

Dyadic Interaction Style and Infant Attention in the
Sticky Mittens Paradigm
Charlotte A. Jeanne
Vanderbilt University

Abstract

Previous research has shown that the “sticky mittens” reaching intervention has a positive effect on reaching and object exploration skills. Further, early reaching and object exploration abilities have been shown to have far-reaching, downstream effects on other developmental domains. Although parents play a crucial role in facilitating the sticky mittens intervention, specific parental scaffolding behaviors and dyadic interaction quality have not yet been explored. The goal of this study was to explore the phenomenon of “motionese,” or infant-directed motions, which are exaggerated object-directed motions used by parents that tend to capture infant attention. The results show that some parents time their infant-directed motions more sensitively to their infant’s attentional state than others, leading to more synchronous dyadic interaction between parent and infant. Results provide evidence for three different dyadic interaction styles present at as early as 2.5-3.5 months: symmetrical, asymmetrical, and disruptive.

Introduction

Parents eagerly anticipate their children's motor milestones. With the mastery of new motor skills, such as reaching, crawling, and walking, infants are able engage in new behaviors as they navigate and manipulate the world around them. The mastery of new motor skills provides an infant with new opportunities to engage with people and objects. As a result, development in the motor domain has been shown to subsequently affect development in other domains (Iverson & Goldin-Meadow, 2005; Libertus & Needham, 2011; Libertus & Violi, 2016; Masten & Cicchetti, 2010; Sommerville, Woodward, & Needham, 2005). The phenomenon of "developmental cascades" is defined by Masten & Cicchetti (2010) as the "spreading effects across levels, among domains in the same level, and across different systems" of development (p. 491). For example, independent sitting behavior at 3 months old has been shown to be a predictor of receptive vocabulary at 10-14 months old (Libertus & Violi, 2016). Similarly, infants who are walking have more developed receptive and productive language skills compared to infants of the same age who are still crawling (Walle & Campos, 2014). Experience with reaching and grasping has been associated with other social and emotional skills, such as the ability to interpret others' actions (Libertus & Needham, 2010; Sommerville et al., 2005). These inter-domain effects are not only observed during early childhood. For example, reaching and object exploration skills at 5 months is related to greater academic achievement at 14 years old (Bornstein, Hahn, & Suwalsky, 2013).

Because the emergence of new motor skills can initiate developmental cascades, providing infants with early experience to practice motor skills could have positive downstream effects in the motor domain and across other developmental domains. Reaching is unique because it is the first opportunity for infants to independently obtain and act on objects

around them. Before this transition, infants can only passively observe the world, and wait for objects to be placed into their hands. Once infants can reach and grasp, they are able to actively manipulate their surroundings and share objects with others (Bushnell & Boudreau, 1993; Libertus & Needham, 2010; Libertus & Needham, 2011; Libertus & Violi, 2016).

Understanding causal links during development

One concept underlying developmental cascades is that there are subtle causal linkages among earlier- and later-emerging skills. Identifying these causal connections can be challenging, but experimentally manipulating the reaching experiences infants receive can allow us to determine which developments are causally linked to the beginnings of reaching experience and which are not.

Although reaching usually emerges when infants are around 4 to 5 months old, Needham et al. (2002) offers evidence that providing younger infants with learning opportunities can lead to earlier reaching. To give pre-reaching (3-month-old) infants input from their environment that they otherwise would not experience, Needham et al. (2002) developed the “sticky mittens” training paradigm. This paradigm involves infants wearing specially designed mittens with patches of Velcro on the palms to be used with toys covered with the corresponding side of the Velcro. When infants’ spontaneous arm movements put the sticky mittens in contact with the toys, the Velcro mittens stick to the toys. This gives the infants a simulated sensation of grasping and manipulating an object, because they can see and feel the attached object move along with their hands (Needham et al., 2002, p. 282). These mittens provide a unique early learning experience because they allow infants who are not yet reaching, but who are beginning to sit up and become interested in toys, to experience interacting with objects (Needham et al., 2002, p.

282). After two weeks of daily practice sessions with the mittens, infants' object-directed behaviors were assessed. Infants who had the experience of playing with the sticky mittens showed greater object engagement and exploration than those who participated in a passive, control experience (Needham et al., 2002, p. 290). This is evidence that exposure to opportunities to engage with objects even before 4 to 5 months can produce advances in a variety of perceptual-motor skills.

The sticky mittens training paradigm has been associated with several changes in infant behavior, including earlier reaching and improved object exploration abilities (Libertus & Needham, 2015; Needham et al., 2002; Wiesen, Watkins, & Needham, 2016), as well as increased preference for faces (Libertus & Needham, 2011). The training paradigm is also associated with early social skills; infants who have had experience with the paradigm demonstrate an understanding of others' goals and actions (Libertus & Needham, 2011; Sommerville, Woodward, & Needham, 2005).

Caregivers are essential to the success of this paradigm. They are responsible for facilitating the training sessions engaging their infants with the toys. The paradigm can therefore be seen as not only an early motor experience, but as an early social experience. For example, caregivers are instructed to "encourage" their children to swipe at the Velcro toys through behaviors like pointing at, tapping, or demonstrating the "stickiness" of the toy (Libertus, Joh, & Needham, 2015; Libertus & Needham, 2010; Needham et al., 2002). These behaviors that are used to encourage and shape the infant's reaching behavior can be characterized as "scaffolding" strategies. While it is established that these "scaffolded reaching experiences using 'sticky mittens' encourage successful reaching" (Libertus & Needham, 2010, p. 2753), the specific nature of caregivers' behaviors when using the paradigm have yet to be studied.

Scaffolding and the Caregiver-Infant Interaction

One frequently studied scaffolding behavior shared between adults and their infants is early joint attention. Caregivers and their infants demonstrate the phenomenon of *visual co-orientation* (the tendency for both individuals to attend to the same object at the same time) during free play (Collins & Schaffer, 1975, p. 319). Visual co-orientation has been shown to occur most frequently when mothers follow the gaze of their infants (Collins & Schaffer, 1975). This finding provides evidence that parents adjust their behavior in response to seemingly insignificant and spontaneous infant behavior (Collins & Schaffer, 1975, p. 319). Early joint attention and visual co-orientation between caregiver are also related to the manipulation of objects. Infants and their caregivers are both most likely to attend to the actions the other person makes on a toy during play, rather than to the other person's face or other stimuli in their surroundings (Deák, Krasno, Triesch, Lewis, & Sepeta, 2014; Yu & Smith, 2017). This looking preference suggests that infants are naturally interested in object manipulation before they are able to reach and explore objects independently.

Studies of dyadic interactions show that adults communicate information about the physical world through their actions on objects (Baldwin et al., 2002). These infant-directed motions, (or “motionese”) occur when caregivers “amplify or exaggerate meaning and structure within their bodily motions” (Baldwin et al., 2002, p. 72). Not only do infants prefer these actions to adult-directed actions (Brand & Shallcross, 2008), motion specifically directed towards infants has been linked with greater attention and object exploration (Deák, Krasno, Jasso, & Triesch, 2018). It has been demonstrated that mothers engage in specific infant-directed motions such as holding out, shaking or activating (if motorized), or pointing at and commenting about the toy (Pêcheux, Findji, & Ruel, 1992, p. 211), and that these behaviors have been linked

to greater attention capacity later in infancy (Bono & Stifter, 2003; Pêcheux et al., 1992).

Caregivers adjust their physical behavior when engaging with their infants, and these behavioral adjustments have consequences on infant development. Further, synchronous dyadic interaction patterns have been associated with shared positive affect (Lindsey & Caldera, 2014) as well as the development of secure attachment (Isabella, Belsky, & von Eye, 1989; Isabella & Belsky, 1991).

Present Study

In the present study, we observe and characterize parent scaffolding behavior using video recordings of parent-infant dyads engaging in the “sticky mittens” paradigm. Each parent-infant dyad that participated in a previous study which used the “sticky mittens” paradigm was filmed for coding purposes. While coding for a variety of infant behaviors of interest, we noticed variability in how parents interacted with their infants while facilitating their infant’s engagement with the “sticky mittens” and toys. The amount of interaction and the type of interaction seemed to vary considerably. Some parents hardly interacted with their infants during the training sessions, while other parents frequently interacted with their infants. Additionally, not all parents interacted using the same behaviors. Some common behaviors which appeared to be bids for infant attention were observed. For example, parents tapped the toys on the table, shook or slid the toys around, held the toys up to the infant’s eyes, and pointed to the toy. Each parent used a different behavior, or set of behaviors in combination, to engage the infant in the task. This interplay between infant and parent behavior during the “sticky mittens” paradigm has yet to be explored.

It is possible that parents will engage in greater infant-directed motions as bids for their infant's attention if their infants demonstrate minimal attention to and engagement with the mittens and toys. Parents whose infants are particularly attentive and proficient at swatting, however, may use fewer infant-directed motions because their infant is engaging in the target behavior. It is also a possibility that parents may redirect their infant's attention too frequently, and therefore inhibit their ability to concentrate on and swat for toys independently. High levels of infant attention-redirecting behaviors, when compared to attention-maintaining behaviors, have been associated with lower infant focused attention at 18 months old (Bono & Stifter, 2003). This result is interpreted to mean that frequent attention redirection is more cognitively demanding, and actually limits infants' opportunities to develop their attentional skills independently (Bono & Stifter, 2003, p. 245).

The present study will explore the relationship between caregiver scaffolding behavior (in the form of infant-directed motions, specifically) and infant engagement level with the "sticky mittens" paradigm. The first hypothesis is that parents will demonstrate sensitivity to their infant's engagement level; infant engagement will be related to the amount and frequency parents' infant-directed motions. Additionally, we hypothesize that both infant engagement level and parents' infant-directed behaviors are related to reaching proficiency after two weeks of at home "sticky mittens" training.

Method

Participants

Participants were 21, pre-reaching infants (12 female) and their parents/caregivers. They ranged in age from 2.5 months to 3.5 months at the time of their first visit. All participants were

healthy and were born full-term. No parents reported any known delays or disabilities. Twelve additional infants participated, but their data were excluded; five because they were too fussy during their lab visit, five because they did not return for the second visit, one because of parental interference with the trial, and one because the parents did not complete the at-home portion of the study.

We obtained the names of the infants from birth records from the state of Tennessee. Parents were contacted by email, phone, or by mail and invited to participate with their infants.

Pre-Training Laboratory Session

Participants came in for the first of two laboratory sessions. Each infant sat on his or her caregiver's lap at a table, positioned so that the infant's arms and hands were resting comfortably on the tabletop. The experimenter sat on the opposite side of the table from the infant. Infants could see the experimenter during the trial. Infants wore "sticky mittens" – special mittens covered in the "soft" side of the Velcro that would therefore stick to small toys covered "prickly" side of the Velcro. The infants participated in "mittens training" led by the experimenter, which involved the showing the infant how the toys stick to the mittens. This mittens training session lasted about 7 minutes ($M = 7.01$, $SD = 1.87$). Experimenters verbally explained how to facilitate the "mittens" paradigm to the parents while facilitating the training. The experimenter presented the infant with several toys, one by one. Each toy was within reach for the infant for approximately one minute. Infant engagement was coded following Libertus, Joh, & Needham (2015) and Libertus & Needham (2010); engagement was coded as either on-task (looking down at their mittens or at the toys on the table) or off-task (distracted or ambiguous looking). After

the training, the caregivers took home a pair of sticky mittens, 10 corresponding Velcro toys, and a training log.

Mittens Training Sessions between Visits

Parents were instructed to facilitate play with the “sticky mittens” and corresponding toys for 10 minutes each day (or until infant fussed or was no longer interested) for 2 weeks. They were told to have the infants seated upright with their arms resting on a tabletop. They could either have the infant seated on their lap or in a high chair. Another person (spouse, sibling, etc.) could help present the toys from across the table. Parents were told they could tap a toy on the table or briefly stick a toy to one of the mittens if the infant was not engaging with or attending to the toys independently.

Post-Training Laboratory Session

Participants returned to the laboratory for a second visit after two weeks of at-home training. The experimenter instructed the caregiver to demonstrate for approximately 5 minutes ($M = 5.38$, $SD = 1.82$) how he/she had been facilitating mittens training at home. These interactions were filmed and coded. The frequency and duration of infant-directed motions were coded. The specific infant-directed behaviors were: pointing at the toy, tapping the toy on the table, shaking the toy, holding the toy up to the infant’s eyes, silently waving the toy through the air, or moving/sliding the toy on the tabletop. On- and off-task looking were also coded for this visit. The experimenter collected the training log from the caregiver to assure all home training sessions were completed.

Behavioral Coding

Using a behavioral coding software, Datavyu (Datavyu Team, 2014), trained coders watched the videos and coded for the onset and offset times of the behaviors of interest. They entered the onset and offset time into the program, so that duration and frequency of the behaviors were recorded. The behavioral measures for the infants were touching/manipulation of the toys and engagement with the task (on- or off-task looking). The behavioral measures for the parents were their infant-directed behaviors: pointing at, tapping/waving/sliding the toy, or holding the toy up close in the infant's visual field. A random one-third of each video was coded by a second trained coder to assure reliability.

Behavioral Measures

Infant Engagement.

Coders used Datavyu (Datavyu Team, 2014) to record the onset and offset of each on-task gaze at Visit 1. The total amount of on-task looking time was then calculated. A two-way mixed effects intraclass correlation (ICC) with a model of absolute agreement was used to assess reliability between coders for a random third of each video. The two coders' judgements were highly correlated for on-task looking duration ($ICC = .986$, 95% CI [.965-.994]). A final engagement score was calculated by finding the proportion of available time spent visually on-task.

Parent Attentional Bids.

Coders watched videos of parents facilitating the sticky mittens training at Visit 2. They recorded the onset and offset of each bid for attention, in the form of an infant-directed motion, and noted the motion type (tapping, pointing, etc.). The total number of infant-directed motions

was then calculated for each parent. The two coders' judgements for total number of infant-directed motions were highly correlated for a random one-third of each video ($ICC = .997$, 95% CI [.993-.999]).

Infant Directed Motions.

For each infant-directed motion, coders categorized the type of motion, the infant's visual engagement state immediately preceding the motion, and whether or not the motion was successful at eliciting infant attention. Success was defined by infant attention to the task within 2 seconds of the motion. Types of infant-directed motions, expanding upon Pêcheux et al. (1992), included: waving the toy in the air (noiseless), holding the toy up to the infant's eye level, tapping the toy on the table, shaking or sliding the toy so that it makes noise, and pointing at the toy. A motion categorized as "other" is a motion which appears to be the combination of two or more infant-directed motions, or is an exaggerated motion which does not fit into any other category. A Cohen's kappa was used to assess reliability for these categorical ratings and an almost perfect level of agreement was found for motion types ($\kappa = .93$), visual engagement preceding the motion ($\kappa = .867$), and the success of each motion ($\kappa = .822$).

Results

Relationship Between Infant Attention and Parent Scaffolding

A Pearson correlation between infant engagement level at Visit 1 and number of infant-directed behaviors used at Visit 2 was obtained. The correlation obtained was nonsignificant ($r = -.211$, $p = .358$). The relationship between infant engagement level and number of infant-directed behaviors is plotted in Figure 1.

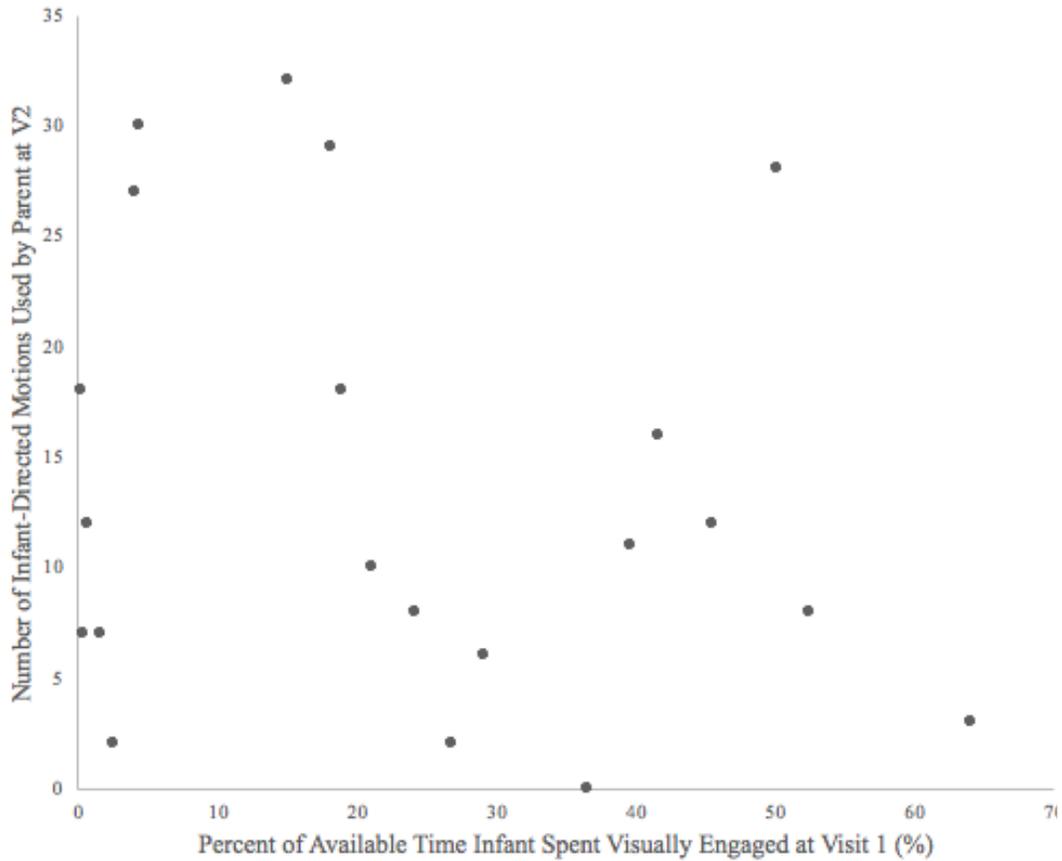


Figure 1. Infant engagement at Visit 1 and number of infant-directed motions at Visit 2.

Qualitative Measures for Infant-Directed Motions

In order to further explore the relationship between infant engagement (in the form of visual attention) and parents' subsequent scaffolding behavior, coders used qualitative measures to characterize the nature of each infant-directed motion. The frequency of each type of motion, across all dyads, is presented in Table 1.

Table 1. Frequency of each type of infant-directed motions across all participants.

Motion	N	%
Waving toy	7	2.41
Holding up toy	52	18.0
Tapping toy	179	61.7
Shaking or sliding toy	24	8.28
Pointing to toy	3	1.03
Other	23	8.28

Parent motions were categorized as “redirecting” motions if the parent engaged in that motion while their infant was distracted. Most (86%) of infant-directed motions happened while the infant was distracted, presumably in an attempt to redirect them back to the task. Finally, infant-directed motions were categorized as “successful” if the infant responded by attending to the target toy or object. Most (57%) infant-directed motions were successful at encouraging on-task looking.

Characterizing Parent-Infant Dyads

Based on these qualitative measures, dyadic interaction patterns observed in this study were classified following the dyadic communication patterns observed in Hsu & Fogel (2001). The dyadic interaction patterns observed in this study are defined in Table 2.

Table 2. *Definitions and examples of dyadic interaction patterns.*

<i>Interaction Pattern</i>	<i>Definitions and Examples</i>	<i>Number of Dyads Observed</i>
Symmetrical	Symmetrical dyads are characterized by synchrony. Parent and infant work together in a balanced way to maintain the infant's focus on the task. Parent attempts to draw infant's attention to the toy only when the infant is not already looking at it. When parent does attempt to draw the infant's attention to the task, the infant is responsive to these bids. The parent's involvement seems to increase the infant's engagement in the task. For example, a parent notices the infant is distracted and shakes the toy to draw the infant back to the task. The infant responds by attending to the toy.	11
Asynchronous Patterns		
Asymmetrical	Both parent and infant are attending to the sticky mittens task, but one partner is engaging with the toys while the other partner passively observed. An example is when a parent watches his or her infant swat at the toys, but never manipulates the toys him or herself.	6
Disruptive	The parent may attempt to direct the infant's attention more than seems necessary. The parent may make frequent bids for the infant's attention even if the infant is already visually engaged. The infant may respond to the parent's involvement, or, involvement may decrease the infant's engagement in the task. For example, a mother begins tapping the toy even though the infant was already looking at it or swatting for it.	4

Coders categorized each dyad according to these descriptions. A Cohen's kappa was obtained to assess reliability between categorical ratings. There was almost perfect agreement ($\kappa = .922$) in ratings between observers. The following were then calculated for each group of

dyads: average number of infant-directed motions used, average number of different motion types used, average number of motions which were sensitively timed (occurred when infant was not already independently engaging with the task), and average number of motions which were successful at eliciting infant attention. These descriptive statistics are shown in Table 3.

Table 3. *Infant-directed motion use across dyadic interaction group.*

	<u>Symmetrical</u>		<u>Asymmetrical</u>		<u>Disruptive</u>	
	M	SD	M	SD	M	SD
Number of Motions	13	9.46	6.83	7.00	26	7.44
Number of Different Motion Types	2.91	1.59	2	1.41	3.5	0.58
Number of Sensitively Timed Motions	10.82	8.30	6.83	7.00	22	4.70
Number of Successful Motions	9.73	8.43	1.5	1.52	12.5	3.70

Rate of success, represented as a percentage, in eliciting infant attention through infant-directed motions was calculated for each group. Several independent-sample t-tests were done in order to compare the rate of success in captivating infant attention across groups. One parent in the asymmetrical group did not use any infant-directed motions, so this dyad was not included in the analysis of success rate. The mean success rate for the symmetrical group ($M = 69.79$, $SD = 28.24$; $N = 11$) did not significantly differ from the success rate of the disruptive group ($M = 48.78$, $SD = 7.96$; $N = 4$), $t(13) = 1.44$, $p = .059$. The mean success rate asymmetrical group, however, ($M = 46.11$, $SD = 49.83$; $N = 5$) was significantly lower than both the symmetrical ($M = 69.79$, $SD = 28.24$; $N = 11$), $t(14) = 1.23$, $p = .021$, and disruptive ($M = 48.78$, $SD = 7.96$, $N = 4$), $t(13) = -.105$, $p = .001$.)

As is commonly done with secure versus insecure patterns of attachment (Isabella et al. 1989; Isabella & Belsky, 1991, Lindsey & Caldera, 2015), the average success rate for the

synchronous, symmetrical group was compared to the average rate for both asynchronous groups (asymmetrical and disruptive), combined. No significant difference was found in success rate for attentional bids between the synchronous ($M = 69.79$, $SD = 28.24$, $N = 11$) and the asynchronous groups ($M = 47.30$, $SD = 35.60$, $N = 9$), $t(18) = 1.58$, $p = .268$.

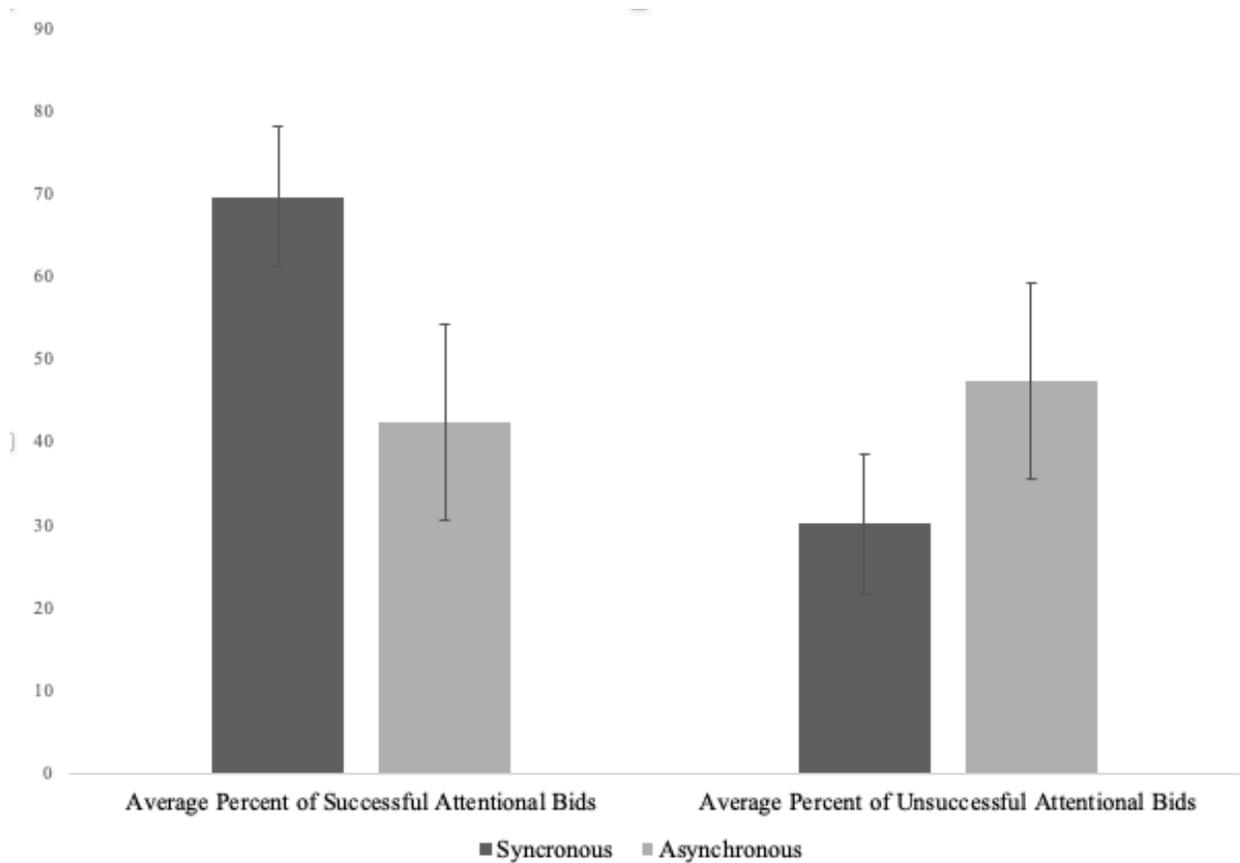


Figure 2. Success Rate for Infant-Directed Motions for Synchronous and Asynchronous Dyads

Discussion

The purpose of this study was to explore parental scaffolding behavior, in the form of infant-directed motions, during the sticky mittens paradigm. The sticky mittens paradigm served as a useful context to explore scaffolding because each parent worked to shape their infant's

behavior towards the same goal of swatting for the toys. The present study also explored the relationship between infant attention and the amount and type of scaffolding behaviors used by parents.

Infant-Directed Motions

The types of infant-directed motions observed were consistent with those observed by Pêcheux et al. (1992). Parents in the present study, however, most frequently tapped the toy on the table in order to captivate their infant's attention, whereas tapping was not one of the motions identified by Pêcheux et al. (1992). The prevalence of this tapping behavior can be explained by the instructions given to parents. The instructions which accompanied a training log stated that if the infant seemed distracted from or uninterested in the task, the parent could try tapping the target toy on the table in order to draw the infant back into the training.

Most infant-directed motions successfully elicited infant attention to the target toy. This finding is consistent with the those of Deák et al. (2014; 2018) which found that early joint attention most frequently occurred when one of the partners manipulated a toy. Additionally, according to Yu & Smith (2017), hand motions and object manipulations are particularly salient stimuli to young infants who are beginning to be able to act on the physical world. Because the participants were at an age when infants typically begin to be interested in (and are about to begin reaching for) toys, infant-directed motions overall were likely captivating stimuli. These findings are further evidence that infant-directed motions, across all dyadic interaction styles, are generally salient stimuli for infants of this age.

Dyadic Interaction Patterns

We hypothesized that parents would demonstrate overall sensitivity to their infant's engagement level with the task, so that parents of less visually engaged infants would attempt more infant-directed motions in order to refocus their children. Results indicate that there is no significant linear relationship between infant attention and parental scaffolding in the form of infant-directed motions. It was expected that parents would be sensitive to their infant's engagement level with the mittens training and respond accordingly; parents of highly engaged infants would exhibit fewer scaffolding behaviors than parents of minimally engaged infants. Surprisingly, parents of infants who had lower visual engagement with the task at Visit 1 did not consistently make more attentional bids than parents of infants with higher visual engagement at Visit 1.

The results suggest a more nuanced relationship between infant and parent behavior than was hypothesized, even at as early as 3 months. While some parents assumed an active, leading role during dyadic play, others simply passively observed their infant's behavior and allowed them to engage in the activity independently. Some parents also only made bids for the infant's attention when the infant was distracted, while others frequently made attentional bids even when their infant was already engaged.

These interaction patterns led us to three categories of dyadic interaction style, using Hsu & Fogel (2001) as a model: symmetrical, asymmetrical, and disruptive. Dyads which follow a symmetrical pattern are characterized by synchrony and similar engagement levels from both partners. Dyads which are asynchronous in their object-directed play can be either asymmetrical or disruptive. Asymmetrical dyads involve one partner who engages while the other partner takes a passive role. Dyads which follow a disruptive pattern are characterized by frequent interference

from the parent, which may have the effect of inhibiting infants from developing skills on their own.

To our surprise, there were no significant differences in success rate of infant-directed motions in eliciting attention between the symmetrical group and the disruptive group. Parents in the disruptive group used twice as many motions, on average, than parents in the symmetrical group. It is possible that because bids for attention in the disruptive group were so frequent, infants attended to approximately half of their parents' bids by chance. Infants with parents who are generally disruptive may have also learned to "tune out" excessive interference. Parents in the asymmetrical group were significantly less successful at eliciting the infant's attention than both other groups. This can be explained by the unequal participation of each partner. With one partner passively observing the other, the training sessions lack the reciprocity that may be crucial in effectively drawing the infant into the task.

We expected that parents in synchronous dyads would have more successful attentional bids. Surprisingly, no statistically significant difference in success rate for parent motions was found between the synchronous and asynchronous dyads. We believe this can be explained by a very small sample size but great individual differences in infant engagement level. Some of the infants in the disruptive group may have been highly interested in the task independently, to the point where a disruptive parent did not affect their desire and ability to engage. Additionally, the asymmetrical group included any dyad that was unbalanced in participation from one of the partners. Therefore, some asymmetrical dyads had disengaged parents while others had disengaged infants. Further research should explore differences between these subgroups.

Based on the findings of Bono & Stifter (2003), it seems likely that synchronous, symmetrical interaction would provide the most support for the development of more advanced

reaching and attentional skills. Disruptive or asymmetrical interaction, however, would likely interfere with an infant's opportunities to develop independent attentional abilities. Interaction style likely does not only have immediate consequences on infant learning during a given task, but longer-term impact on the parent-child relationship. Isabella et al. (1989) and Isabella & Belsky (1991) provide evidence that synchronous interaction is a precursor for secure attachment between dyadic partners. Longitudinal research with longer periods of observation is needed to answer the question of what effect interaction style has on infant learning and attachment quality.

Another limitation, in addition to the short observation periods, is that parents may have behaved differently during the laboratory mittens training sessions than they did during the at-home portion of the study. As a result, videos of dyadic interaction may not fully capture what is typical for that dyad. An experimenter was in the room while parents demonstrated how they played with the mittens and toys at home, which could have added pressure to perform a certain way in front of someone they perceived to be an expert. In the laboratory setting, parents facilitated the sticky mittens training with their infants on their laps. This setup could have made it difficult for parents to assess their infant's attentional state because it was challenging to follow their infant's gazes. We observed many parents adapt to this challenge by adjusting their position so they could more easily see where their infants were looking, but future research should include observations of a more naturalistic setting, with more face-to-face interaction to better categorize dyadic interaction.

These findings demonstrate that dyadic interaction can be characterized from the observation of each partner's object-directed behavior in addition to vocalizations. These characterizations, which are based on parental object manipulation, could provide a simple framework for assessing dyadic interaction quality and joint attention, particularly in children who are not yet

verbal. Furthermore, the classification of dyadic interaction during the sticky mittens paradigm may provide meaningful background for the development of interventions. Interventions which focus on object-oriented dyadic interaction could help infants become more proficient at reaching and other motor skills, which could have positive downstream consequences in other domains.

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