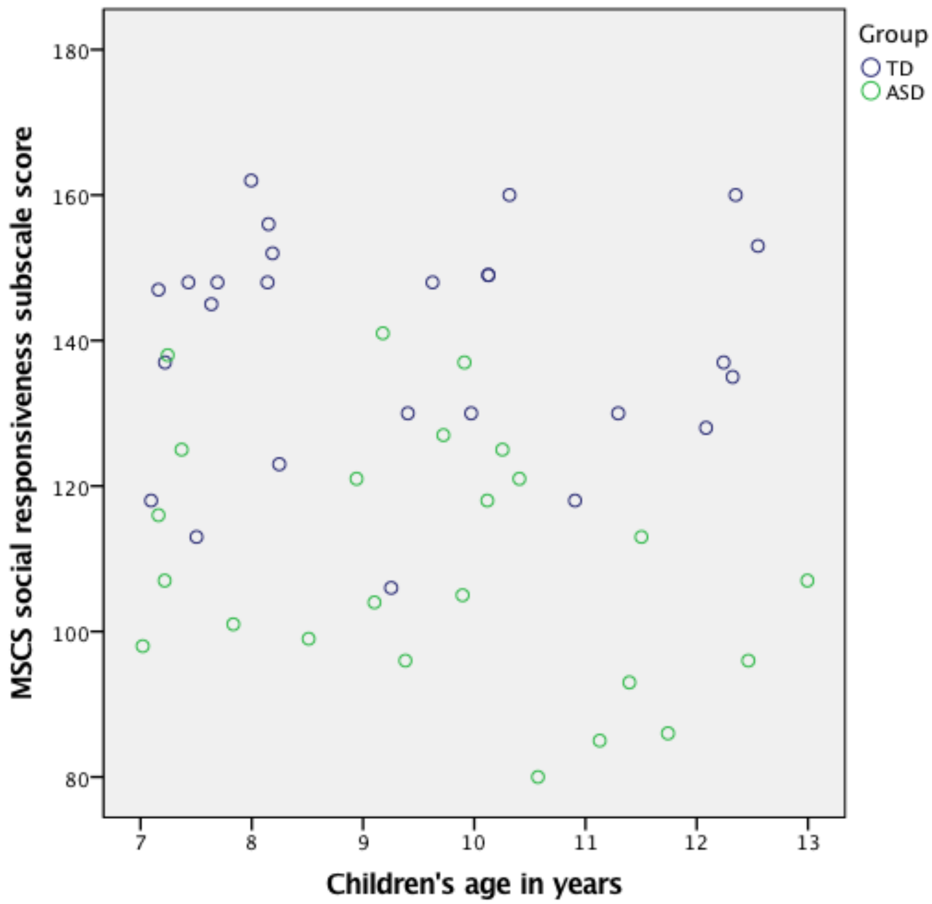

Figure 3.2 Children's Parent-Reported MSCS Social Responsiveness Subscale Scores by Age and Group.

3.1.2. Duration

In the social learning task, children took an average of 165.7 seconds (*SD* = 69.7 seconds, range 54 to 377 seconds) to complete one origami figure. When learning from their parent, children with ASD took significantly longer to complete one origami figure (*M* = 187.8 seconds, *SD* = 75.5 seconds, range = 54 to 377 seconds) than TD children (*M* = 145.3 seconds, *SD* = 58.2 seconds, range = 80 to 334 seconds), as indicated by one-way ANCOVA, $F(1, 49) = 7.04$, $p = .01$, partial $\eta^2 = .13$. Duration was also significantly associated with children's age in years, which was entered as a covariate in the model, $F(1, 49) = 11.14$, $p = .00$, partial $\eta^2 = .5$. I investigated this relationship further using a Pearson product-moment correlation coefficient. Children's age was negatively correlated with their mean duration to complete one origami figure (*r* = -.39, *p* = .00), indicating that younger children took longer to complete the task than older children.

In the individual learning task, children took an average of 152.4 seconds (2.5 minutes, *SD* = 100.9 seconds, range = 65 to 656 seconds) to complete one origami figure. When learning on their own from the video, children with ASD again took significantly longer to complete one origami figure (*M* = 186.6 seconds, *SD* = 131.4 seconds, range = 68 to 656 seconds) than TD children (*M* = 120.9 seconds, *SD* = 43.9 seconds, range = 65 to 282 seconds), as determined by one-way ANOVA, $F(1, 48) = 5.8$, $p = .02$, partial $\eta^2 = .11$. Children's age in years, however, was not significantly associated with duration in the individual learning task (*r* = -.22, *p* = .13).

3.1.3. Communicative Cues

When teaching their children how to make the origami figure, parents of TD and ASD children were comparable in their behavioural cue production (i.e., gestures), as determined by a one-way ANOVA, $F(1,48) = 2.57$, $p = .12$, partial $\eta^2 = .05$. This suggests that children were presented with comparable opportunities to use cues (see Table 3.2). Children were also comparable in their attention to these cues their parents provided (one-way ANOVA, $F(1,44) = 2.91$, $p = .1$, partial $\eta^2 = .06$), suggesting that children were equally aware of the presence of the cues. On average, children with ASD attended to 80% of the cues their parents produced (*SD* = 21%) and TD children attended to 89% of the total cues their parents produced (*SD* = 14%).

Table 3.2 Descriptive Statistics and ANOVA Results of Study Variables

Variable	ASD		TD		ANOVA results	
	M	*SD*	*M*	*SD*	*F*	partial η^2
Duration: Total time to complete one origami figure (seconds)						
Social learning task	187.8	75.5	145.3	58.2	7.04	.13**
Individual learning task	186.6	131.4	120.9	43.9	5.8	.11*
Cues:						
Number of total cues produced by parent (per minute)	5.5)	3.9	3.9	3.2	2.57	.05
Proportion of gesture cues attended to by child	89%	14%	80%	21%	2.91	.06
Proportion of gesture cues used by child	62%	27%	85%	17%	15.6	.26***
Proportion of gaze cues attended to by child	43%	34%	40%	35%	.06	.002
Number of pauses produced by parent (per minute)	1.8	.99	1.8	1.2	.00	.00

Note. ANOVA (analysis of variance) results. *p< .05. **p < .01. ***p < .001.

Children with ASD (n = 22, M = 43%, SD = 34%) and TD children (n = 18, M = 40%, SD = 35%) also completed their parent's eye gaze at a similar rate (i.e., the parent looked towards the child's face and the child subsequently met the gaze), as determined by one-way ANOVA, $F(1,40) = .06$, $p = .8$, partial $\eta^2 = .002$. Finally, parents of TD (M = 1.81, SD = 1.16) and ASD children (M = 1.81, SD = .99) paused and waited for their child at comparable rates, as determined by one-way ANOVA, $F(1,49) = .00$, $p = .99$, partial $\eta^2 = .00$.

To explore any effects of the child's gender on parent behaviour, I conducted a one-way ANOVA with the number of communicative cues presented by the parent as the dependent variable and child's gender as the between-subjects factor. Parents interacting with male children produced significantly more behavioural cues (i.e., gestures) per minute (n = 33, M = 5.78, SD = 2.54) than parents interacting with female children (n = 17, M = 2.54, SD = 2.07), $F(1,49) = 10.69$, $p = .002$, partial $\eta^2 = .18$ (see Figure 3.3). Additionally, parents interacting with male children also paused more often than parents interacting with female children, as indicated by one-way ANOVA (F(1,49)

= 6.37, p = .01, partial η^2 = .12). Parents interacting with a female child paused an average of 1.3 times per minute (*SD* =.23), whereas parents interacting with a male child paused 2.1 times per minute (*SD* =.18). When examined within each group separately, parents produced more behavioural cues and pauses on average when interacting with male children than female children in both the ASD and TD samples (see Table 3.3).

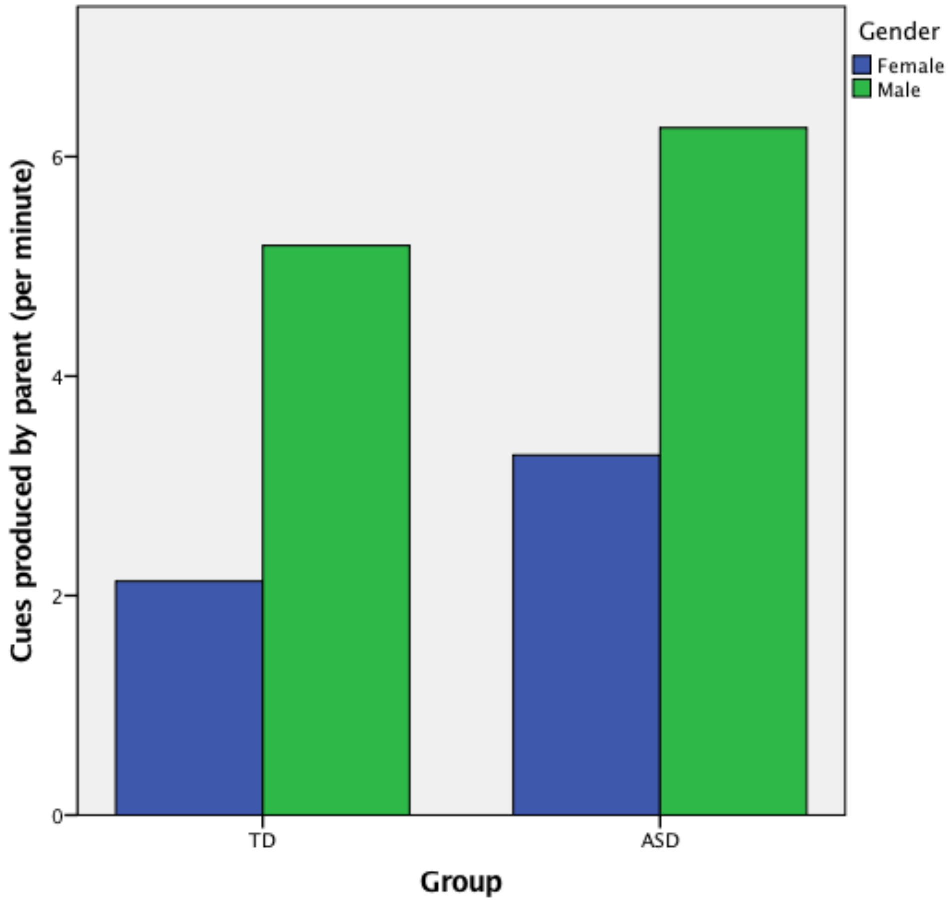

Figure 3.3 Mean Number of Cues Provided by Parents by Children's Group and Gender.

Table 3.3 Mean Number of Cues and Pauses Provided by Parents Per Minute by Children's by Group and Gender.

Variable	Male			Female			ANOVA results	
	n	*M*	*SD*	*n*	*M*	*SD*	*F*	partial η^2
Behavioural cues provided by parent	33	5.7	2.5	17	2.5	2.1	10.69	.18*
ASD	18	6.3	1.0	6	3.3	1.0	-	-
TD	15	5.2	.9	11	2.1	.5	-	-
Pauses provided parent	-	2.1	.2	-	1.3	.2	6.37	.12*
ASD	-	2.1	.2	-	1.1	.3	-	-
TD	-	2.1	.3	-	1.4	.3	-	-

Note. ANOVA (analysis of variance) results. *$p < .01$.

Next, I investigated the rate to which children used the cues their parents provided. I defined cue use as children changing their behaviour following the parent's presentation of a cue (not including eye gaze and pausing). I conducted a one-way ANCOVA with the proportion of cues children used (change of behaviour/cue production) as the dependent variable, group (ASD versus TD) as the between-subjects factor, and children's age in years as a covariate in the model. Despite receiving and attending to similar numbers of cues, TD children adjusted their behaviour following parents' cues significantly more than children with ASD, $F(1,46) = 15.6$, $p = .00$, partial $\eta^2 = .26$. On average, TD children changed their behaviour following 85% (n = 23, SD = 17%) of the cues their parents provided, whereas children with ASD changed their behaviour following 62% of the cues provided by the parent (n = 23, SD = 27%). Additionally, there was a significant effect of children's age on children's use of their parents cues, $F(1,46) = 7.62$, $p = .01$, partial $\eta^2 = .15$, which I investigated further using a Pearson product-moment correlation coefficient. Age was positively correlated with children's use of cues ($r = .3$, $p = .04$), indicating that older children were more likely to change their behaviour following a gesture or behavioural cue from their parent (see Figure 3.4).

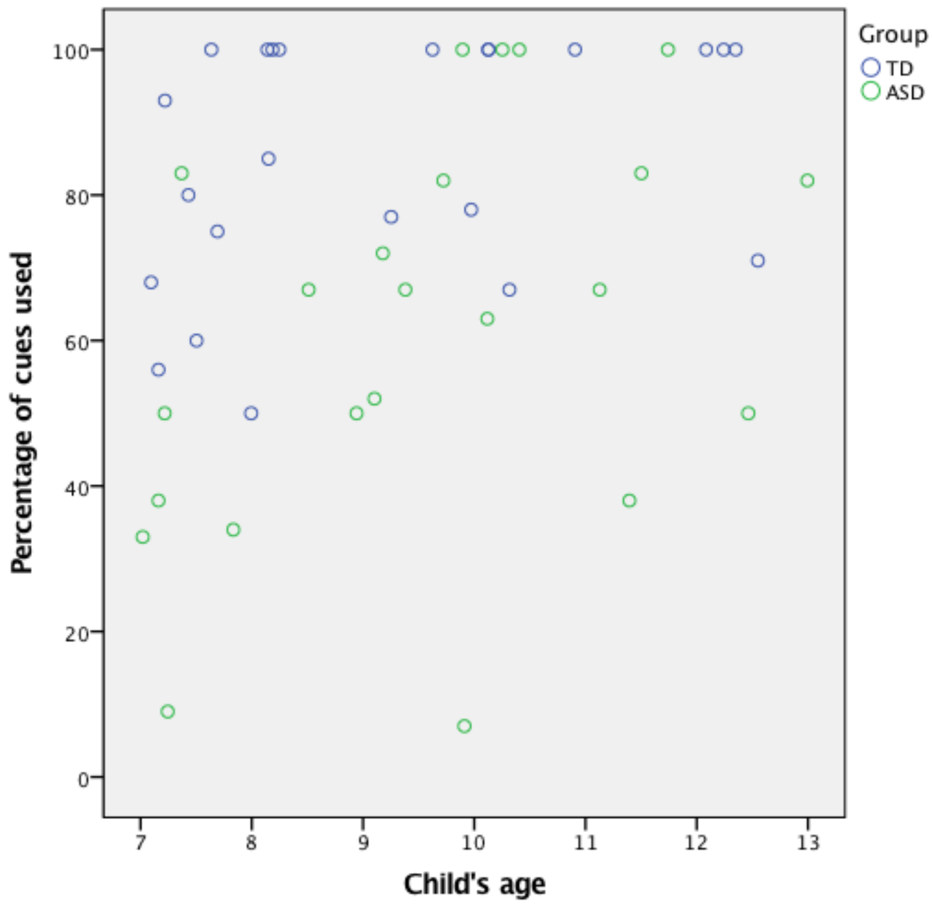

Figure 3.4 Proportion of Cues Used by Child's Age and Group.

3.2. Research Questions

3.2.1. Research Question #1: Efficiency

To determine whether cues provided by the parent in the social learning task increased children's learning efficiency, I first examined the difference between children's duration to make one origami figure between the social learning and individual learning tasks. Children's duration to complete one origami figure did not significantly differ between the social (M = 165.72 seconds, SD = 69.74 seconds) and individual learning tasks (M = 152.42 seconds, SD = 100.95 seconds), as determined by a repeated measures ANOVA ($F(1, 49) = 1.53$, $p = .22$, partial $\eta^2 = .03$), suggesting that children did not learn more efficiently when learning from their parent. To investigate this question further, I then examined children's duration scores within each group individually. Repeated measures ANOVA analyses indicated that children's duration to complete one origami figure significantly differed between the social and individual learning tasks among TD children ($F(1, 25) = 5.69$, $p = .025$, partial $\eta^2 = .186$), but not children with ASD ($F(1, 23) = .004$, $p = .95$, partial $\eta^2 = .00$). TD children took significantly less time to complete one origami figure in the individual (M = 120.88 seconds, SD = 43.94 seconds) rather than the social learning task (M = 145.31 seconds, SD = 58.24 seconds), indicating that their parents' presence and non-verbal instruction did not facilitate their learning.

To further examine whether the presence of ostensive cues, specifically, facilitated more efficient learning, I examined children's use of cues (i.e., propotion of cues used per minute) in relation to their duration scores (i.e., the length of time to complete one origami figure) in the social learning task. I conducted a partial correlation analysis to determine the relationship between children's use of cues and their duration to complete one origami figure in the social learning task, while controlling for children's age in years. There was a negative partial correlation between children's use of cues (M = 73%, SD = 25%) and duration (M = 171.63 seconds, SD = 69.56 seconds), but this partial correlation was marginally significant, $r(43) = -.25$, $p = .10$. On average, children who used fewer cues took longer to complete one origami figure (see Figure 3.5).

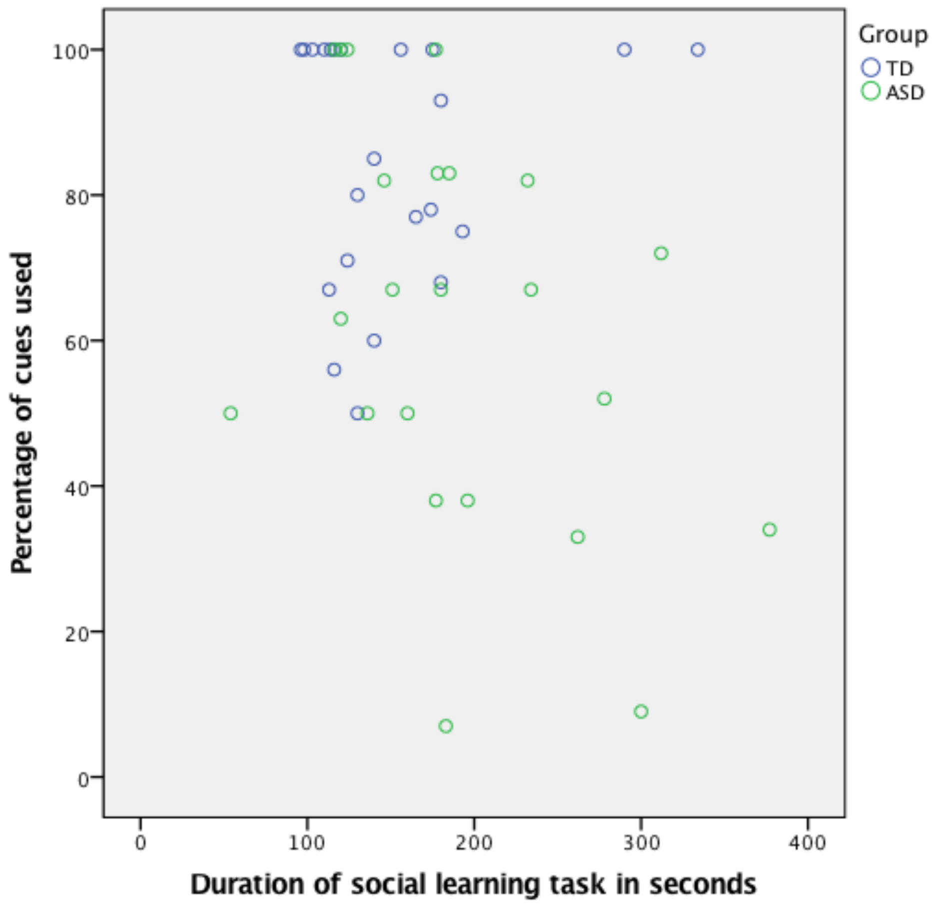

Figure 3.5 Proportion of Cues Used by Duration to Complete Task and Group.

I also analyzed this relationship within each group separately (ASD versus TD) given that children with ASD changed their behaviour following parents' cues less than TD children. There was a negative partial correlation between children's use of cues (*M* = 62%, *SD* = 27%) and duration (*M* = 191.22 seconds, *SD* = 75.26 seconds) only in children with ASD, *r*(20) = -.25, *p* = .26. There was a positive partial correlation between children's use of cues (*M* = 85%, *SD* = 17%) and duration (*M* = 152.04 seconds, *SD* = 58.56 seconds) in TD children, *r*(20) = .28, *p* = .20, but again, neither of these associations were statistically significant.

3.2.2. Research Question #2: Social Motivation

Given that there is variability in social motivation among children both within and between groups (ASD and TD), it is important to analyze children's use of ostensive cues by social motivation as well as group. To determine whether children's tendency to use ostensive cues was related to their desire to be social, I conducted a partial correlation analysis of children's scores on the social motivation domain of the MSCS and their proportion of cues used, while controlling for age. There was a positive partial correlation between children's use of cues (M = 73%, SD = 25%) and their social responsiveness subscale scores on the MSCS (M = 125.95, SD = 21.86), $r(43) = .32$, $p = .03$. On average, children who were rated by their parents as having higher levels of social motivation tended to use a higher proportion of ostensive cues (see Figure 3.6).

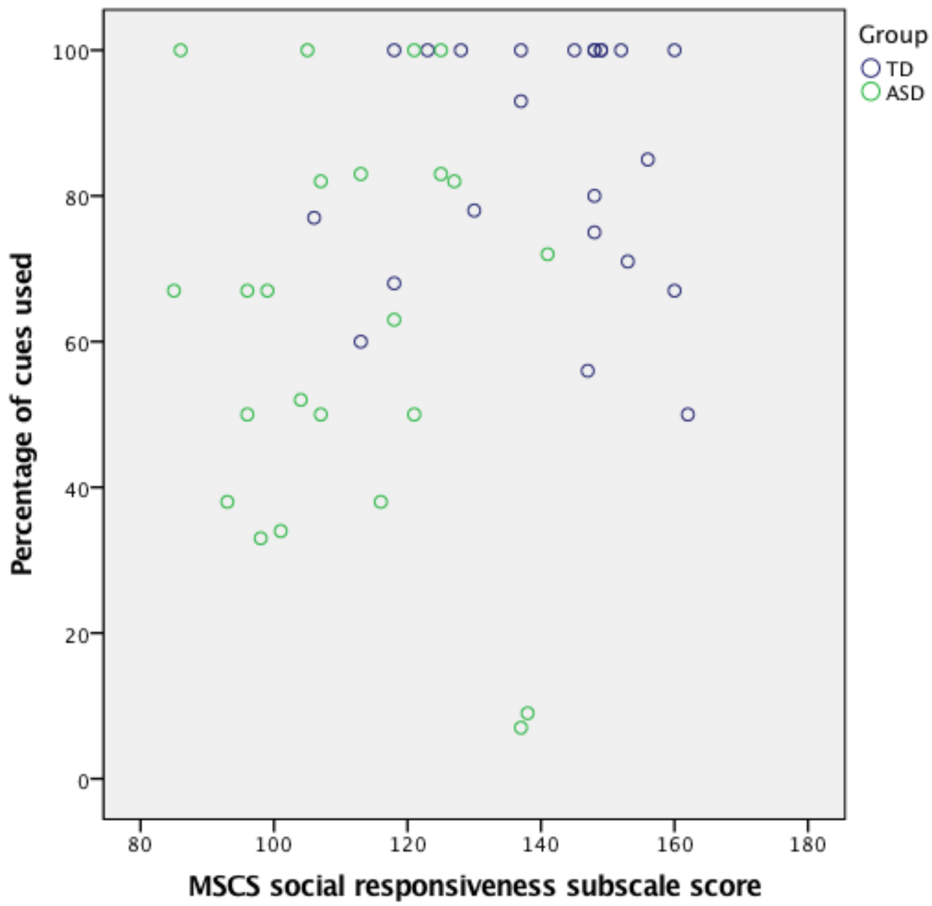

Figure 3.6 Proportion of Cues Used by Social Responsiveness Subscale Score of the MSCS and Group.

3.2.3. Research Question #3: Overimitation

In order to answer the third research question, whether children's overimitation varies depending on their social motivation, I first examined children's performance on the Motor Imitation Scale (MIS) to determine if there where group level differences in children's basic imitative abilities. Every child included in the study imitated all eight actions of the MIS produced by their parents, indicating no differences between groups in basic imitative abilities. Next, I examined children's tendency to imitate causally unnecessary steps demonstrated by their parent in the both the social learning and individual learning tasks. In the social learning task, none of the parents reproduced the unnecessary tapping of the paper, likely because this action was obviously causally unrelated to the outcome. Forty-one parents reproduced the unnecessary fold in the paper, as this action was more causally opaque. All but four children imitated their parents and reproduced the unnecessary fold in the parent. The four children who did not overimitate were all males and on average 9.19 years of age (*SD* = 1.35 years, range 7.37 to 10.32 years). Two of the four children were diagnosed with ASD and two were TD.

In the individual learning task, I examined children's tendency to overimitate either one or both of the two unnecessary steps presented in the video. Forty children imitated the unnecessary fold in the paper (28 males; 21 with ASD; *M* age = 9.54, *SD* = 1.65 years, range 7.09 to 12.46 years; *M* social responsiveness = 125.27, *SD* = 21.89, range 80 to 162) and 13 of those children also imitated the tapping of the paper (8 males; 5 with ASD; *M* age = 9.74, *SD* = 1.81 years, range 7.09 to 12.32 years; *M* social responsiveness = 130.15, *SD* = 24.23, range 85 to 162). All 13 children who imitated the tapping of the paper also imitated the unnecessary fold, and there was no difference in children's overimitation by group (ASD vs. TD), $t(48) = -.23$, $p = .82$.

Finally, I examined children's propensity to imitate the unnecessary steps presented by the parent as well as their scores on the MSCS subscale of social responsiveness. I analyzed this relationship using a Pearson product-moment correlation coefficient and found that children's social responsiveness scores were not correlated with their overimitation ($r = .059$, $p = .72$).

Chapter 4.

Discussion

4.1. General Discussion

Through the current research, I aimed to investigate the role of ostensive communication and social motivation in children's social learning and imitative behaviours. The purpose of this research was to tease apart the influence of children's social competency and motivation from the social learning process. Indeed, I examined three broad research questions related to these concepts: (1) does the use of ostensive cues lead to more efficient learning, (2) does children's social motivation, or their motivation to engage with others, predict their use of ostensive cues, and (3) is children's tendency to imitate unnecessary actions (i.e., overimitation) related to their social motivation?

Overall, results indicated that parents of children with and without ASD produced similar amounts of ostensive cues for their children (including gestures, gazes, and pausing), and children attended to these cues at similar rates. However, children with ASD used these cues to adjust their behaviour accordingly significantly less than their TD counterparts. Whereas TD children used an average of 85% of their parents cues to direct their behaviour, children with ASD only used an average of 62%. This is in line with previous research on social communication and learning in ASD, and supports the theoretical viewpoint that there may be a social underlay to the production and use of ostensive communication that goes beyond learning outcome.

Regarding my first research question, the efficiency of children's learning, children with ASD took longer than their TD counterparts to learn to make a novel origami figure, both from a parent (social learning task) and from a video (individual learning task). In contrast with my predictions, while the average length of time to complete the origami figure was similar across the tasks for children with ASD, TD children were able to complete the origami figure faster when learning from a video (individual learning task) than from their parent (social learning task). Children who used a higher proportion of ostensive cues took slightly less time on average to learn a new skill from their parent, but this finding was not significant. Additionally, when broken down by group, this relationship was only true for parent-child dyads with children with ASD. Typically developing children's learning efficiency did not appear to benefit from the ostensive cues. One possible interpretation of this finding is that given that TD children completed the task faster than children with ASD, the task may have been overall easier for the TD group and therefore they did not require the assistance of ostensive communication – in fact, it slowed them down. These findings call into question the assumption of social learning theories that ostensive cues and similar social learning mechanisms serve to facilitate more efficient learning.

Next, in addressing my second research question, results indicated that children's scores on the social responsiveness subscale of the MSCS were significantly related to their use of ostensive cues. One interpretation of this result is that the use of ostensive cues at least partially rests on a motivation to be social, rather than a motivation to learn. However, it is important to note the context of the current research: although social motivation and the use of ostensive cues were found to be related in the current study, the context was specifically and explicitly teaching and learning. Much of the other research on ostensive communication, particularly in infancy, is conducted in a broader social context, where the overall goal of the interaction is not learning, specifically. Therefore, the current findings further suggest that even in an explicit learning situation, children's use of ostensive appears to be impacted by their social motivation.

Finally, regarding my third research question, results on children's imitation of unnecessary actions (i.e., overimitation) indicated that neither children's parent-reported social motivation nor diagnosis of ASD was related to their rate of overimitation. Theoretically, if overimitation was socially driven, children with higher scores on the measure of social motivation would engage in more overimitation than children with lower scores. Since I did not find this effect, one interpretation is that overimitation in the current task was not socially driven. However, there was limited opportunity for overimitation in the social learning task (i.e., maximum of one unnecessary step) and there was little variation in overimitation of the causally opaque action, which did not allow for adequate analysis of the true range of children's social overimitation. Although I found variability and was able to report differences in overimitation in the individual learning task, it is unlikely that social motivation would be as related to this behaviour given that there is no social partner present. The child imitated the causally unnecessary steps from a video, and thus likely would experience dampened motivation to affiliate or bond with this type of demonstration. Future research into this topic would benefit from an experimenter presenting different casually opaque and causally transparent unnecessary steps to children with and with ASD.

4.2. Limitations

The goal of the current study was to further our understanding of the social motivations potentially underlying the social learning process. I designed this study to provide an ecologically valid representation of a learning context that would elicit ostensive communication between the parent and child. However, this design had several limitations. First, ceiling effects likely occurred due to the age range and accessibility of the current tasks. For example, there were four parent-child dyads in which the parent did not produce any ostensive cues except for pausing. The children in these dyads were all TD and above the age of ten. This likely occurred because the task was too easy for these children and they did not require any additional guidance or instruction from their parent – they were able to keep up with their parent's demonstration (with a few pauses from the parent) and copy their actions step by step. The potential occurrence of ceiling effects also may explain the lack of a relations between children's learning efficiency and their use of ostensive cues. In order to ostensive cues to be beneficial, they must be needed. If the task were more complex in nature, I may have observed a larger benefit of the ostensive cues provided by the parents. However, the current task was designed to be applicable to children of varying ages and abilities. Future research may benefit from a narrower age range to tailor the task complexity more specifically to children's abilities.

These ceiling effects were particularly problematic in the assessment of children's imitative abilities. On the MIS administered prior to the social and individual learning tasks, all children were able to imitate the eight actions demonstrated by their parents, and thus there was no possibility to investigate variability. Interestingly, it's unclear whether the children with ASD would have experienced increased difficulty with a more complex imitation task, or whether the imitation deficits seen in young children with ASD have been remediated by this age (7-12 years). Similarly, I was unable to capture variability in children's overimitate behaviours in a social learning context. This was due to the fact that all parents removed the causally transparent unnecessary step of tapping the paper when teaching their child how to create an origami figure. Future research to address the question of whether children's social motivation is related to their tendency to overimitate would benefit from a more complex, experimenter delivered task where opportunities to overimitate were presented consistently to all children. Then, by using a measure of children's social motivation such as the MSCS, the relations between children's performance and their social motivation scores could be analyzed.

Although the study design had a number of other minor methodological flaws (e.g., small sample size, different locations of data collection, experimenter presence in some but not all participants, ecological validity of not speaking during the social learning task), there were conceptual limitations present as well. The motivation underlying children's behaviour in the social learning context remains unknown. In adjusting their behaviour following ostensive cues provided by their parents, I suggested that children may be motivated by a desire to complete the task correctly and efficiently (i.e., learning) or a desire to interact and affiliate with the teacher (i.e., social). However, a third interpretation of this behaviour may be that children were simply complying with their parents' requests. For example, if a parent gestured to their child to flip over their origami figure and their child ignored the request, this may be seen as an act of noncompliance rather than a disinterest in learning or social affiliation. Given that children with ASD have been shown to be less susceptible to social pressures than their TD peers (Izuma, Matsumoto, Camerer, & Adophs, 2011), this hypothesis warrants further investigation.

4.3. Conclusion

Overall, this study contributes to a growing body of literature investigating the complex social processes driving children's social learning. I investigated the tendency for parent-child dyads to engage in non-verbal forms of social communication (i.e., ostensive cues) and examined whether this facilitated children's learning process and resulted in more efficient learning. Although children with and without ASD were provided with and attended to similar amounts of ostensive cues, children with ASD appeared to use these cues to adjust their behaviour less frequently than their same-age TD peers. Children with ASD took longer overall to learn a novel skill, both when being taught by their parent and when learning on their own from a video. While children with

ASD took a comparable amount of time to learn the skill regardless of whether they were alone or with their parent, TD children learned faster when learning on their own from a video. Finally, children's use of ostensive cues was not related to their learning efficiency, but was related to their parent-reported social responsiveness and motivation as measured by the MSCS. Thus, the role of social motivation and the drive to affiliate or bond with others in the social learning process requires further exploration.

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Appendix A

Questionnaires

Family Demographic Questionnaire

Identification Information

What is your full name?

What is your email address?

What is your current home address?

What is the name of your child participating in this study?

What is your relationship to your child (e.g., mother, father, grandparent)?

What is your child's date of birth?

What is your child's gender?

(Male, Female, Other)

What is the primary language spoken in your household?

What is your child's cultural or ethnic background (e.g., Italian, Metis, Cantonese, English, Canadian)?

Diagnostic Information

Has your child been diagnosed with autism or another developmental disability?

(Yes, No)

If yes, what is your child's primary diagnosis?

Do you receive funding from the Ministry of Children and Family Development?

Has your child ever been given any other diagnoses (e.g., ADHD, anxiety, intellectual disability, learning difficulties)?

(Yes, No)

If yes, please list all other diagnoses:

Does your child participate in any type of therapy or tutoring program?

(Yes, No)

If yes, please describe:

What is your child's highest completed grade?

Is your child placed in a special education classroom?

(Yes, No)

If yes, please describe academic situation:

Does your child receive any extra help at school?

(Yes, No)

If yes, please describe this extra help:

Other Information

How often does your child do origami?

(Never, Rarely, Sometimes, Regularly, Always)

Is there any other information we should know about your child?

Multidimensional Social Competence Scale (MSCS).

Sent by email in PDF format.

Autism Quotient – Child Version (AQ-Child).

Sent by email in PDF format.

Appendix B

Coding Procedure

Motor Imitation Scale

I coded the videos of the parent-administered imitation battery for both parental administration and child imitation of each of the eight actions. I coded actions as either 0 (not attempted), 1 (partially or incorrectly attempted), or 2 (correctly completed). I then assigned each child a score ranging from 0 to 16 based on their completion of the eight imitated actions.

Social Learning Task

In order to quantify children's use of ostensive cues, I coded all of the cues produced by the parent as well as the child's responses to them. I also quantified the efficiency with which children were able to learn the skill through coding the duration of time elapsed while they were learning, from start to finish, as well as the parent's production and child's imitation of the two unnecessary steps. In order to gather all of this information, I coded each social learning task video in three passes: parent behaviour, child behaviour, and overimitation.

Parent behaviour codes. Parent behaviour codes included pausing (e.g., the parent stopped manipulating their own origami figure and waits for the child to catch up), gaze (e.g., the parent gazed towards the child's face), gestures (e.g., the parent produced a point or referencing gesture with any part of their body), and other behaviours intended to direct the attention or behaviour of the child (e.g., the parent held their origami figure in front of the child). These cues were summed to create a frequency count per each category, and then averaged per minute for comparison.

Child behaviour codes. Following the parent's cues, I coded the child's attention and behaviour. First, I recorded whether or not the child attended to the parent's cues by gazing in the direction where the cue was produced (e.g., gazing at the parent's face in response to a gaze or hand in response to a point). Next, I recorded the child's behavioural response to the parent's cues. Specifically, I coded whether or not the child ignored the cue, continued their behaviour appropriately, used the cue to change their behaviour, or acknowledged the cue in another way (e.g., nodding). I used these codes to create a proportion of cues attended to variable for each child, which was calculated as follows: total frequency of cues attended to divided by total frequency of cues produced by the parent. Similarly, the child's use of cues was calculated as follows: sum of child's total frequency of the use of cues codes (e.g., continues, uses, acknowledges) divided by the total frequency of cues produced by the parent.

Overimitation. Lastly, I coded the social learning videos for the parent's production and child's imitation of the unnecessary steps present in the original demonstration video. Each video continued two causally unnecessary steps: a re-fold (e.g., folding the paper, unfolding, then folding again) and a tap (e.g., tapping the paper with one's finger three times). I coded the presence or absence of whether each of these steps were first produced by the parent and then imitated by the child.

Individual Learning Task

Finally, I coded the individual learning task videos for duration of time required for the child to complete one origami figure, as well as their overimitation. Similar to the social learning task, each demonstration video contained two unnecessary steps (e.g., a re-fold and a tap). I coded the presence or absence of whether each of these steps were produced by the child from the video.

Appendix C

Coding Manual

Motor Imitation Scale (MIS)

MIS administered by parent:

Enter 2 if the parent completes the action.

Enter 1 if the parent partially completes the action or changes the action.

Enter 0 if the parent does not attempt to complete the action in anyway and therefore there is nothing for the child to imitate.

MIS imitated by child:

Enter 2 if the child imitates the action produced by the parent within 5 seconds after the parent completes the action. Actions completed by the child prior to the parent completing the action are not coded. If the parent changed the action, and the child accurately imitates the changed action, codes as a 2.

Enter 1 if the child attempts to imitate the parent's action, but does so only partially or inaccurately (see examples), or their response is delayed longer than 5 seconds.

Enter 0 if the child does not attempt to imitate the action or completes a different action.

Enter N/A if the parent did not perform the action and thus the child cannot imitate (i.e., administered by parent = 0).

Social Learning Task

Action	Administered by parent	Imitated by child
Smoothly push car across surface	Flicks car across the table (not holding on) = 1 Makes care "hop" across the table = 1	Picks up car and makes it "hop" across table = 1 Picks up car and plays with it = 0 Throws car across room = 0
Wave hand	Waves two hands at once = 1	Raises hand but does not wave = 1
Make hairbrush "walk"	Pick up hairbrush and throws it = 1	Child picks up the hairbrush and smoothly pushes it along the table = 1
Clap hands twice	Claps hands once = 1 Hits face = 1	Claps hands once = 1 (if parent claps hands twice)
Smoothly push cup across surface		Child picks up the cup and makes it "walk" across the table = 1
Open and close fist		
Make toy "walk"		
Pull earlobe		Pulls parent's earlobe instead of their own = 1

Efficiency:

Behaviour	Operational Definition	Examples
Duration	The duration of time (in seconds) it takes the child to complete the first origami figure. Calculated as follows: Finish time minus total interruptions minus start time = DURATION	
Start time	The time code on the video when the child first touches a piece of origami paper AFTER THE INSTRUCTIONS HAVE BEEN READ. If the child is holding the paper throughout the reading of the instructions, code the time when the parent finishes the instructions.	Child picks up paper, puts in front of themselves, then watches parent. Code the time code on the video when they FIRST touch the paper (regardless of what they do next).
Interruptions	Anything outside of the parent or child's control that interrupts the study. Record the time code when the interruption began and when it finished. The interruption begins the moment when either the parent or child's attention is drawn towards an external stimulus and ends once both the parent and child are attending to the task.	The video camera falls over and the parent stops to go pick it up. Code the beginning as the time when the parent noticed the camera had fallen over (e.g., looked up from task) and the end as when they return to the task.
Finish time	The time code on the video when the child puts down the pen after drawing the face on the origami figure (last step).	Child draws one eye, puts down pen, picks it back up, draws the other eye, and puts the pen down again. Record the time code when they put the pen down a second and final time.

Use of Cues:

Parent Codes: Record the TIME CODE on the video for reference later. Total number of time codes will equal the total frequency.

Behaviour	Operational Definition	Examples
PAUSING	START TIME: The parent stops manipulating their origami figure and gazes towards the child's figure. END TIME: The parent starts manipulating their origami figure again.	
GAZE	The parent gazes towards the child's head, regardless of where the child is looking. Any perceptible shift away from then back towards the child's head is coded as a new gaze contact code.	Parent looks directly towards child's head, then looks at the child's figure, then their face again. Code gaze – checking – gaze.
GESTURES	The parent produces a point, or referencing gesture with any part of their body (i.e., movement of the body intended to direct the child's attention or behaviour).	Parent points, extends their chin while gazing at the child, or produces a hand gesture indicating the child should flip over the paper.
OTHER	ANY other behaviours produced by the parent intended to direct the attention or behaviour of the child. This includes other types of "gesture"-like behaviours that involve the origami figure (e.g., showing).	Parent make sounds to indicate correct or incorrect action. Parent holds figure in front of child (showing).

Child Codes: Record whether or not the child ATTENDS to the cue (gazes in the direction where the cue was produced), as well as the child's response to the cue intended to direct their behaviour.

Child Attends: (Y or N)

Behaviour	Operational Definition	Examples
GAZE	The child looks towards the parent's head while or immediately after (within 1 second or count to 1 Mississippi) the parent looked towards their head.	The child looks up from their own work and looks at parent's head.
GESTURES	The child's gazes towards the parent's hand or body part producing the gesture.	The child looks in the general direction of the parent's hand while the parent produces a gesture (e.g., flipping motion).
OTHER	The child attends to the other behaviour intended to direct their attention or behaviour.	The child looks in the direction of the parent's behaviour.

Child Response: A=ACKNOWLEDGES, U=USES, C=CONTINUES

Behaviour	Operational Definition	Examples
GESTURES	Acknowledge (A): The child provides a communicative cue or gesture (e.g., nod) in response to the parent's gesture (within 1 second). Uses (U): The child adjusts their behaviour to make the correct next step following the gesture (within 1 second). Continues (C): The child continues their behaviour following a POSITVE gesture (i.e., nod, thumbs up).	A: The child nods immediately following a parent's thumbs up or nod gesture. U: The child flips their paper immediately following a gesture from the parent. C: The child continues their behaviour immediately following a thumbs up from the parent.
OTHER	Acknowledge (A): The child provides a communicative cue or gesture (e.g., nod) in response to the parent's behaviour (within 1 second). Uses (U): The child adjusts their behaviour to make the correct next step following the parent's behaviour (within 1 second).	A: The child nods in response to the parent "showing" (e.g., parent holds up their figure in front of the child, child NODS). U: The child stops what they are doing following a sound from the parent indicating they are making a mistake.

Overimitation:

Unnecessary step:	Produced by parent: TIME	Imitated by child: (Y or N)
Half/quarter fold again (flip)		
Tap three times		