The Development of Object-Extension Gestures:
An Action-Based Approach

by

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Abstract

Around their first birthdays, typically developing infants begin to use various object-extension gestures. However, the processes through which they develop are not well understood. In this thesis, I contrast two metatheoretical approaches to explaining gesture development. I review and offer a critique of cognitivist approaches and argue for an action-based approach, according to which intentional gestures develop within enjoyable shared routines. Based on this approach, I describe and trace the development of object-extension gestures longitudinally in two infant–caregiver dyads. Consistent with the current action-based approach, I found that (1) both dyads organized their activities into enjoyable shared routines within which infants' object-extensions played a role before infants were using object-extensions intentionally as gestures, and (2) infants' object-extensions developed into means through which infants elicited these prior routines. These findings suggest that object-extension gestures develop within shared routines as infants learn the meaning that their actions have for others.

Keywords: communication; development; gestures; action-based; cognitivism

Acknowledgements

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Chapter 1.   Introduction

The ability to coordinate our attention and activities with each other around objects is foundational to participating in human forms of life. In their mature forms, these skills are manifest in our everyday language and practices with others, from playing a boardgame with a friend, to sharing food, to exchanging gifts with a loved one. Within Western cultures[1], from infancy, objects become a central pivot around which enjoyable interactions with others take place (Bakeman & Adamson, 1985; Cameron-Faulkner, Theakston, Lieven, & Tomasello, 2015; Carpendale, et al. 2021; Rodríguez, 2009). These "triadic" interactions involving infant, other, and object are initially structured by others, typically the infant's caregivers (Adamson, 1995; Bakeman & Adamson, 1984; Bruner, 1983; Fogel, Garvey, Hsu, & West-Stroming, 2006; Moreno-Núñez, Rodríguez, & del Olmo, 2017). Before their first birthdays, infants begin to take on a more active role in triadic interactions with the emergence of various forms of object-extensions, such as holdouts and gives, and participation in object exchanges (Bakeman & Adamson, 1986; Bruner, 1983; Carpendale et al., 2021).

As socially embedded actions, infants' object-extensions create interactive contexts within which they are further drawn into more complex and diverse forms of life around the shared use of objects. Thus, researchers have linked infants' early object-extensions to later prosocial development, especially the development of sharing (Carpendale et al., 2021; Hay, 1979; Hay & Murray, 1982; Rheingold, Hay, & West, 1976; Xu, Saether, & Sommerville, 2016), to the development of more complex forms of communication, such as pointing and language (Bates, 1979; Bates, Camaioni, & Volterra, 1975; Cameron-Faulkner et al., 2015; Cameron-Faulkner et al., 2021; Choi, Wei, & Rowe, 2021; Puccini, Hassemer, Salomo, & Liszkowski, 2010; Rodríguez, Moreno-Núñez, Basilio, & Sosa, 2015; Werner & Kaplan, 1963), to the development of more complex forms of coordinating and sharing attention with others (Adamson & Bakeman, 1985; Bakeman & Adamson, 1986; Boundy, Cameron-Faulkner, &

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[1] The development of triadic forms of communication, including object-extension gestures, has mostly been investigated in Western infants (for an in-depth discussion, see Bard et al., 2022), a trend that is generally true across both developmental psychology (Kline, Shamsudheen, & Broesch, 2018; Nielsen, Haun, Kärtner, & Legare, 2017) and psychology more broadly (Arnett, 2016; Henrich, Heine, & Norenzayan, 2010). This trend continues with the current thesis. Thus, unless otherwise specified, the theories and research that are discussed in this thesis are based on studies involving Western infants in their cultural contexts.

Theakston, 2019; Carpenter, Nagell, & Tomasello, 1998), and to the development of social knowledge regarding the culturally conventional uses of objects (Cameron-Faulkner et al., 2015; Moreno-Núñez, Rodríguez, & Miranda-Zapata, 2020; Rodríguez, 2009; Rodríguez et al., 2015).

Despite these links, several researchers have noted that the lion's share of attention in infant gesture development, both empirical and theoretical, has gone towards infants' pointing gestures (Boundy et al., 2019; Cameron-Faulkner et al., 2015; Rodríguez et al., 2015). Although several accounts of the ontogenetic origins of pointing have been put forward (e.g., Carpendale & Carpendale, 2010; Tomasello, Carpenter, & Liszkowski, 2007; Vygotsky, 1978; Werner & Kaplan, 1963), few attempts have been made to illuminate the ontogenetic origins of object-extension gestures. As a result, the processes through which object-extension gestures develop are not well understood. The goal of this thesis is to further our understanding of the processes underlying the development of object-extension gestures through a longitudinal study of three infants in their naturalistic settings. My focus will be on object-extensions that serve a non-instrumental purpose—that is, where interaction with others is part of the infant's goal, rather than a means to a non-social goal (Bates, 1976, 1979; Bates et al., 1975; Messinger & Fogel, 1998).

I begin with a historical overview of major theoretical perspectives on the ontogenetic origins of infants' object-extension gestures. Following this, I critique cognitivist approaches, according to which triadic gestures emerge once infants understand that others are intentional beings with attention that can be directed, followed, and most importantly, shared (Camaioni, 1997; Camaioni, Perucchini, Bellagamga, & Colonnesi, 2004; Carpenter, 2009; Carpenter et al., 1998; Stern, 1985; Tomasello, 1995, 1999, 2003, 2008, 2019; Tomasello, Carpenter, Call, Behne, & Moll, 2005; Tomasello et al., 2007). I argue that these approaches are rooted in problematic assumptions that derive from dualist conceptualizations of communication, meaning, and the mind. In their place, I argue for an action-based approach (Carpendale, Atwood, & Kettner, 2013; Carpendale & Carpendale, 2010; Carpendale et al., 2021), which is derived from classic relational thinkers such as Mead (1934), Vygotsky (1978), Piaget (1952), and the later work of Wittgenstein (1953/2009). According to this approach, human forms of communication such as triadic gestures emerge from the coordination of activity within shared routines, which are rooted in characteristics of a typical human

developmental system (Canfield, 1995, 2007; Carpendale, 2018; Carpendale et al., 2013; Carpendale & Carpendale, 2010; Carpendale & Lewis, 2020; Carpendale et al., 2021).

Next, I turn to the issue of a proper methodology for studying the development of object-extension gestures. Drawing on Danziger (1985), I argue that methods are not neutral with respect to theories. Rather, the typical ways of investigating gesture development often load the dice in favour of cognitivist theories and against action-based explanations through certain methodological decisions that are made. I argue that a particular methodology follows from a relational perspective which focuses on describing the processes through which infants and their caregivers gradually coordinate their activities within shared routines (Carpendale et al., 2013; Carpendale & Carpendale, 2010; Carpendale et al., 2021). Finally, I report and discuss the resulting empirical project which is based on this process-oriented methodology.

Chapter 2.   Theoretical Approaches

Studies of typically developing infants have found that infants begin to use various object-extensions at around 9 or 10 months (Bakeman & Adamson, 1986; Bruner, 1983; Cameron-Faulkner et al., 2015, 2021 ; Masur, 1990; Moreno-Núñez et al., 2020; Trevarthen & Hubley, 1978), typically before they are pointing to communicate (Bates, 1979; Bates et al., 1975; Carpenter et al., 1998). Several cross-cultural studies have found similar ages for the emergence of object-extensions across diverse geographical areas and subsistence lifestyles (Callaghan et al., 2011; Cameron-Faulkner et al., 2021; Fernández-Flecha, Blume, Junyent, & Tijero Neyra, 2021; Lieven & Stoll, 2013; Salomo & Liszkowski, 2013), including among the !Kung hunter-gatherers (Bakeman, Adamson, Konner, & Barr, 1990). Among Western infants studied, slight variations in average age have been reported depending on the methodology used (e.g., home- versus lab-based studies; Crais, Douglas & Campbell, 2004) and how strict the criteria are for counting an infant's behaviour as an object-extension gesture (e.g., requiring gaze alternation; Beuker, Rommelse, Donders, & Buitelaar, 2013; Crais et al., 2004). Although object-extensions tend to emerge before their first birthdays, Bakeman and Adamson (1986) found that they do not become a routine part of infants' communicative repertoire until they are into their second year of life. However, when reported, there is considerable variation in the frequency of object-extensions among individual infants (Crais et al., 2004; Masur, 1990; Moreno-Núñez et al., 2020).

The first major theoretical approach to the ontogenetic origins of object-extension gestures was put forward by Bates and her collaborators (Bates, 1976, 1979; Bates et al., 1975; Bretherton & Bates, 1979). In their classic diary study, Bates et al. (1975) describe two functions of infants' object-extension gestures: *protodeclarative* and *protoimperative*. Drawing on Austin's (1962) speech act theory and Piaget's (1952) sensorimotor theory of development, they argue that later, linguistic declarative and imperative constructions are "first constructed on the plane of action, employing objects rather than propositions" (p. 209). They define protodeclaratives as the use of an object as a means of obtaining adult attention—that is, for "social interaction as a goal itself"

(Bates et al., 1975, p. 213), and protoimperatives as the use of a person to get at a desired object[2].

Bates et al. (1975) argue that infants develop schemes for engaging with others and schemes for engaging with objects, which are initially kept separate. They argue that the coordination of infants' person- and object-related schemes awaits the development of sensorimotor stage 5 (Piaget, 1952), which is characterized by the development of tertiary circular reactions, or "the creation of novel means to familiar ends" (p. 215), and by a new understanding of adults as causal agents within infants' constructions of means-end loops. Using this framework, they argue that declarative forms of communication originate in the development of schemes for getting enjoyable attention from adults that become increasingly distanced from the self. This begins with seeking literal physical contact, then seeking attention to the self, then to the self's activities (e.g., through showing off or clowning), and then through incorporating objects in acts of "showing". This progressive distancing continues after the emergence of showing. In their accompanying diary study, when one infant, Carlotta, first extended objects to others, she did so with objects already in her hands. Having learned about the enjoyment that would result from such interactions, she soon looked for objects to show adults, awaiting a response. For Carlotta, "giving" emerged slowly over the course of months, but eventually stabilized into another means of engaging with others for declarative purposes[3].

Reddy (2003, 2011, 2018) has put forward a similar account, though she contextualizes her explanation within a second-person, phenomenological framework.

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[2] Though their original focus was on requests for objects, protoimperatives are often conceptualized more broadly as "the child's preverbal, intentional use of the adult as an agent or tool in achieving some end" (Brinck, 2004, p. 431). These "ends" can vary with regards to how much they encompass purely practical goals versus how much they also encompass social goals. For example, Bruner (1983) distinguishes between three types of requests, the latter two of which are especially relevant for object-extensions: (1) requests for an object, typically accomplished through a stylized reach or pointing gesture; (2) a "request for supportive action" (p. 93), when the child recruits an adult's skill or strength for accomplishing a goal; and (3) an "invitation… [which] is a request to an adult to share a *role relationship* in play or in a game" (p. 93; italics in original). Categories such as "invitations" illustrate why the distinction between protoimperatives and protodeclaratives is not always clear, although he reported no instances of invitations in the infants that he was studying within their first year.

[3] They argued that this distancing continues even further with the coordination of the non-social pointing scheme and pre-established schemes for drawing others attention towards objects that become established in more proximal settings through the use of object-extensions.

Similar to Bates et al. (1975), Reddy argues that showing and giving objects to others emerges from prior ways of eliciting enjoyable attention from caregivers. She argues that (1) from very early on, infants are aware of and responsive to others' attention towards them; (2) infants become active in seeking out others' attention; and (3) the development from dyadic to triadic forms of seeking others' attention is made possible by infants' "expanding awareness of the objects of attention" (Reddy, 2003, p. 401). This begins in the first 6 months with infants enjoying others' attention on them in face-to-face, dyadic interactions. In the second half of the first year, this awareness of others' objects of attention expands to include the infants' actions. At this point, infants begin to seek others' attention through actions such as teasing, clowning, and showing off. Finally, as this awareness expands to include others' attention towards external objects, infants begin to seek attention through acts of showing and giving objects to others. Thus, object-extension gestures become new ways for infants to elicit enjoyable interaction with their caregivers. However, for both Bates and Reddy, it is not only the infant who takes enjoyment from such interactions. Rather, it is the mutual joy taken in such interactions by infants and their caregivers that serves as a crucial foundation for the development of non-instrumental object-extension gestures.

The primary focus of Bates and her collaborators (Bates, 1976, 1979; Bates et al., 1975) was on illuminating the cognitive prerequisites for the development of intentional gestures—that is, the infant's developing capacities for intentional action and causal understanding that are brought to bear in social interactions. Thus, the precise experiences and processes through which object-extensions develop as a new means through which adult attention can be obtained were not described by Bates or her collaborators. Later approaches have tended to focus on describing the developmental processes that occur within triadic interactions (Adamson, Bakeman, & Smith, 1990; Adamson & Bakeman, 1985; Bakeman & Adamson, 1986; Bruner, 1983; Hay, 1979; Hay & Murray, 1982). Within games of give-and-take, Hay and Murray (1982) found that it was experience participating in object exchanges, not exposure to a person modeling the action of giving, that facilitated infants' giving at 12 months. Xu et al. (2016) similarly found that 7- to 14- days of experience within give-and-take games with their caregivers,

but not experience dropping objects into a bucket, facilitated infants' giving actions as early as 7.5 months[4].

Researchers inspired by social theories of development, such as Vygotsky's (1978) and Mead's (1934), argue for a necessary, facilitative role of caregivers within enjoyable shared activities for the development of object-extension gestures (Adamson & Bakeman, 1985; Adamson et al., 1990; Bakeman & Adamson, 1986; Bruner, 1983; Clark, 1978). In their classic set of studies, Bakeman and Adamson (1984, 1986) looked at infant–object and infant–caregiver forms of interaction at two- to three-month intervals from 6- to 18-months. Interactions were categorized into discrete forms that they called *engagement states*. These included dyadic states, such as infant–caregiver and infant–object engagement, as well as triadic states, which they referred to as *joint engagement*[5]. Bakeman and Adamson (1986) found that approximately 75% of infants' object-extensions were produced within episodes of joint engagement, while approximately 25% took place while infants were engaged dyadically with objects. These proportions did not change between 9, 12, and 15 months. Further, during the condition where mothers were asked to sit to the side and not attend to their infants unless necessary, they found rates of object-extensions at less than one per hour. At 9 months,

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[4] Both Hay and Murray (1982) and Xu et al. (2016) link infants' participation in these early forms of object exchanges to the development of sharing and prosociality later in ontogeny. Other researchers link infants' experience with object exchanges to their developing skills of coordinating their attention and activities with others (e.g., Clark, 1978; de Barbaro, Johnson, & Deák, 2013; de Barbaro, Johnson, Forster, & Deák, 2016; Trevarthen & Hubley, 1978), whereas still others link these experiences to the development of intentional communication (e.g., Bruner, 1983). This complexity in the literature on give-and-take games illustrates some of the complexity around the diversity of the forms of life in which object-extensions play a crucial role. It also illustrates a possible inextricable link between prosocial and communicative development (Carpendale, 2018; Carpendale et al., 2021). However, although the joint activity and communication literatures are often explicitly linked both in theory and research (Bakeman & Adamson, 1986; Clark, 1978; Racine & Carpendale, 2007), there is relatively little overlap between these two literatures and the prosocial development literature (Carpendale et al., 2021).

[5] In their 1984 paper, but not their 1986 paper, they further divided joint engagement into two categories. In *passive joint engagement*, it is the caregiver who is structuring the joint engagement around an object, with no indication of any awareness of the joint nature of the triadic activity from the infant. In passive joint engagement, the infant attends only to the object, not to the caregiver. Nor does the infant coordinate their attention between the two. In *coordinated joint engagement*, infants are said to be aware of the triadic nature the activity being engaged in, as indexed through certain behaviours, particularly through their use of gaze towards the caregiver. Bakeman and Adamson (1984) argue that it is through caregivers' scaffolding within episodes of passive joint engagement that infants develop the skills to coordinate their attention triadically. Consistent with the theoretical perspective of Vygotsky (1978), they argue that caregivers "socialize object attention, embedding it within the interpersonal sphere well before infants can structure this integration by themselves" (p. 1288).

0/28 infants produced an object-extension in this condition, while at 12 months 1/28 infants did so, and at 15 months 2/28 did so. Based on these findings, they argue that infants' object-extensions, from early on, are "facilitated by the availability of an attentive, comprehending partner, joint attention toward an object with this partner, and the enactment of an action format" (p. 226). Thus, they suggest in a later paper that "the critical ingredient for the very early production of words and gestures at 9 and 12 months may well be joint engagement with an adult" (Adamson et al., 1990, p. 39). They argue that these early contexts of joint engagement, which may be embedded within action formats (i.e., highly routinized games; Bruner, 1983), constitute the scaffolding that is critical for the development of object-extensions for the purpose of coordinating attention and activities with others around objects (Adamson et al., 1990; Bakeman et al., 1990). However, as Bakeman and Adamson (1986) only observed a large sample of infants at two- to three-months intervals, they were not able to provide a detailed description of precisely how object-extension gestures develop through parental scaffolding.

Bruner (1983) provides one possible explanation for how caregivers might facilitate the development of object-extensions. As part of his *Language Acquisition Support System*, Bruner argues that parents include infants in highly routinized games, which he refers to as *action formats*. These include games such as peekaboo and give-and-take. He argues that the enjoyable and predictable nature of these games provides an ideal context within which communication can develop as they are intrinsically motivating and provide an opportunity for infants to form expectations and anticipate what is coming up next in the activity. He argues that caregivers facilitate the development of communication within these formats through a scaffolding process which culminates in infants taking on an increasingly agentic role within the activity. This *handover principle*, as Bruner calls it, is facilitated by a caregiver who performs the infants' role within the activity and gradually pulls back that assistance as the infant's skills in executing their role increases. In his longitudinal description of the development of give-and-take games—which were initially completely structured by caregivers—this handing over began when infants handed over the object within games initiated by the caregivers. In the final stage of the process, infants would themselves initiate the games with their caregivers. Bruner argues that this handover principle applies more generally to the development of gestures for establishing shared reference and for requests.

However, beyond their role in give-and-take games, Bruner (1983) did not focus on the development of infants' object extensions.

The approaches reviewed above, many of which draw on relational thinkers such as Piaget (1952), Vygotsky (1978), and Mead (1934), are broadly consistent with the current action-based approach according to which gestures develop within shared activities. The picture painted from these approaches, taken together, is one of complexity, but also complementarity. Collectively, three core claims can be derived from these accounts:

(1) Infants are active agents who seek out attention from, and engagement with, their caregivers. The means through which they do so become increasingly complex and distanced from the self, eventually including the use of objects.

(2) Caregivers scaffold triadic forms of engagement before infants are able to play an equal role within the shared activity. Thus, infants are already immersed within triadic interactions before the development of object-extension gestures. It is based on experience within these caregiver-structured triadic interactions that object-extensions gestures develop.

(3) It is because of the mutual joy taken in engagement that claims (1) and (2), noted above, characterize infant–caregiver relationships. Thus, mutual joy is a necessary ingredient for the development of non-instrumental object-extension gestures.

To this point, no account has attempted to integrate these approaches. One reason for this is that research based on these theoretical perspectives primarily took place in the 1970s and the 1980s, though similar approaches to the development of object-extension gestures have been carried on to varying degrees more recently (Carpendale et al., 2021; de Barbaro et al., 2013; Moreno-Núñez et al., 2020; Reddy, 2003, 2011, 2018; Rodríguez et al., 2015). Since the 1990s, cognitivist approaches have arguably become the predominant theoretical framework for explaining infant social and communicative development. Notably, many of these more recent perspectives have been, in part, responses to the rise and dominance of cognitivist approaches (Carpendale et al., 2021; de Barbaro et al., 2013; Moreno-Núñez et al., 2020; Reddy, 2003, 2011, 2018; Rodríguez et al., 2015). I will return to the question of integrating these action-based core claims below.

The most influential of the cognitivist perspectives has arguably been that of Tomasello and his collaborators (Carpenter, 2009; Carpenter et al., 1998; Tomasello, 1995, 1999, 2008; Tomasello et al., 2005). According to this perspective, the development of intentional gestures, along with other joint attention skills, requires that infants first understand others as intentional agents, rather than merely as "causal" agents (Bates, 1976; Bates et al., 1975). Intentional agents, Tomasello (1999) argues, "have goals and make active choices among behavioral means for attaining those goals. Importantly, intentional agents also make active choices about what they pay attention to in pursuing those goals" (p. 302). In the original version of his theory, Tomasello (1999) argued that

> all the specific joint attentional behaviors in which infants follow, direct, or share adult attention and behavior are not separate activities or cognitive domains; they are simply different behavioral manifestations of this same underlying understanding of other persons as intentional agents. (p. 302).

However, based on research that showed that chimpanzees could also demonstrate some ability to understand the intentional actions of others, Tomasello et al. (2005) argued that what facilitates the development of human social and communicative skills is that infants possess a "special motivation to share psychological states with other persons" (p. 681). As Carpenter (2009) argues, the importance of this uniquely human motivation is that it

> transforms whatever social-cognitive understanding and skills infants have at any given age into a special, shared version of that understanding and its resulting skills: if infants understand others' emotions, they will be able and motivated to share emotions with others, if they understand goals they can and will share goals, and if they understand attention they will engage in joint attention. (Carpenter, 2009, p. 384).

Thus, according to this perspective, triadic gestures—particularly for non-instrumental purposes—begin to emerge at nine months from the coordination of infants' "intention-reading" skills with their motivation to share psychological states with others (Tomasello, 2019; Tomasello et al., 2005).

These two approaches—action-based and cognitivist—derive from contrasting assumptions regarding the nature and origins of communication, meaning, and the mind (Carpendale et al., 2013; Lock & Zukow-Goldring, 2010). These assumptions are important to examine and make explicit because they are often not recognized *as* sets of

assumptions, and so are not recognized as potentially problematic ways of thinking or as constraining explanations of development (Carpendale et al., 2013; Reddy, 2010). Thus, what appear to be empirical debates in the literature are instead often fundamental disagreements on a metatheoretical level which cannot be solved merely by collecting more data (Allen & Bickhard, 2013; Dahl, Baxley, & Waltzer, 2021; Lock & Zukow-Goldring, 2010; Overton, 2015; Racine, 2011; Witherington et al., 2018).

I now turn to making explicit the assumptions underlying cognitivist and action-based explanations of gesture development. My goals in doing so are threefold: (1) to illustrate how the assumptions underlying cognitivist approaches to the development of object-extensions derive from a problematic dualist view of the mind; (2) to illustrate how these cognitivist assumptions misdirect researchers in what they focus on in their explanations of infant gesture development; and (3) to present and argue in favour of an alternative action-based approach that is derived from a relational metatheory, which I take for this thesis.

Chapter 3.   Metatheoretical Approaches

3.1. The Cognitivist Approach

Cognitivism refers to a means of explaining human cognition and action by reference to individual "internal" processes or mechanisms (Jopling, 1993). Thus, cognitivist explanations of development are explained through changes in those "internal processes hidden behind behavior" (Adamson, 1995, pp. 3-4). In cognitivist approaches to the development of communication, the hypothesized internal processes are typically the infants' understanding of others' psychological states and the means through which that understanding is achieved (Baron-Cohen, 1995; Camaioni, 1997; Camaioni et al., 2004; Carpenter, 2009; Carpenter et al., 1998; Lieven & Stoll, 2013; Stern, 1985; Tomasello, 1995, 1999, 2019; Tomasello et al., 2005; Tomasello et al., 2007). According to this position, such an understanding is what makes human forms of communication and engagement possible (Bibok, 2011; Carpendale et al., 2013; Jopling, 1993).

Explaining social and communicative skills by appeal to internal processes "conceals a number of assumptions that constrain subsequent theory construction." (Jopling, 1993, p. 291). These assumptions cohere in a metatheoretical view of the mind that long predates cognitivism[6], but which has been adopted by cognitivist theorists in their explanations of interpersonal relations (Bennett & Hacker, 2003; Martin & Sugarman, 1999; Overton, 2015; Racine, 2004; Witherington, Overton, Lickliter, Marshall, & Narvaez, 2018). This view of the mind has been referred to as *Cartesian* (Bennett & Hacker, 2003; Fogel et al., 2006; Fuchs, 2011, 2013; Lock & Zukow-Goldring, 2010; Overton, 2015; Reddy, 2011; Ryle, 1949; Witherington et al., 2018), *Individualistic* (Carpendale & Carpendale, 2010; Carpendale & Lewis, 2004, 2006, 2015; Müller & Carpendale, 2004), *Dualist* (Carpendale et al., 2013), and by Jopling (1993) as the *Philosophy of Subjectivity*.

From this perspective, the starting point is the individual infant's mind, split from others and from the world (Carpendale & Lewis, 2006; Carpendale et al., 2013; Fuchs,

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[6] Although this view of the mind is commonly traced back to Descartes, Ryle (1949) and Wittgenstein (1953/2009) trace elements of dualist thought at least back to St Augustine's *Confessions*, while other dualistic elements can be traced back as far as Plato (Bennet & Hacker, 2003).

2011, 2013; Jopling, 1993; Reddy, 2010). The mind is taken as the private, inner sphere of subjective experience—with a fundamentally "unbridgeable gap" (Racine & Carpendale, 2007, p. 183) separating what is "internal" to the mind from what is "external" to the mind. What is internal to the mind can be known directly, whereas what is external to the mind can only be known by virtue of being represented in and by the mind. Mental states are the property of minds, which are private, and so are not given in action and activity. This means that "only our bodies can really meet; the rest is merely inferential" (Jopling, 1993, p. 296).

Carpendale et al. (2013) argue that two implications follow from this assumption that minds and mental states are private while bodies and behaviours are public. First, it follows that others can be understood either on a "behavioural" or on a "mental" level. Second, to develop an understanding of others on a mental level requires some means of going beyond what is perceivable—others' bodies and behaviours—to the mental states that underlie and cause those behaviours. That is, it requires that infants solve what is known as the "problem of other minds" (Jopling, 1993, p. 294). Thus, if one starts from this dualist conceptualization of mental states, then explanations of infant communication development depend crucially on "whether young infants are attempting in their prelinguistic communication to influence the intentional/mental states of others … or whether, alternatively, they are simply aiming to achieve certain behavioral effects in others" (Tomasello 2008, p. 113). In other words, does infants' prelinguistic communication require understanding others on a mental level or only on a behavioural level? This debate has played out primarily in the literature on infants' pointing, typically studied in 12-month-old infants, with researchers defending contrasting[7] rich (e.g., Camaioni, 1997; Camaioni et al., 2004; Carpenter et al., 1998; Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004; Tomasello et al., 2007) and lean (e.g., Corkum & Moore, 1995; Moore & D'Entremont, 2001) interpretations of infants' pointing gestures, respectively[8].

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[7] As Carpendale et al. (2013) and Racine (2011) argue, rich and lean interpretations contrast on only one level. They both share the underlying dualist view of the mind that splits mental states from activity.

[8] Not all positions within this debate fall cleanly within a lean or a rich explanation. For example, Camaioni (1997) argues for a lean explanation of imperative pointing, arguing that imperatives only require infants to understand others as "causal" agents (i.e., on a behavioural level).

The role of infants' object-extension gestures within this debate has been significantly less prominent. This is reflected in the scarcity of research focused specifically on infants' object-extension gestures, particularly when compared with research on infant pointing. Rather, the assumption from the cognitivist perspective has been that infants use object-extensions as a means to share attention with others, and so their use is based on the same underlying insight that others are intentional agents with attention that can be directed, followed, and shared (Carpenter et al., 1998; Tomasello, 1995, 2003, 2008). However, Liszkowski (2010) notes that

> it is not clear precisely how these gestures work from the infants' point of view. There are no experiments to my knowledge which have directly tested referential intent underlying infants' showing or placing …. The underlying communicative and cognitive complexities … are not yet clear. (p. 39).

Echoing this sentiment, Boundy et al. (2019) note that "the motives behind … [holdout] gestures are yet to be studied and so remain unclear" (p. 229). They argue that this is because "there are no experiments which investigate the underlying intentions of infant holdout gestures" (p. 231), and thus "it is important to understand exactly what infants are trying to do when they use these gestures" (p. 230).

In their study, Boundy et al. (2019) elicited holdouts in infants who were 10 – 11 months and manipulated how others responded to their holdouts: with attention to the toy that they were holding out, attention to the infant, alternating attention between the two (joint attention condition; JA) or ignoring the infant altogether. Their goal was to test whether infants' holdouts (1) displayed a declarative motive, which they defined as a motive for sharing attention on the toy with the other person, (2) were produced to get attention to the self, or (3) were produced for individualistic reasons (e.g., exploratory play). In their analyses, they distinguished between holdout gestures, which they defined as the infant holding up the object towards the experimenter and looking at them, and the use of a toy as an attentional tool, which they defined as the infant holding up an object towards the experimenter while maintaining eye contact and acting on the object (e.g., waving, dropping, or banging it).

However, she defends a rich interpretation of declarative pointing, arguing that declaratives require understanding others as intentional agents (i.e., on a mental level).

Boundy et al. (2019) found that infants showed more positive emotional expressions (e.g., smiling, laughing) and fewer negative emotional expressions (e.g., frowning, getting frustrated or upset) in response to the JA condition relative to the three other conditions when infants displayed a holdout gesture. Conversely, they found that in the three non-JA conditions, infants displayed relatively more negative expressions and fewer positive expressions in response to how others responded to their holdouts. They also found that infants repeated the use of a toy as an attentional tool significantly more in the three non-JA conditions than in the JA condition, whereas infants repeated their holdouts significantly more in the JA condition. They argue that their "findings are suggestive of a rich interpretation insomuch as they demonstrate that prelinguistic infants use holdout gestures to communicate declaratively, to share attention and interest" (pp. 245-246), which they argue, citing Tomasello's (2008) cognitivist theory of shared intentionality, "allows infants to participate in the shared experiences and psychological states of others" (p. 246).

The findings of Boundy et al. (2019) thus seem to confirm the assumption made by Tomasello and his collaborators (Carpenter et al., 1998; Tomasello, 1995, 2003, 2008) that infants use object-extensions for the purpose of sharing attention. Thus, their findings might be taken as support for Tomasello's cognitivist theory. However, in evaluating the implications of their study for this question, there are two issues that must be addressed, neither of which are directly addressed by Boundy et al. (2019). The first issue is how psychological states are conceptualized—and thus what sort of understanding of others is required for infants to use object-extensions to share psychological states such as attention with others. As noted earlier, cognitivist approaches adopt the Cartesian, internal–external dualism of mental states and action[9].

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[9] It should be noted that it is not entirely clear where Boundy et al. (2019) fall on this issue, specifically. That is, it is not clear the degree to which they adopt a cognitivist view of mental states. Although they contextualize their work within the "rich" versus "lean" debates that took place within the pointing literature, their explicit goal is to test two possibilities: (1) that infants' holdouts are used to share attention; or (2) that they are used for some other purpose, communicative or not. The main problem with the way that Boundy et al. set up their study is that they seem to imply that if infants do indeed use holdouts to share attention, then this rules out "lean" theories of how the function of sharing attention *develops*. Further, through contextualizing their work within Tomasello's (2008) theory of shared intentionality, they seem to be implying that if infants use holdouts to share attention, then their development is based on something like an understanding of others as intentional agents. If this is the case, then they would indeed fall under a cognitivist view of mental states, and the criticisms that apply to that position would apply equally to their position.

Thus, forms of communication such as declaratives that indicate that infants understand others' attention or mental states require as part of their explanation some means through which infants can gain access to others' internal states (Carpendale & Lewis, 2004; de Barbaro et al., 2013; Gallagher, 2008; Reddy, 2003, 2010, 2011). Camaioni (1997), in defending a rich interpretation of infants' declarative gestures, articulates this when she argues that "in order to declare the child must be able to represent the adult as being interested or not interested in something, and deliberately must intend to influence the drift of these internal states [emphasis added]" (pp. 218-219).

Thus, what awaits the advent of declarative gestures is the development of some means through which infants can solve the problem of other minds. Three "solutions" to this problem are typically offered, with each finding a broader articulation within the childhood theory of mind literature (Carpendale & Lewis, 2004). Infants are said to either (1) form a theory that explains and predicts others' behaviours by reference to the underlying mental states (Meltzoff, Gopnik, & Repacholi, 1999); (2) learn about others' mental states through a process of analogizing from knowledge of their own mind (Humphrey, 1984; Tomasello, 1999; Meltzoff et al., 1999; Tomasello & Carpenter, 2013; Tomasello et al., 2005); or (3) be equipped with various innate "modules" designed through natural selection to interpret others' behaviours in terms of the underlying mental states (Baron-Cohen, 1995; Onishi & Baillargeon, 2005).

Each of these has been extensively critiqued elsewhere on grounds of biological, developmental, or conceptual implausibility or incoherence[10]. Briefly, each of these solutions assumes a complex mind and complex cognitive processes that are themselves assumed rather than explained, such as the ability to form theories or reason by analogy through experience of one's own mind (Carpendale & Lewis, 2004; Carpendale et al., 2013; Gallagher, 2007, 2008; Zahavi, 2008). Rather than providing an in-depth critique of each proposed solution, my goal in laying out the logic of cognitivist theories of communication development is to illustrate Jopling's (1993) argument that "starting points have a tendency to haunt us all the way through to our theoretical conclusions" (p. 290). The starting point assumed by cognitivists, I argue, results in

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[10] For in-depth critiques of these "solutions", as well as the dualist assumptions that they are based on, see Carpendale and Lewis, 2004; Jopling, 1993; Carpendale et al., 2013; Racine, 2011; Racine and Carpendale, 2007; Gallagher, 2007; Gallagher, 2008; Zahavi, 2008; Bennett and Hacker, 2003; Scheler, 1954.

researchers focusing on the wrong problems and thus overlooking what must be explained for human forms of communication to develop. This leads to the second issue.

The second, related issue is how the ontogenetic origins of object-extension gestures, and their functions, are explained—or rather what is often overlooked in research in this area. In the cognitivist theory of Tomasello and his collaborators (Carpenter et al., 1998; Tomasello, 1995, 1999, 2008; Tomasello et al., 2005; Tomasello et al., 2007), within which Boundy et al. (2019) contextualize their work, joint attention skills as diverse as gaze following and object-extension gestures originate from an insight that others are intentional agents. Consequently, Tomasello's theory overlooks what is unique about gestures among other joint attention skills such as gaze following—they are intentionally used to convey meaning (Carpendale & Carpendale, 2010). Rather, the meaning of infants' gestures is assumed in the form of distinct "motives" (e.g., a declarative or imperative motive) or "intentions" (e.g., to show or give) for which gestures are an expression. For Tomasello, this expression merely awaits an insight that others are intentional beings. Thus, in his theory, the origins of meaning are not explained—indeed, are seemingly not treated as something that requires an explanation. And yet, communication *is* meaningful, and so we must have an explanation for where meaning comes from.

Cognitivist perspectives that overlook the problem of where meaning comes from originate from the same dualist worldview that splits the infant from others (Carpendale et al. 2013). Starting from the infant's mind, and its constitutive internal–external dualism, the "function of communication is to *express what is inside* [emphasis added]" (Clark, 1978, p. 233). From the conceptualization of communication as for expression, it makes sense to ask what infants' underlying intentions are when they produce an object-extension, as it is assumed that infants are trying to express a communicative intention. This view, Clark (1978) argues, "derives quite naturally from our experience as language-using adults" (p. 232). However, this view runs into problems when we try to apply it to infants. That is, what is not explained is from where these communicative intentions, nor the complex mind to form them, originate (Carpendale et al., 2013).

3.1.1. Cross-Cultural Research and Cognitivism

In addition to the conceptual arguments that I have presented, there is empirical evidence from cross-cultural research that challenges current cognitivist theories of the development of object-extension gestures. The view that infants use object-extension gestures to deliberately seek out the sharing of experiences and psychological states with others around objects is common in developmental psychology (Boundy et al., 2019; Cameron-Faulkner et al., 2015; Carpenter et al., 1998). From the perspective of Tomasello and his collaborators (Tomasello et al., 2005), declarative gestures are viewed as expressions of a uniquely human "motivation to share psychological states with other persons" (p. 681), which is first expressed in gestural form through showing and giving objects to others before being expressed through pointing gestures (Tomasello, 1999, 2008). Although it is often implicit—though, in the work of Tomasello and his collaborators it is explicit—the assumption is that this is a *human* trait that results in species-typical forms of interaction (i.e., shared attention towards objects), which are crucial to the development of uniquely human forms of communication, such as language (for an in-depth discussion of this assumption, see Bard et al., 2022). This view often draws support from the findings that a lack of declarative object-extension gestures is an indicator of autism (Baron-Cohen, 1989; Camaioni, Perucchini, Muratori, & Milone, 1997; Camaioni et al., 2004; Clements & Chawarska, 2010; Özçalışkan, Adamson, & Dimitrova, 2016) and that non-human apes do not show or give objects to others for the purpose of sharing attention (Gómez, 2010; Tomasello et al., 2005).

Although cross-cultural research looking at infants' object-extensions is sparse (Fernández-Flecha et al. 2021), studies looking across diverse geographical areas and subsistence lifestyles (Bakeman et al., 1990; Callaghan, 2011; Fernández-Flecha et al., 2021; Lieven & Stoll, 2013; Salomo & Liszkowski, 2013) have found a developmental pattern largely consistent with that found in Western populations. That is, infants begin to coordinate their activities with others triadically between eight and twelve months through the use of object-extensions. In a study of Yucatec-Mayan, Dutch, and Chinese infants, Salomo and Liszkowski (2013) found no cross-cultural differences in the presence of showing and giving gestures. However, there were systematic differences in frequencies in use of these gestures between cultures, with Chinese infants using these gestures within joint activity the most, and Yucatec-Mayan infants using these gestures within joint activity the least. Similarly, Lieven and Stoll (2013) found that infants in a

village in Nepal and infants in rural Germany used showing and giving gestures, though they found no evidence of systematic differences in their frequencies across these two cultures. Based on the disparate cultures in which these gestures have been found, these studies would seem to lend further support to the assumption of human universality of declarative object-extension gestures among typically developing infants.

However, there is reason to be cautious about this assumption. In a study of !Kung infants, whose culture practices a primarily hunter-gatherer subsistence lifestyle, Bakeman et al. (1990) found that object-extensions begin to emerge at around 8 months, consistent with ages found in other cultures. However, the object-extensions that were reported were exclusively offers of objects to others, with no report of showing gestures. Despite moderate levels of object play by infants, they argue that there was no indication that infants attempted to involve others in their object engagement. Additionally, infants' engagement with objects was largely ignored by others, with the only exception being when infants offered objects to others.

Bakeman et al. (1990) contextualize these findings with reference to two important values that have been reported in the ethnographic literature on the !Kung and which are manifest in their practices with children. First, the folk theory of parenting among the !Kung is one that "emphasizes a child's need for space to explore, a view that is revealed by the !Kung phrase, *a n/tharo an/te* [he/she is teaching/learning him/herself]" (p. 796). Second, the !Kung place a high value on the exchanging of objects and sharing more broadly. This is embodied in the practice of *hxaro*, which is a ritualized form of gift exchange. Adults begin to scaffold object exchanges with infants starting at six months, with the goal of beginning to teach infants the practice of *hxaro*. They argue that the combination of these two values results in patterns of infant–caregiver triadic interactions wherein there is little sharing of attention on objects. Rather, caregivers seem to scaffold the use of object-extensions for purposes of exchanging objects with others, rather than for sharing attention.

Bard et al. (2022) argue that these findings challenge the assumption that infants universally use object-extension gestures to share attention with others. They write that, whereas "in the U.S., offering an object is usually thought to have a function of sharing attention about the object" (p. 27), among the !Kung, "offers have a primary social function of giving to another" (p. 27). These findings suggest that the development of

object-extension gestures and their functions likely depends on more than the coordination of intention-reading skills and a uniquely human motive to share psychological states with others, as is argued by Tomasello and his collaborators (Tomasello, 2008, 2019; Tomasello et al., 2005; Tomasello et al., 2007). Rather, they suggest that object-extension gestures and their functions are rooted in the shared forms of life within which infants are immersed, and consequently depend on infants' experiences within these forms of life. Thus, explanations of object-extension gestures must also, as a necessary constitutive element, ground the development of object-extension gestures in shared forms of life, as it is only within shared forms of life that meaning can emerge (Wittgenstein, 1953/2009). I return to this point below.

3.2.   The Relational Approach

Starting from the infant's mind, split from others and the world, is not the only possible starting point. Rather than viewing relations with others as a "cognitive achievement" (Jopling, 1993, p. 242) made possible through the possession of a complex mind, the relational metatheory argues that infants are, from the beginning, already immersed in relations with others (Carpendale & Lewis, 2004; Carpendale et al., 2013; Hobson, 2002; Fuchs, 2011, 2013; Müller & Carpendale, 2004; Reddy, 2010; Werner & Kaplan, 1963). Because of their embodiment, infants are necessarily embedded in a social world in which they must be taken care of by others (Savage-Rumbaugh & Fields, 2011). This biological reality creates a social environment within which human forms of communication develop within shared routines (Carpendale & Lewis, 2006; 2021). A complex mind emerges from this social process, and so cannot be the basis for this process (Carpendale et al., 2013; Clark, 1978; Fuchs, 2013; Mead, 1934; Vygotsky, 1978), as is assumed in cognitivist approaches.

3.2.1. A Relational Approach to Social Understanding

The shared routines that develop between infants and their caregivers are infused with psychological states, including emotions, intentions, and attention (Carpendale et al., 2013; Gallagher, 2007, 2008; Reddy, 2010, 2011; Zahavi, 2008). However, the relational perspective rejects the internal–external dualism constitutive of the dualist view of mind. It thus also rejects the logical implication of this dualism—that

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we can only ever engage with others' bodies and behaviours, not their minds and mental states (Fuchs, 2011; Jopling, 1993; Reddy, 2010). Rather, this perspective takes the view of interpersonal relations articulated by many phenomenologically-oriented thinkers (Fuchs, 2011, 2013; Gallagher, 2007, 2008; Jopling, 1993; Scheler, 1954; Reddy, 2003, 2010, 2011, 2018; Zahavi, 2008) and several ordinary language philosophers (Bennett & Hacker, 2003; Ryle, 1949; Wittgenstein, 1953/2009) that "others are encountered directly and immediately .... Meeting them as persons is prior to treating them as bodies or minds or bodies-with-minds." (Jopling, 1993, p. 297).

From this perspective, behaviour is not split from the mind (Carpendale et al., 2013; Fuchs, 2011; Lock & Zukow-Goldring, 2010; Racine, 2011), and so it is not a conceptually coherent question to ask whether infants understand others on a behavioural or on a mental level. Thus, infants do not develop from a behavioural to a mental understanding of others, and so this cannot be an explanation for the development of gestures and other joint attention skills. Rather, the relational metatheory takes an action-based approach to knowledge (Allen & Bickhard, 2013; Piaget, 1952), according to which infants first develop a practical, sensorimotor understanding of others within shared activities (Bibok, Carpendale, & Lewis, 2008; Carpendale & Lewis, 2004; Carpendale et al., 2013; Chapman, 1999; Fuchs, 2011; Racine & Carpendale, 2007). "Others' intentions, attention, and knowledge are all manifest in their activity. It is this activity that is understood" (Carpendale et al., 2013, p. 387). Later, conceptual understanding—of the kind needed to form a theory of, or to reason by analogy about, others' minds—is made possible through mastering language. Language is first learned as a way of talking about the psychological world before becoming a tool for thinking about the psychological world (Bibok et al., 2008). The ability to reflect upon the psychological world is thus built on top of, and presupposes, an earlier practical understanding of others developed within activity (Bibok et al., 2008; Carpendale & Lewis, 2004; Chapman, 1999; Fuchs, 2011, 2013).

3.2.2. A Relational Approach to Meaning

From the relational perspective, explaining the development of human forms of communication, such as intentional gestures, requires an explanation of how meaning works and how it develops (Canfield, 1995; Carpendale et al., 2013; Clark, 1978; Mead, 1934). From this perspective, meaning does not originate in the minds of individuals in

the form of communicative intentions to be expressed[11]. Rather, Wittgenstein (1953/2009) argues that meaning must be grounded in shared forms of life—that is, in the things that we do together. Thus, the relational perspective takes an action-based approach to the nature and development of meaning (Carpendale et al., 2013; Carpendale & Carpendale, 2010; Carpendale et al., 2021). For Wittgenstein (1953/2009), an action conveys meaning—can only convey meaning—because of the function that it has within a shared form of life. One implication of this is that the same action (e.g., a pointing gesture) can function to convey almost any meaning, depending on the specific routine being engaged in (Canfield, 1995; Carpendale & Carpendale, 2010). A second implication is that intentionally communicative gestures must be based on prior ways of acting together (Canfield, 1995, 2007). Thus, what we need to explain is the process through which intentional gestures emerge from these prior shared ways of acting (Canfield, 1995, 2007; Carpendale et al., 2013; Clark, 1978; Lock & Zukow-Goldring, 2010).

Mead (1934) articulates such a process. For Mead, meaning originates in the responses of one animal to the actions of another in the carrying out of a shared activity—what he calls a social act. The meaning of an action is the response that it calls forth from the other. Mead gives the example of two dogs fighting to illustrate this process. The action of the first dog has meaning in that it calls forth an adjustive response from the second dog. The response from the second dog then calls forth a new response from the first dog. Each response becomes a new stimulus for the other to respond—to the completion of the social act. Mead refers to such interactions of mutual responsiveness and adjustment as a *conversation of gestures*. For this process to work, the animals do not need to be aware that they are communicating. Rather, the meaning is objectively there, "implicit in the structure of the social act" (p. 81).

However, human forms of communication such as language *are* based on being aware that our actions have meaning for others (Carpendale & Lewis, 2020). This awareness affords the possibility of intentionally communicative actions—what Mead (1934) refers to as *significant gestures*. For Mead, this is made possible through anticipating the others' response to one's own actions within a conversation of gestures.

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[11] Nor does an action or a word work to convey meaning through being linked to something inside the mind (e.g., a mental representation), as is articulated in the code or message model of communication adopted by many cognitivists (Canfield, 1995; Turnbull, 2003).

Carpendale et al. (2013) illustrate this social process with the development of the arms-up gesture. An infant's desire for their caregiver is manifest in the action of reaching out towards their caregiver. This is not yet intentional, though it is meaningful for the caregiver who responds by picking up the infant. When the caregiver moves to pick up the infant, the infant anticipates being picked up and stiffens her own body to facilitate this (Lock, 1992; Reddy, 2018), showing that the caregiver's action has become meaningful for the infant. Each move is a turn in the social act that calls forth a complementary response, which allows for a *coordination* of actions that can develop into a stable, repeatable routine[12] (Clark, 1978). Carpendale et al. (2013) argue that through repeated experience with this social act, the infant will gradually come to anticipate their caregiver's response to their action of reaching and can then intend to initiate that social act through the action of reaching. Through this process, the action of reaching for her caregiver becomes an intentional (i.e., significant) gesture to initiate this routine. Thus, from this perspective, intentional gestures are rooted in earlier patterns of interaction—that is, conversations of gestures—that infants are already immersed in before they are aware of the role of their actions within the shared activity (Canfield, 1995, 2007; Carpendale & Carpendale, 2010; Carpendale et al., 2013; Clark, 1978; Lock, 1978, 1992; Vygotsky, 1978). Communicative intentions are thus emergent from this process.

Although there is significant variation cross-culturally in what shared activities infants and their caregivers participate in, and thus what gestures might develop (e.g., Bakeman et al., 1990; Bard et al., 2022), Carpendale and Lewis (2006, 2020) argue that certain gestures are likely to emerge across cultures due to the characteristics of a typical human developmental system. As an illustration, they argue that routines around picking up an infant develop due to the constraints of, and opportunities afforded by, our unique form of embodiment. Unlike the infants of our closest relatives, chimpanzees and bonobos, human infants do not possess a functional clinging reflex and would be too heavy to cling (Savage-Rumbaugh & Fields, 2011). However, because infants are born early—long before they can locomote without assistance—they must be carried. This sets up a problem space within which infants and their caregivers learn to coordinate

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[12] It should be noted that the word "turn" is a bit of a misnomer for this process, as it is more correct to characterize a conversations of gesture as a process of continuous coordination through mutual anticipation, rather than a simple sequence of taking turns through responding to the partner.

their actions to facilitate this necessity. This biological reality of relative helplessness thus sets up a context in which certain forms of request are likely to develop, such as the arms-up gesture (Carpendale & Lewis, 2006, 2020; Lock, 1978).

3.2.3. An Action-Based Approach to the Development of Object-Extension Gestures

The arms-up gesture is an example of a dyadic form of communication emerging from the coordination of activity within a shared routine, rooted in the characteristics of a typical human developmental system. From the current action-based perspective, the emergence of triadic forms of communication must similarly be rooted in the coordination of activity with others within shared routines—though, within shared routines involving objects (Clark, 1978). Human forms of life involve coordinating activities around objects, and so both objects and shared activities around objects are a reliable part of the world within which human infants develop. However, as noted, how others engage with infants around objects is, at least in part, dependent on what is culturally valued (Bakeman et al., 1990; Bard et al., 2022). As the current study is focused on infants developing in what Henrich et al. (2010) call *WEIRD* (Western, Educated, Industrialized, Rich, and Democratic) societies, the following sketch of an action-based approach to the development of object-extension gestures, which will inform the empirical part of this thesis, is derived primarily from research and theories specific to infant–caregiver dyads studied in WEIRD societies[13].

Research based in WEIRD societies have predominantly characterized infant–caregiver forms of engagement as involving different forms of sharing. These include the sharing of emotions (Hobson, 2002; Stern, 1985), experiences (Trevarthen, 1979), attention towards objects and events (Boundy et al., 2019; Camaioni, 1997; Cameron-Faulkner et al., 2015; Carpenter et al., 1998), and intentions or goals (Tomasello et al., 2015; Tomasello, 2008, 2019; Trevarthen & Hubley, 1978). Ontogenetically, these forms of engagement begin with emotion sharing in face-to-face interaction that involve mutual visual orientation and the coordination of complementary affective expressions (Hobson,

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[13] Though, as Broesch and Carpendale (2022) argue, there are significant similarities across diverse cultures, including similarities in the frequency and timing of contingent responsiveness by caregivers (Broesch, Rochat, Olah, Broesch, & Henrich, 2016) and, they argue, a foundation of mutual joy that structures infant–caregiver relationships.

2002; Stern, 1977, 1985; Trevarthen, 1979; Tronick, 1989). Within these mutually enjoyable interactions, infants develop expectations based on a history of contingent responding from their caregivers (Bigelow & Rochat, 2006; Markova & Legerstee, 2006) and respond in characteristic ways when the typical sequence is disrupted. In response to a still-face, infants show signs of wariness, withdrawal, distress, and increasingly complex ways of trying to re-engage their caregiver throughout development (Adamson & Frick, 2003; De Schuymer, De Groote, Striano, Stahl, & Roeyers, 2011; Mcquaid, Bibok, & Carpendale, 2009; Tronick, Als, Adamson, Wise, & Brazelton, 1978). From early on, infants are thus active participants in the organization of, and co-regulation within, face-to-face interactions (Hobson, 2002; Stern, 1977, 1985; Trevarthen, 1979; Tronick, 1989), making these forms of interaction some of the earliest emotionally rich and elaborate conversations of gestures that infant–caregiver dyads engage in.

Infants' own skills of *eliciting* mutually enjoyable engagement with their caregivers become increasingly complex, and the means through which they do so become increasingly distanced from the self (Bates, 1976; Bates et al., 1975; Reddy, 2003). This is first achieved through direct social bids such as smiling and looking towards their caregiver—behaviours that are used within face-to-face interactions (Hobson, 2002; Reddy, 2003). Ontogenetically, this is followed by seeking adult attention and engagement through the self's actions (e.g., showing off, clowning), then through "showing" and "giving" objects in the self's possession (Bates et al., 1975; Reddy, 2003). Objects thus become a new means through which infants seek out engagement with their caregivers that was previously achieved through dyadic means. According to one perspective, enjoyable dyadic interactions are the socioemotional foundation for object-extension gestures for non-instrumental (i.e., social) purposes (Bates et al., 1975; Broesch & Carpendale, 2022; Carpendale et al., 2021; Hobson, 2002; Reddy, 2003, 2011, 2018; Reddy & Vanello, 2022). What remains an open question are the developmental processes through which objects become new means through which infants elicit adult attention and engagement. Aside from the development of give-and-take games (Bruner, 1983; Clark, 1978), the on-the-ground processes through which infants begin to use object-extensions as meaningful social actions have not been studied in detail.

From a sociocultural perspective (Vygotsky, 1978), several researchers have argued that caregivers scaffold their infants' participation in routines involving joint

engagement with objects before infants are able to play an equal role (e.g., Adamson et al., 1990; Bakeman & Adamson, 1984, 1986; Bruner, 1983; Clark, 1978; Moreno-Núñez et al., 2017). The development of non-instrumental object-extension gestures is thus made possible by infants beginning to take an active coordinating role in these triadic interactions that were previously structured by caregivers (i.e., the handover principle; Bruner, 1983). However, there is reason to think that caregivers following in on their infants' attention to, and actions with, objects might represent an important process through which object-extension gestures develop, particularly for non-instrumental purposes. A growing number of researchers have argued that caregivers' following-in is a key facilitative process through which communication develops, including pointing (Cameron-Faulkner et al., 2015; Carpendale & Carpendale, 2010; Carpendale et al., 2013; Kettner, 2021; Kettner & Carpendale, 2018) and language (Goldin-Meadow, 2007; Goldin-Meadow, Goodrich, Sauer, & Iverson, 2007; Iverson & Goldin-Meadow, 2005; Masur, 1982; Olson & Masur, 2011, 2013; Rollins, 2003; Tomasello & Farrar, 1986; Wu & Gros-Louis, 2015).

Looking at interaction sequences initiated by infant object-extensions, Cameron-Faulkner et al. (2015) found that at 10 and 11 months both the frequency of these interactions, and the time spent in joint engagement as a result of infant object-extensions, predicted pointing but not reaching at 12 months. They argue that infant object-extensions "result in infant-focussed interactions … [the] infant decides which object is of interest, and … the caregiver follows in to the infant's focus of attention" (586). They further argue that it is this following in on the infants' interests manifest in their object-extensions that facilitates the development of more complex forms of declarative communication, such as pointing. Building on this study, Kettner (2021) found that time spent in joint engagement as a result of caregivers following in on their infant's focus of attention at 9 months predicted pointing three months later. Conversely, she found that time spent in joint engagement as a result of caregivers directing their infant's attention did not predict pointing three months later. Additionally, she found that what was important for predicting pointing at 12 months was that, within these episodes of infant-led joint engagement, caregivers maintained their infant's attention to the object rather than following in on new foci of attention after joint engagement had been established. Thus, similar to the work of Cameron-Faulkner et al. (2015), it is the

extended sequence that results from caregivers following in on their infants' attention that facilitates the development of pointing.

Although these studies look specifically at pointing gestures, they suggest that a key context within which object-extension gestures develop might be episodes of triadic joint engagement that result from caregivers following in on their infants' attention to, and actions with, objects. Thus, caregivers following-in might represent one process through which the sociocultural perspective (Bakeman & Adamson, 1984, 1986; Bruner, 1983; Vygotsky, 1978), which emphasizes the caregiver's structuring role (*action-based core claim #2*), can be integrated with perspectives that emphasize infants' agency in seeking out attention and engagement (*action-based core claim #1*; Bates, 1976, 1979; Bates et al., 1975) in the development of object-extension gestures. This integration is made possible through the application of a Meadian approach, according to which intentional gestures develop as infants learn to anticipate the response to their actions within a conversation of gestures (Carpendale & Carpendale, 2010; Carpendale et al., 2013; Carpendale et al., 2021; Clark, 1978; Mead, 1934). Meanings are thus co-constructed within this process.

Taking a Meadian perspective, Carpendale et al., (2021) argue that one possibility is that it is in the process of following in on (i.e., responding to) their infant's actions with objects that caregivers demonstrate the meaning that the infants' actions have for others. Thus, similar to the development of the arms-up gesture (Carpendale et al., 2013; Lock, 1978), infants' actions which are interpreted by caregivers as "showing", "giving", or "sharing", among other meanings, might be unintentionally communicative actions which create the interactive contexts within which object-extension gestures develop. That is, when caregivers interpret their infant's actions with objects as communicative, or as an opportunity to engage with their infant, they might respond by engaging with their infant around the object. Through responding, caregivers (1) scaffold their infants into a new shared activity involving objects—that is, a new conversation of gestures—through which infants can develop expectations and come to anticipate what comes next in the activity; and (2) demonstrate to the infant the relationship between their actions and a social outcome (Clark, 1978). Through this process, infants learn that objects can be a new means through which they can elicit enjoyable attention from, and engagement with, their caregivers (Carpendale et al., 2021). Similar to the processes involved in the development of the arms-up gesture, infants' object-extensions then

become intentional means through which they initiate enjoyable shared routines. I now turn to issues regarding a proper methodology for studying the development of object-extension gestures from the current action-based perspective.

3.3. Metatheoretical Approaches and Methods

Methods are not neutral arbiters of theories, particularly when those conflicting theories derive from contrasting metatheoretical assumptions regarding the nature of the phenomena researchers are trying to explain (Bibok, 2011; Carpendale & Carpendale, 2010; Carpendale et al., 2013; Danziger, 1985). Rather, methodologies are based on, and find their grounds for justification within, metatheoretical frameworks (Overton 2015; Witherington et al., 2018). In developmental research into infant gestures, a common set of methodological practices focuses on attempting to pick out "true" instances of the gesture or a particular function of a gesture (e.g., declarative). In this section, I will (1) argue that these practices have obscured the processes through which object-extensions develop and, as a result, have led to data that load the dice in favour of cognitivist theories and against action-based theories; and (2) argue for a particular methodology that follows from the current action-based perspective which is counter to many of these practices commonly used by researchers.

Research into infants' gestures typically begins with definitions of the phenomena under investigation. However, definitions are not theory-neutral, particularly in developmental work. Rather, definitions derive from and reflect metatheoretical assumptions. From the metatheoretical assumption that "communication is to express what is inside" (Clark, 1978; p. 233), it follows that whether an infant's action is considered a communicative act depends on determining whether, and what, they were trying to express—in other words, what their underlying intention is. This assumption is reflected in the definitions used in studies of object-extensions in two ways and is further reflected in specific methodological decisions.

First, object-extensions and their functions are typically conceptualized as "categorical" (Lock & Zukow-Goldring, 2010, p. 399) phenomena. This is reflected in the coding schemes used to study object-extensions through two common practices: (1) the

coding of infants' object-extensions as dichotomous, present/absent phenomena[1415]; and (2) the placement of infants' object-extensions into mutually exclusive categories (e.g., declarative/imperative, showing/giving[16]), based on the infant's hypothesized communicative intent. However, the use of "clear definitions can create artifactual developmental Rubicons that then obscure the very processes of change that scientific investigations are seeking to understand." (Lock & Zukow-Golding, 2010, p. 399). One reason for this is that the use of high-level, categorical coding schemes removes the possibility of capturing ambiguity. Infants' actions which are ambiguous with respect to the coding scheme being used are either forced into one of the mutually exclusive categories or are ignored in the analyses and reporting of the data[17].

However, the role that ambiguity plays in research depends on the metatheoretical approach that is taken. In cognitivist approaches, ambiguity of infants' actions is not considered theoretically important because actions are theorized to result from internal cognitive mechanisms or processes which are themselves typically

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[14] For an in-depth discussion of this problem, see Andrén (2010, 2014), who refers to this problem the *lower limit of gestures*.

[15] To clarify, I do not mean that researchers merely code gestures as present or absent as opposed to, for example, giving frequency scores. Rather, the issue is that any infant's action is typically conceptualized dichotomously as either an instance of the target gesture or not an instance of the target gesture. There is typically no in-between.

[16] "Showing" and "giving" are not always coded as mutually exclusive variables. Rather, they are often collapsed into a single category due to two considerations. Infants' object-extensions are often rare events, especially early in their development (Bakeman & Adamson, 1986; Masur, 1990; Moreno-Núñez, 2020). As a result, researchers often collapse these two object-extension gestures into a single category to increase the overall frequency of events (Bakeman & Adamson, 1986; Cameron-Faulkner et al. 2015; Lieven & Stoll, 2013). Theoretically, they are often collapsed into a single category (e.g., proximal declaratives) based on the belief that they both index the presence of a single underlying variable (e.g., a declarative motive; Carpenter et al., 1998; Cameron-Faulkner et al., 2015). However, in such cases, the category (e.g., proximal declarative) is still typically treated as a distinct and dichotomous, present/absent phenomenon.

[17] As an illustration, Boundy et al. (2016) sought to test whether infants' early object-extensions represent distinct intentions to "show" or to "give" through determining whether there are distinct micro-behaviours, such as arm and hand position, that are associated with each gesture. This involved two steps. First, two coders independently categorized infants' actions as either a show or a give. Next, quantitative analyses were used to determine which micro-behaviours were associated with which gesture. They argued that (1) infants' early gestures represented distinct communicative intentions to show or to give; and (2) the micro-behaviours associated with each gesture can help researchers distinguish between infants' early communicative intentions. However, infants' actions which could not be agreed upon by the coders were removed from the quantitative part of the study. Thus, the conclusion that "giving" and "showing" represent distinct communicative intentions was drawn by discarding the instances where this distinction was not clear.

conceptualized as dichotomous, present/absent phenomena (Allen & Bickhard, 2013; Bibok, 2011; de Barbaro et al., 2013). Thus, there is no need to pay any empirical attention to ambiguous actions. However, from the current action-based approach, it is through action that gestures, and thus communicative intentions, develop. Thus, ambiguity in infants' actions might represent key transitional forms in the development of intentional communicative gestures from prior ways of acting (Canfield, 1995; Carpendale & Carpendale, 2010; Carpendale et al., 2013; Clark, 1978; Mead, 1934; Vygotsky, 1978). And yet, this ambiguity is precisely what is overlooked in typical methodologies used to study object-extensions.

Further, definitions, and the coding schemes derived from them, in some cases represent only one aspect in determining whether an infant's action counts as an object-extension gesture. Often, the process through which researchers decide whether to code infants' actions as gestures—or whether to code the infant as a gesturer—involves criteria for attributing "intentionality" to the infant. That is, it is only if intentionality is judged to be present that the infant's action is coded as a gesture. Bates (1976, 1979) argues for three criteria for determining infant intentionality: (1) ritualization of the action; (2) the addition or substitution of signals until the goal is achieved; and (3) the use of gaze alternation. She argues that ritualization allows for the attribution of intentionality because the original action (e.g., reaching), which serves as a direct means to achieve the infant's goal, becomes stylized as elements begin to appear that serve no direct function in achieving the goal, but are rather produced so that another person might act on them (e.g., opening and closing the fingers).

As with high-level coding schemes, the use of such additional criteria has its place in research. For example, the goal of Bates (1979) was to investigate the relationship between intentional communicative actions and intentional action more broadly. However, as with the use of high-level coding schemes, the use of such criteria for attributing intentionality can be problematic, as it it is only when an infant's action is determined to be intentional that it is coded as a gesture and reported (e.g., Bates, 1976, 1979; Bates et al., 1975; Carpenter et al., 1998; Beuker et al., 2013; Crais et al., 2004). This is problematic from a Meadian perspective (Carpendale & Carpendale, 2010; Carpendale et al., 2013; Clark, 1978; Mead, 1934), as it neglects earlier forms of meaning—that is, the conversations of gestures—from which intentional object-extension gestures might develop. Thus, the requirement that infants' actions meet strict

criteria for intentionality leads to these prior forms of meaning being overlooked and thus not represented in the literature.

Second, definitions of object-extension gestures and their functions, and thus the coding schemes derived from them, tend to be focused solely on the infant's behaviours. For example, Boundy et al. (2016) define showing as "Infant holds up object in the view of the co-participant" (p. 89) and giving as "Infant hands over object to the mother in one action (i.e., no prompt from co-participant)" (p. 89)[18]. In such individualistic definitions, there is no role for the other person other than to be the recipient of a gesture—object-extension gestures are solely part of the behavioural repertoire of the infant. This practice might work if we are interested in capturing when the gesture is mastered by the infant—that is, when the gesture represents what Andrén (2010, 2014) calls *first-person intentionality*. This is what coding schemes are typically designed to capture. However, this is distinct from what Andrén refers to as *second-person intentionality*, wherein an action is recognized by others as a communicative act, regardless of whether it was intentionally communicative. From the current action-based approach, gestures develop within shared routines within which infants learn the significance that their actions have for others—that is, gestures develop within the space of second-person intentionality, consistent with Vygotsky's (1978) notion of a *zone of proximal development* (Clark, 1978; Lock, 1978, 1992). Thus, the role of the other person is critical for their development, and so it must be empirically treated as a constitutive part of the system within which object-extension gestures develop.

The consequence of conceptualizing infants' object-extensions as categorical phenomena and as individual competencies is that researchers construct coding schemes which (1) obscure the processes through which action-based approaches argue that gestures develop and (2) produce data wherein object-extension gestures suddenly appear, discontinuous with previous abilities[19]. What tend to follow from the appearance of qualitatively new abilities are theories that posit the development of a

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[18] Choi et al. (2021) point out differences in definitions of object-extensions found across studies. However, the definitions used by Boundy et al. (2016) are representative of how holdouts and gives are defined with regards to the individualistic nature of the definitions.

[19] Bibok (2011), de Barbaro et al. (2013), and Rodriguez (2009) each make similar arguments with respect to cognitivist theories of joint attention development more broadly. The arguments of de Barbaro et al. (2013) were particularly influential for my arguments in this section.

qualitatively new cognitive ability in order to account for the changes in behaviour (Bibok, 2011; de Barbaro et al., 2013; Reddy, 2003, 2010), such as an understanding of others' minds (Camaioni, 1997; Camaioni et al., 2004; Carpenter et al., 1998; Lieven & Stoll, 2013; Stern, 1985; Tomasello, 1995, 1999, 2008, 2019; Tomasello et al., 2005). Thus, what begins as a metatheoretical assumption—that infants' object-extensions express individually formed, discrete communicative intentions—leads to the production of data that seem to require a cognitivist theory to explain it. Such a feedback loop is what Danziger (1985) calls a *methodological circle*. In this phenomenon, researchers make methodological and data analytic decisions which follow from their theoretical framework, but which load the dice in favour of their own theory and against competing theories. This need not be intentional on the part of the researchers. However, if our goal is to explain the ontogenetic origins of object-extension gestures, then this link between metatheory and method must be acknowledged.

Just as certain methodological decisions follow from a cognitivist perspective, a particular methodology follows from the current action-based perspective (Carpendale et al., 2013; Carpendale & Carpendale, 2010; Carpendale et al., 2021). Based on the relational perspectives of Mead (1934), Vygotsky (1978), and Wittgenstein (1953/2009), this methodology focuses on describing the emergence of increasingly complex forms of communication as infants and their caregivers coordinate their activities within shared routines. For the current thesis, the focus is on describing this process as it relates to the emergence of triadic forms of communication involving infants' use of object-extensions. Because it is within dyads that communication develops, it is only through a close examination of dyads that the development of communication can be described and explained (Carpendale & Carpendale, 2010). This is best facilitated through a case study approach that focuses on describing development within a small number of dyads—a methodology that has a rich history in infant developmental research (e.g., Bates, 1976; Bruner, 1983; Fogel et al., 2006; Piaget, 1952; Trevarthen & Hubley, 1978). One practical advantage of this approach is that individual differences amongst dyads can be highlighted, rather than painted over, as is typical with methodologies that focus on large numbers of infants in order to achieve the statistical power necessary to detect statistically significant relationships (Carpendale & Carpendale, 2010). Thus, a case study approach allows for the discovery and examination of different developmental pathways.

Chapter 4.   Current Study and Purpose

Few attempts have been made to illuminate the ontogenetic origins of infants' object-extension gestures. As a result, the processes through which object-extension gestures develop are not well understood. This partly stems from the lack of a detailed description based on careful, naturalistic observation of infants' early object-extensions before they are mastered as intentional gestures. I have argued that one reason why detailed descriptions are missing is due to researchers conceptualizing infants' object-extensions as mutually-exclusive, categorical phenomena (e.g., intentional/unintentional; showing/giving; declarative/imperative), and as inherently individual competencies, thus obscuring the processes through which intentional object-extension gestures emerge from prior shared ways of acting. Careful description of the phenomenon is a necessary step for constructing sound scientific theories but is often overlooked in psychology (Carpendale et al., 2021; Rai & Fiske, 2010), which tends to be "observation- and description-deprived" (Rai & Fiske, 2010, p. 107).

My goals for the current thesis are thus (1) to remedy this gap in the literature to some extent through providing a longitudinal qualitative description of infants' object-extensions as they develop within three infant–caregiver dyads; and (2) to trace possible pathways to the development of object-extension gestures within each dyad. Both study goals are informed by Mead's (1934) distinction between forms of meaning. According to Mead, intentional (i.e., significant) gestures are rooted in prior shared ways of acting—that is, conversations of gestures. Within these conversations of gestures, dyads begin to coordinate their activities through mutual anticipation based on a shared history with the activity. Through this process, (1) stable, repeatable routines develop within dyads (Clark, 1978); and (2) intentional gestures develop as infants begin to anticipate the response to their actions, which had played a role within the conversation of gestures, and so begin to use those actions to initiate that routine. For the current study, the application of this framework involves describing the shared activities within which infants' object-extensions play a role and tracing these forms of object-extensions to later forms that are used in ways that suggest that they have become intentional means of initiating the shared routine.

4.1. Methods

Participants were three infants (two boys, one girl) living with their families in Greater Vancouver. Parents were recruited for a longitudinal study of infant gesture development through word of mouth[20]. They were not told that the study was specifically about infant object-extensions. Ages were chosen based on past research to capture the infant's earliest uses of object-extensions (Bakeman & Adamson, 1986; Bates et al., 175; Carpenter et al., 1998; de Barbaro et al., 2013; Masur, 1990). However, one infant (the girl) was dropped from the current analysis because (1) she was already using object-extension gestures at the beginning of the study; and (2) there was relatively little change to her use of object-extension gestures throughout the course of the study. Infants' ages at the start of the study ranged from approximately 8.5 to 10 months, and by the end of the study ranged from approximately 13 to 14 months. Details about each infant's age range during the study are provided below. The study ran between September of 2019 and March of 2020. Two methodologies were chosen that were designed to complement each other with the goal of producing longitudinal data from which the development of infant object-extensions could be described in detail.

4.1.1. Home Sessions

I video recorded infants in their home family contexts for the duration of their participation in the study. Numbers of recording sessions, times between sessions, and the ages of infants during each session are given below for each infant. The goal of the home sessions was to collect a set of data-rich videos in a naturalistic setting from which infants' object-extensions could be carefully described. The recording setup included two cameras. One was held by me for the duration of the sessions. I held this camera lower down in my lap with the viewscreen angled up towards me so that I could see what the camera was capturing while keeping it as inconspicuous as possible. For the majority of the sessions, particularly in the earlier sessions, the camera was largely ignored by the infants. The second camera was situated on a tripod in a location chosen to capture as much as was possible. Parents were not instructed to keep their infants within sight of

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[20] The current thesis was based on secondary use of data that was collected as part of a larger study on infant communication development. However, this fact has no implications on the nature of the methods, procedures, or analyses, as the larger study was designed with the current thesis in mind.

the tripod camera. This allowed for more free-flowing interactions during the sessions. As a result, some parts of each session were not captured by the tripod camera and were only captured by the handheld camera. Recordings were 60 minutes per session. A small number of sessions, where there were time constraints due to scheduling conflicts, were between 25 and 45 minutes. There were no research assistants or other experimenters involved in this process, with the exception of one graduate student accompanying me in the introductory meeting of one of the infants to facilitate the introduction.

During these sessions, I was not a passive observer but an active participant. This was a deliberate choice and was made for both practical and theoretical reasons. From the current action-based perspective, communication develops within dyads (Carpendale & Carpendale, 2010). Thus, part of the process of describing each infant's developing skills involved getting to know the infants and their caregivers well. This was facilitated through treating each session more like a visit from a family friend, where we could sit and talk about the infant's developing skills. This also involved the infants and parents getting to know me so that they would be comfortable with me in their homes. Being an active participant also allowed me to see how the infants treated people other than their parents as interactive partners, as well as how they began to coordinate interaction with multiple partners. It also allowed for me to get a feel for infants' developing skills as an interactive partner when they engaged with me, which each infant did at certain points during each session. That is, it gave me a feel for, or a second-person perspective on, their developing social and communicative skills (Fuchs, 2013; Lock, 1992; Newson, 1978; Reddy, 2018). Practically speaking, with my goal of capturing infants' object-extensions in their everyday contexts, along with the infrequency of early object-extensions as has been reported by Bakeman and Adamson (1986), the recordings needed to be of a sufficient length in order to capture as much as possible. In an enclosed space such as a home, it would have been difficult to record the infants as an observer for 60 minutes without asking parents to keep their infants engaged for the duration of the sessions. I felt that it would have been unreasonable to ask this of the parents for such a long duration.

4.1.2. Diary Method

The home sessions were supplemented with a diary methodology (Bates et al., 1975; Carpendale & Carpendale, 2010; Carpendale et al., 2021; Gómez, 2010; Kettner & Carpendale, 2013, 2018). The goal of the diary component of the study was to capture changes in infants' object-extensions that occurred between home sessions, as well as rare events that might be theoretically important but difficult to capture on video. Parental diary methods are well suited to this task because the observations are made by caregivers who spend a significant proportion of their time with their infants and so can better place the infant's actions within the context of the infant's current and past skills (Carpendale & Carpendale, 2010; Kettner & Carpendale, 2018). One additional advantage is that diary methods allow for object-extensions to be described outside the home setting and in contexts that are not typically part of methods based on video such as bath time or feeding routines.

Parents were provided with their choice of a physical copy or a PDF of specific instructions for the diary component of the study (Appendix A) along with sample observations to illustrate what they should look like (Appendix B). Parents were not asked to write observations according to any fixed schedule. They were instructed to record general descriptions, examples of, and changes in their infants' gestures, ways of making requests, and ways of getting attention. Additionally, parents were instructed to provide objective details in their observations, including their infant's use of gaze, vocalizations, indications of enjoyment, body- and arm-position, and whether and how objects were involved in the sequence. They were also instructed to describe how they interpreted and responded to their infant's actions, as well as their infant's reaction to their response (e.g., satisfied, persistent).

Parents were instructed to send the observations through email, either in the body of the email or in an attached Word document. Throughout the course of the study, parents were asked in email exchanges and during the home sessions to clarify and elaborate on some of their diary observations. Additionally, as their infant's skills changed and new forms of object-extensions emerged, parents were asked to pay attention to and write diary observations of specific behaviours, such as the changing use of gaze or indications of enjoyment, within specific routines. This process allows for specific details to be captured, allowing for a more detailed sequence of observations to

be described. Some of the diary observations presented have been edited in minor ways for flow and to correct punctuation and spelling.

4.2. Analytic Strategy

The present qualitative analysis was conducted in six steps and took place after the conclusion of the study. First, I watched and carefully transcribed the videos over the course of several months. This involved three steps. (a) I watched the videos and isolated sequences where the infant is holding an object. (b) I noted sequences where infants' actions either fit with object-extensions as they are defined in the literature (Boundy et al., 2016; Boundy et al., 2019; Carpenter et al. 1998; Choi et al. 2021) or functioned as object-extension gestures, based on how their caregivers responded to their actions. For step (b), I cast a wide net relative to other studies investigating object-extensions because I was not concerned with deciding whether the infants' actions represented a clear instance of an intentional gesture or a pre-defined category thereof ("showing", "giving", "declarative", "imperative"). This is because the current study goal was to trace the development of object-extension gestures which, according to the current action-based approach, develop from prior, unintentionally communicative actions through how others respond. Ambiguity thus might represent these prior forms of meaning or represent transitional forms between these two forms of meaning (Mead, 1934). For this reason, when I refer to infants' object-extensions in the current analysis, I describe them based on their objective characteristics (e.g., object-transfer, holdout), rather than as "showing" or "giving", as the latter might imply that the infant has a communicative intention. (c) I went back over each sequence carefully, in several iterations, to describe them and fill in details. Part of step (c) involved carefully examining the sequences to determine whether the object-extensions captured in step (b) were functioning as communicative actions and cutting sequences where they did not satisfy the criteria laid out in step (b).

Second, I isolated the diary observations that involved infant object-extensions. Third, for each infant, I combined the diary and video observations and placed them in a chronological order. Fourth, for each infant, I organized the observations to illustrate significant changes in their uses of object-extensions throughout the course of the study. Changes to the ordering of the observations between steps 2 and 3 were minimal (one for DL, three for AM) and were the result of deciding to group together similar

observations that took place within a short span of time. Fifth, from the total pool of observations, I selected which ones to present for analysis. Several observations were omitted to avoid redundancy, as they were not significantly different from other observations that are presented. In the final step, I analyzed each sequence in light of the current study goals.

4.3. Analysis of Selected Observations

4.3.1. Infant DL

I begin with DL, whom I video recorded in five sessions, not including the introductory meeting at 9;29 (month;day). These sessions took place in the home at 10;06, one month later because of illness at 11;02, and then at 11;13, 11;27, and 13:02. Primarily, these sessions involved DL, the mother (M), and me. On some weeks, the father (F) was home, as well as DL's sister (S; age 3) and his brother (B; age 10). Both parents were born in Canada and are of European background. M had a master's degree and was on maternity leave during the study. F had a PhD and worked as a post-secondary teacher. In the introductory meeting, I asked about DL's current use of triadic gestures. At the beginning of the study, he was not yet pointing to communicate. He also was not holding out objects towards others. He had "given" objects to others in two ways. First, on one occasion he had put a biscuit into M's mouth while she was feeding him in a highchair. There was no indication that he had a social goal as he did this, as he did not look at her eyes and showed no positive emotional expressions, which are typical of face-to-face interactions, but are not typical when infants engage in solo play with objects (Adamson & Bakeman, 1985; Stern, 1977, 1985; Tronick, 1989; Weinberg & Tronick, 1994). As Carpendale et al. (2021) suggest, these early forms of object-transfers might result from infants seeing the affordance of a mouth, knowing that this is where food goes. Second, when DL did place an object in someone's hand, he again did not look at the recipient's eyes. Therefore, there is no evidence that he had a social goal in these instances. However, soon after the start of his participation in the study, DL began to hold up objects towards M while making eye contact.

> Diary Obs1—10;03. DL was on my lap using a teething ring toy. A few moments after using it, he turned to look at me and reached the toy up to my eye level. I asked, "What's that? Is that your teether?" I made a face like I was going to bite the teether and he put it back to his mouth

and continued chewing on it. He looked at me a few more times and held it up in the same way and I would ask again, "what's that?" and he'd take it back and continue chewing.

To M's knowledge, this was the first time DL had held up an object to someone. This was also the first time he had extended an object towards someone and looked at them in the eyes. M later clarified that she thinks DL was holding the toy up to see what her reaction would be. It is not clear that DL had a particular goal, nor that he was anticipating any specific outcome. However, M does respond to DL's object-extension, and so DL's action does function to get a particular activity going, based on M's response. She notes that he remained serious throughout the interaction and was focused on the toy when he took it back. However, sequences involving DL's object-extensions start to become clearly enjoyable for him.

> Diary Obs2—10;07. While waiting in line to pay I gave him my debit card to hold, and he was really interested in it. He passed it back and forth in his hands and would look at it and then look back at me. He passed it back to me a few times, looking at the card as he passed it and then at me as I took it. When I gave it back, he started to wave it and began tapping it on the handle of the grocery cart a few times. At first, he was looking at the card and (I think) at the sound it made then the third or fourth time he tapped it he looked at me and smiled when it made the noise. I talked to him while he was doing all this ("what have you got?... Have you got all my money?... Do you have my card?... Wow you're making noise!").

Similar to Diary Obs1, DL is looking at M during the object exchanges. What follows this exchange is M's attention on DL's actions with the card. When DL looks up at M and smiles, it is not clear whether he is doing so because he wants to share the experience with M or if this is a response to her talking to and paying attention to him. This observation shows that M is attentive and responsive to DL's object play, as she is first participating in a give-and-take sequence before talking to him about the object as he acts on it. It also illustrates that sequences involving DL's engagement with objects are opportunities to enjoy emotional contact with M. Through M's response, at this point, some of DL's object-extensions are starting to involve, or become coordinated with, his enjoyment of contact with M. This starts to become evident two days later.

> Diary Obs3—10;09. I was rocking him in the chair and trying to get him to sleep but he was fidgeting and not settling. He kept grabbing my face and staring at me and smiling with his soother in his mouth. His soother fell out and he grabbed it with his hand and tried to give it to me, putting it near my mouth. I pretended to take it (putting the handle in my mouth

and turning my head away). He would reach out and try to take it back and smile as I turned my head from him, playing "keep away." When I let him have it back, he smiled at me, while making eye contact. He kept trying to give me his soother again and again, and he also started laughing when the soother dropped on the floor (which it did a couple of times...).

In this observation, DL and M are first engaged in face-to-face interaction, which DL is enjoying, before he extends the soother to M's mouth. M interprets this as DL trying to "give" the soother to her. His actions to this point are similar to his actions in Diary Obs1, where he extended the teether ring towards his mother. However, this time M responds to his action by teasing him, which changes the emotional character of the exchange. One possibility is that DL's response to M's teasing (his first smile) is because her response violated his expectations, based on previous similar sequences (Diary Obs1). Based on his enjoyment of M's teasing, he tries to repeat the action, which M obliges, likely because of her own enjoyment of engagement with DL. Based on this mutual enjoyment, his initial object-extension turns into a fun game that both participants work to continue and maintain. This is the first time an activity initiated through his object-extensions have become clearly coordinated with his enjoyment of engagement with M.

The first home session took place in between Diary Obs. 1 and 2. In the diary observations, sequences that were initiated by DL's object-extensions were beginning to become coordinated with his enjoyment of engaging with M. In the following sequence (Video Obs1), DL is awaiting M's attention before he makes social contact with her, which is a common way that engagement is initiated. Sometimes, DL seeks out engagement and contact with M when he is holding objects. In so doing, he places the object in a shared space where M can engage with him around the object.

> Video Obs1—10;06. DL, M, and I (BW) are sitting in a triangle. M and I have our attention on him. He is holding a ball in his hand—an "Oball rattle" that can be easily gripped by infants and can be shaken to make a noise. M and I stop looking at him and talk to each other. During this, he is smiling and shaking the toy, looking back and forth between M and me. He seems to be waiting for our attention, which continues until M looks at him and shakes her hands. He turns and crawls towards her and M puts both her hands out and asks, "what you got?". Before he reaches her, he shakes the toy in front of one of her outstretched palms. She says "oh my gosh, it's so noisy! Can I try?", while holding both her palms up near the floor, perhaps in anticipation of either receiving the object or helping DL stand or get closer to her. As he gets closer, he places the hand with the toy in her lap. M tries to take the toy, but he pulls back, sits up on his knees, and starts to shake the toy. M takes the

toy from him, and he does not protest. Rather, he sits back and up as M starts to shake it, watching her hands as she does this. He then takes the ball back from M, vocalizing as he does so, to which M excitedly says, "Oh that's so cool!". DL begins to shake it, first at a normal pace, then as his excitement builds, he starts to shake it more vigorously while looking at M. They are both laughing while looking at each other.

This observation illustrates a shared routine involving an object that M and DL engaged in several times in the first home session. It involves an exchange of the toy, though it is M who initiates this exchange as she takes the toy from him. This is consistent with Clark (1978), Bruner (1983), and Carpendale et al. (2021), who note that caregivers often scaffold infants' early "giving" through taking the object from their infant's hands. When M takes the toy, she acts on it through shaking it, mirroring DL's previous actions on it, before letting DL take it back. Cameron-Faulkner et al. (2015) found that the most common sequence involving infants' object-transfers at 10 months was: infant gives object > caregiver acts on it > caregiver returns it to the infant > infant acts on object. This sequence is a common occurrence when M and DL are jointly engaged with an object throughout the course of the study, though it is typically initiated through M taking the object from DL when he places it between them. This is a steady, repeatable pattern that takes place within the broader routine of M and DL engaging with each other around an object. It can also again be discerned in the following sequence.

> Video Obs2—10;06. DL is sitting down with a ball in his hand. He turns back towards M, who holds out both her palms and says, "Can you share with mommy?". He twists to try to put himself into M's outstretched hands as if he is trying to use her assistance to stand up. M pulls her hands back and starts to take the ball with one hand while helping him up with her other hand. DL pulls the ball away from her outstretched hand and shakes the ball, hitting it against her palm. He drops it in her hand, but immediately after this tries to close his hand around the ball again to grab it. However, M is already lifting it away from him, as DL keeps holding his arm up and seems to be trying to reach for the ball. M begins to shake the ball while looking at it. DL stops actively reaching for it and, instead, intently watches M shake it, with a bit of a smile. M says, "Oh my gosh, it's so shaky, okay" as she continues to shake it and her smile gets bigger. DL looks from the shaking ball towards M's eyes. When she turns her gaze back from the ball towards him, he begins to vocalize excitedly and shake his arms up and down. M excitedly says, "It's so shaky! You wanna have it back?" and puts her palm up with the object towards DL, who takes it back from her, stands up, and shakes it in front of her before accidentally dropping it.

In this observation, M continues to scaffold DL's sharing of the toy, though this time he is, at least at first, reluctant to give it up. She attempts to get DL to give her the toy

through putting her palms up and asking for DL to share. However, as with Video Obs1, DL uses this as an opportunity to stand, rather than give her the toy. As these requests do not work, she takes the toy from him as it drops from his hand. Again, this is not an intentional transfer by DL, but it functions to transfer the object to M. This is consistent with Bates et al.'s (1975) description of Carlotta in their diary study. They note that it was difficult to discern precisely when Carlotta began to intentionally give objects to others because, at first, her "giving" was more of an unintentional dropping of objects into others' hands when she was distracted. When M takes the toy from DL, the same pattern observed in Video Obs1 occurs. M acts on it and gives it back to DL, who then acts on it in turn. This pattern contains two additional, emotional characteristics which are present in the majority of its iterations. First, as M acts on the object, DL watches intently and with interest. Second, a significant aspect of this pattern is a sharing of emotions, particularly excitement. In Video Obs1 and 2, there is a ramping up of excitement while either M or DL acts on the object and the other observes. It is clear that it is not just the act of shaking that is leading to these emotional crescendos, but rather excitement based on sharing in the activity. Later in home session 1, DL seems to try to initiate this routine again, this time assimilating a toy cup into the routine.

> Video Obs3—10;06. M and I (BW) are sitting on the floor having a conversation, not really attending to DL, who is sitting playing with a toy cup while facing towards M. He turns towards M and puts his free hand on her leg. He brings himself to the same kneeling position that he was in Video Obs1, looks up towards M, and begins to wave his arms a little. Throughout this, he is vocalizing persistently, perhaps in an attempt to get her attention. She notices and tries to grab his arms, interpreting his actions as him wanting to stand. As she does this, he frees his right arm (which is holding the toy) and holds the toy up between them, but then lets her take his arm again and help him stand. Standing, he frees both arms and lunges towards her. She helps him stand just in front of her, holding him by the torso. He starts to wave the toy in front of him, just a bit to M's left, while vocalizing and bouncing up and down. M and I continue to converse while M only looks at him for brief moments to check in, without addressing him. DL is vocalizing throughout this. Finally, M breaks off from our conversation and, looking at him, says "What are you doing, are you shaking?". He turns to fully face her, stops vocalizing, and holds the toy up towards her and shakes it. At this, she says "Should we go put that one with the others?". While shaking it, he lets go and, whether intentional it not, the toy goes flying off to the side. M proceeds to gather the set of cups so that she and DL can stack them.

In this observation, it looks as if DL might be trying to get the previous "shaking" routine going by facing her with the object in his hand, trying to get her attention. At first, M does

not respond to his actions as a bid to engage around the object, but rather as a request to help him stand. When M finally orients visually towards DL, she responds to him and the toy he is holding. DL in turn responds by holding the toy cup in front of her face and shaking it. There are several possible interpretations of his actions in this observation. First, holding the object up towards M's face might be considered a holdout gesture. However, his actions are also consistent with Boundy et al.'s (2019) notion of using a toy as an attentional tool, which they argue are distinct from holdout gestures in that they are used by infants to gain attention to the self, rather than to share attention on the object. In both home session 1, and home session 2 one month later, DL enjoys acting on objects—particularly shaking them—while maintaining eye contact and smiling. During these interactions, he does not alternate his gaze between the person and the object. A lean interpretation of this behaviour might be that DL enjoys others' attention on him while he is engaged with an object, as opposed to coordinating attention between the person and the object (Boundy et al., 2019). However, M does typically respond to these actions through commenting on the object (e.g., "it's so shakey!"). A third possibility is that his actions are based on his experience within the "shaking" game seen in Video Obs1 and 2, and so he is trying to initiate this game again. However, rather than responding to his actions as a bid to get the "shaking" game going, as she did when he shook the ball in front of her, M suggests that they put the cup with the others. Previously in home session 1, DL and M had engaged in the shared activity of stacking the set of cups. Thus, based on (1) the affordances of the different toys, and (2) the shared history with DL, M's response to DL's similar action of placing a toy between them and shaking it results in a different routine. Later, DL also shows some discrimination of the different social affordances of his toys.

> Video Obs4—10;06. We are all sitting together. M and I (BW) are having a conversation not really paying attention to DL. He is playing with toy cups, concentrating on them, not trying to involve us in his activities nor get our attention. He then drops the cups, picks up the ball from Video Obs. 1 and 2, and reaches out towards M with the ball in his hand. Rather than grabbing the ball, she grabs his arm to help him stand. At this, D drops the ball and watches it roll away. He then turns back to face M and starts bouncing up and down and vocalizing excitedly while looking at M, who then engages with him in a face-to-face interaction.

Prior to this observation, when DL and M were stacking cups together, DL's emotional state was one of focus, rather than joy. Additionally, throughout the "cup" routine, DL rarely looked towards M, and did not give her the cups for her to act on them. Thus, this

routine did not involve the same kind of emotion sharing or mutual responsiveness as the "shaking" routine. In this observation, DL is playing with his cups, and it is only when he grabs the ball that he attempts to re-engage with M by making physical contact with her. One possibility is that DL has learned that the ball is a means through which he can make enjoyable, emotional contact with M. However, as DL attempts to re-engage M, she is not fully attending to him, and so she does not provide the same scaffolding as she does in Video Obs1 and 2 by ensuring that the ball remains in the shared space. Instead, DL drops the ball. It is not clear whether this was an accident or whether he anticipated that M was going to take it, like in Video Obs1 and 2. However, after the ball rolls away, DL "settles" for an enjoyable face-to-face interaction.

These triadic interactions, particularly Video Obs1 – 3, are routine forms of engagement between M and DL that start to become more complex in the following home session, which took place one month later. In home session 2, there are several observations of DL holding objects up and out towards M within routines where they are engaging around an object.

> Video Obs5—11;02. M and DL are sitting together, playing with toys. The only object exchanges involve M giving toys to DL. He then reaches for a new toy, a stuffed elephant, from behind him. When he turns back, he is holding the elephant in one hand while both arms are raised upwards (holdout 1; HO1) as he faces M. They look at each other and DL smiles as M puts her palm up and says "What? What did you find?". Smiling and vocalizing, he crawls over to her and as he reaches her, the elephant drops in her lap. She picks it up and says, "Is that an elephant?", then shakes it in front of him as he looks on. He reaches up to grab it, and M lets go. He then hugs the elephant, to which M responds, "Aww, that's nice". He keeps the elephant between them and begins to touch the elephant's face with his index finger while looking at it. While he does this, DL and M are engaging in a "conversation", with M talking to him about the elephant and DL responding by vocalizing. This continues for several turns before he pauses his interaction with the elephant to look up at M. After this, they engage in face-to-face interaction for a few seconds before DL returns to exploring the elephant's face.
>
> M holds out both her palms and says, "Can I see?". He looks at her palms for a moment and, as he looks back up at her face, he also raises both hands towards her face, including the one with the elephant in it (HO2). M's hands close around the elephant and she says, "Thank you! Should I give it a hug?" and hugs it. DL still has not let go of the elephant and, as M is hugging it, he looks like he is trying to pull it back from her. She lets go and he pulls back, smiling and vocalizing happily.

He holds the elephant up between them while M continues to talk to him about it, then raises it back towards M's face, using both hands (HO3). M grabs the elephant and says "Should I hug?". DL releases the elephant, though it is not clear whether he intends to transfer it over. M says "Should I give the elephant a hug? Aww!" and hugs the elephant as DL alternates between looking at the elephant and at her. M hands it back to him.

He holds the elephant between them, looking between the toy and M. He holds it up towards her face again, using both arms (HO4). She says, "Should I take it back?" and tries to take it, but he doesn't let go and instead swings it towards his side and away from her hand. She says "Oh, you're just showing me". He moves the object back in between their faces and begins to explore it with his other hand while she looks on.

This observation illustrates that DL is becoming skilled at coordinating his attention and activities with others around objects (Bakeman & Adamson, 1984; Carpenter et al., 1998), and shows how M is complementing his developing skills through engaging him in more complex and elaborate sequences than were observed in home session 1 (de Barbaro et al., 2013). In contrast to the relatively straightforward structures observed in Video Obs1 and 2, this sequence involves several different "mini sequences" involving mutual responsiveness in between moments where DL is exploring the stuffed animal's face while M talks to him. However, even when DL is engaging visually and haptically with the elephant, he is still engaging in a proto-conversation with M as she talks to him about the elephant, and seems to enjoy engaging with the elephant while M's attention is on him. Additionally, in this observation, DL produces several holdouts and object-transfers that function in particular ways within the interaction. In the first holdout (HO1), DL first holds an object upwards after retrieving it. It is not clear whether DL was holding up the object for M, as he had both arms raised in the air and did not extend it out towards her. His actions look similar to others in home session 1 and 2 where, when DL has an object, he will act on it—typically through shaking it—while making eye contact with another person and smiling. HO1 shares the same "upward" characteristic of his prior holdouts, rather than the "outward" arm extension that typically characterizes holdout gestures (Boundy et al., 2019; Carpenter et al., 1998; Choi et al., 2021). However, in contrast to previous holdouts, HO1 does not involve any actions on the object. M does respond to his holdout, which DL takes as an opportunity to engage with her in his characteristic way of making physical contact. Thus, his action functions to get an interaction going based on M's response. A similar pattern as observed in Video Obs1 and 2 can be discerned from this interaction, which involves the following: M

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takes/receives object > M acts on object > DL and M share positive emotions > DL receives the object back. However, in contrast to prior observations where each observation of the pattern was initiated by M taking the object from DL, it is initiated several times within the same sequence through DL's object-extensions, either spontaneously (HO2) or in response to M's request (HO3). Similar to home session 1, these moments during and after M acting on the object involve positive emotional expressions from DL and M as they look at each other. In contrast to home session 1, as DL watches M act on the elephant, he alternates his gaze between M's face and the elephant, reflecting his developing skills at coordinating triadically. DL held up an object towards M in one more sequence in home session 2.

> Video Obs6—11;02. M and I (BW) are talking, not paying attention to DL. He is standing a couple feet away from M, supported by an ottoman footstool, which is between them. He is playing with a playing card while facing M. He looks up towards her and gives an insistent sounding "uh" vocalization, before looking back down towards the card. After a few seconds, M turns and looks at him. He looks back towards M's eyes and smiles. M says, "What did you find? What's that? Can I have that?" and holds up her palm. At this he vocalizes sharply and continues playing with it. M tries to take it, but he is reluctant to give it up. M informs me that it is one of her daughter's playing cards, which he should not be playing with. He moves around the ottoman to get closer to M while she continues to try to take the card. M continues talking to him, asking for the card. He briefly lifts the card in both hands towards her face and back down (HO5). M tries to take the card again. He avoids her hand and moves the card back upwards and towards her face, using both hands. She eventually grabs it out of his hands, which he is not happy about. She notices that it is a joker, and so not likely to be a valuable card to his sister, and so she hands it back to him. At this point, he is sitting, facing M. He leans in towards her with the card in both hands in front of him, and M tries to take the card from his hand again. He pulls his hands back, leans back, and holds the card up towards M's face (HO6), first with one hand then with both hands. It is difficult to tell whether he is only looking at the card or alternating between looking at the card and M's eyes. As he slightly lowers the card, he briefly looks to M, who does not respond as she continues looking towards me. After a second, and with no response from M, he lowers the card and looks away from M's face before crawling away.

In this observation, DL tries to get M's attention while holding a card, which is successful. DL shows awareness of the meaning of the palms-up gesture, evidenced by his sharp vocalization in response to M's palms-up gesture combined with his reluctance to give the card up throughout the sequence. DL produces two holdouts (HO5 and HO6) within this sequence which, similar to Video Obs5, both involve extending the object

upwards, towards her face. Additionally, DL starts to show some persistence in his holdouts. During HO5, M repeatedly tries to take the card from DL. At the same time, DL is alternating between trying to hold the card up to M's face and avoiding her attempts to take it. This happens three times during HO5. This perhaps shows some anticipation of the social outcome of holding up an object towards M and might constitute an early form of "showing" objects to others for the purpose of sharing attention. However, during both HO5 and HO6, DL continues to manipulate the card with both hands as he holds it up towards M. Thus, his holdouts show similarities to earlier observations from home sessions 1 and 2, where DL enjoyed others' attention on him while he acted on the object. In these earlier forms, his visual attention would remain focused on the person, rather than on the object. In contrast, in HO5 and HO6 he alternates his gaze between M and the card as he manipulates it. It is possible that the holdouts seen in this sequence represent a more complex form of his use of objects in home session 1 and earlier sequences in home session 2—that is, as an opportunity to enjoy M's attention on him as he engages with an object, rather than to show M the object for the purpose of sharing attention. His ability to alternate his gaze allows him to monitor M's attention as he engages with the object. Soon after home session 2, DL's object-extensions begin to become clearer and more deliberate.

> Diary Obs4—11;05. Tonight, DL started deliberately showing and passing a toy around to me, and the whole family. We were sitting in the living room watching a movie together and he was puttering around playing with his toys. He crawled over to the couch where I was sitting and held up one of his stacking cups, making eye contact with me. I went to take the stacking cup (thinking he wanted to give it to me) but when I took it, he reached back out for it, keeping eye contact. He kept putting it back in my hand making an "Uh! Uh!" sound. I would respond saying, "Is that your cup? Nice cup! Are you sharing your cup with me? Cool! Here you go, take your cup." Then he turned to S, who was sitting beside me, offering her the cup too. She took it and made a silly gesture and DL did the same "Uh! Uh!" noise before taking it back. He repeated that with B who was sitting on the other side of the room. Each time he was looking not at the cup but at our faces and making eye contact.

In this observation, clear discernable changes are evident in DL's use of object-extensions, which were present in the majority of his object-extensions from this observation forward. First, his object-extensions have become much clearer and deliberate—that is, they have become more consistent with the typical characteristics used to define different object-extension gestures (Boundy et al., 2016, 2019; Carpenter et al., 1998; Choi et al., 2021). In the majority of observations from this date, there is no

longer the same degree of ambiguity as in home sessions 1 and 2 in whether he is using an object-extension. However, it isn't always clear what his goal is. In Diary Obs4, it is clear that he has a social goal, and shows some sign of expecting if not a specific response, then at least a response from his family members. However, his actions are still ambiguous in terms of what his expectations are, or whether he has a specific goal. Similarly, his goal is not clear to M, who first interprets his action as a "give", before commenting on the toy. A second discernable change, which is evident in Diary Obs4, is that he is now more active in initiating interactions through object-extensions. Prior to this point, even though DL was initiating engagement, all of his object-transfers during the home sessions were facilitated by others taking the objects from him or were at least not clearly initiated by him. Additionally, all of his holdout gestures that did not involve object-transfers took place when M's attention was already on him. Third, he is beginning to coordinate his triadic engagements with more than one person at a time. In home sessions 1 and 2, within joint engagement with M, his object-extensions and transfers were exclusively aimed at M, with only minimal gazing towards me. He now begins to alternate his gaze and extend objects towards multiple others during sequences involving objects.

In addition to these changes, M notes that object-extensions have now become a frequent—or in her words, "big time"—part of his means of initiating engagement with others. This contrasts with the general pattern found by Bakeman and Adamson (1986) that object-extensions do not become a common part of infants' behavioral repertoire until well after the first birthday. However, when individual differences are reported, large variations are found between infants in frequencies of object-extensions from early on (Crais et al., 2004; Masur, 1990; Moreno-Núñez et al., 2020). In addition to using object-extensions frequently and clearly, DL is now using them within several distinct routines and to accomplish several goals.

> Video Obs7—11;13. DL and I (BW) are sitting facing each other while M is in the kitchen. He is holding a toy car, which I briefly gesture towards with my hand with a half reach, half point, before pulling my hand back. He reaches out and puts the car in my hand while looking at my hand. He takes it back right away and looks up at my face. He begins to wave his arms up and down excitedly and smiles. I offer him a different toy car, which he reaches for. He grabs this new toy car from my hand and drops the old one. As I say "Oh, what have you got there?", he reaches out to give the second toy car back to me. I take it and he leans back, alternating between looking at my eyes and at the truck. He isn't

smiling, though he looks alert and interested, clearly engaged in the interaction. I accidentally press a button on the car which causes it to light up and start playing a song. I put it down in front of him, and he picks it up and plays with it using both hands. He is holding it in front of him, between us. He lets his left arm drop in front of him, using only his right hand to hold the toy. He extends the toy towards me and, as he does so, he raises both arms towards me. He places the toy in my hand and leans back, watching me. Soon after he hands the toy car to me, the lights and song turn off. I turn it back on and hand it back to him. He immediately extends it back towards me, holding it in his right hand. Again, he extends both arms towards me as he hands me the toy car.

Video Obs8—11;13. This observation picks up where Video Obs7 left off. As DL extends the object towards me, M enters the room. As he turns his gaze towards her, he swings his arm with the toy in it towards her, palm up, smiling as soon as he notices her. She is still standing across the room from him. His gaze drops to the toy car, and he drops his arm and begins to play with it on the floor. She begins to make her way closer to him, though she stops several feet away. As she moves towards him, he looks up at her and again extends the toy car, palm up, before lowering it once again. As M finally makes her way over to him, he again extends the toy towards her. M accepts the car from him and says "Oh, thank you for sharing", as he looks towards her eyes. He reaches to get it back from M and she hands it back. He tries to give it back to her, but accidentally drops it. As M picks up the toy car, he picks up a second toy car and extends this one to M, who takes it. He gives a small wave of his arms to indicate his excitement. M extends the first toy car to him, and he takes it. Immediately, he extends this one back to M, who takes it and says "Oh, I get both? Thank you". He watches her for a couple of seconds before reaching for one of the cars from M, who gives one back. He smiles, then looks over to me and, while smiling, crawls over to me and places the toy car in my hand. He leans back while looking from me back to the car. The sequence continues for some time as he continues to pass me the toy cars while smiling and watching me.

In previous observations of triadic interactions within the home sessions, DL had been an unequal partner, with much of his role being scaffolded by M. This was particularly true for object-transfers, which were largely facilitated by M. In this extended sequence, DL shows how he has started to become an equal partner within routines involving object-transfers in several ways. First, he responds to my request by giving me the object in a smooth and coordinated fashion. Second, when M enters the room, he extends the object towards her multiple times until she is in a position to take it, showing persistence in trying to engage with M triadically. Third, it is primarily DL who is structuring the interaction through choosing which objects to give to whom, and when. As a result, the sequences between the three of us are more complex and elaborate than previous triadic interactions, involving many more turns and the coordination of

multiple objects and people. In contrast with previous observations in the home sessions (Video Obs1, 2 and 5), there is little manipulation of the objects, but rather enjoyment in just exchanging to them, which he expresses through smiling and waving his arms excitedly. Thus, sequences initiated by DL that involve his object-extensions have started to become opportunities for mutually enjoyable engagement.

> Video Obs9—11;13. DL is sitting in M's lap facing towards me (BW). I am watching him as he eats crackers. As M hands him another cracker, he looks at me and briefly extends the cracker towards me (less than one second), palm up (HO7). M says, "Are you sharing or are you just showing?". As he pulls his arm back, he looks at the cracker, then back towards me. He continues to watch me as he puts the cracker in his mouth. When his hand is empty, he again holds it out towards me, briefly, and pulls it back. His sister gives him another cracker and he drops a piece of it. I hand it back to him. He is holding pieces of the cracker in both hands. He looks towards me and raises both arms in my direction (hands are empty now) while continuing to watch me. After a couple seconds, he lowers his hands. M's hand is open in front of her (he is sitting on her lap, facing away from her). He briefly puts one of the pieces of cracker onto her open hand. M, noticing this, says "Mm, is that for me?". He picks the piece back up and extends that hand towards me while looking at me. I move closer and put my palm up. He puts it in my palm but doesn't fully let go, watching what he is doing with the piece while it is touching my palm (he is turning it around in his fingers). After a few seconds, he looks back up towards my eyes, smiles, and takes it back and eats it.

In this sequence, DL produces several distinct object-extensions that function differently within the interaction. This includes placing the cracker in our hands while manipulating it, consistent with previous weeks where he would enjoy acting on objects in a shared space. This sequence also includes a holdout towards me that M is ready to interpret as "just showing", as DL will sometimes hold out objects towards others that he does not want to relinquish (e.g., the playing card in Video Obs6). However, one significant change that has occurred in DL's holdouts this week is that he is now holding out objects towards others at a distance. In the previous home session, he would only extend objects towards M when they were in physical contact (Video Obs5 – 6). Additionally, his holdouts would involve DL placing the object right up to M's face, in contrast with the current observation and his holdouts from this home session forward. In the following observation, DL shows his ability to use object-extensions to request that others play their role in an ongoing game.

> Video Obs10—11;13. M and DL are sitting across from each other, a couple of feet apart. DL's sister (S) is sitting on M's lap. M is holding a

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thin sheet that is approximately 18-24 inches by 18-24 inches. M and S play a modified game of peek-a-boo with him using the sheet. This involves three steps: (1) holding the sheet up between the two of them; (2) DL pulling it away, after which; (3) M exclaims "Boo!". He is really enjoying this game. After the first round, S grabs the sheet from DL's hands in order to get the game going again. After the second round, DL places the sheet on the floor behind him and stares up at M, vocalizing. M points to the sheet, which DL then look at, and hands the sheet back to her. In doing so, he leans quite far forwards to pass the sheet back to M. In the next round, he readily passes the sheet back to M. This time, he does not lean forwards to pass it back to M. Rather, he stays seated and raises his arm parallel to the floor and holds it there while looking at M, smiling and laughing as she takes it from him.

In this home session, DL's object-extensions are beginning to show characteristics of developing into intentional gestures. In previous observations of DL's object-extensions, they typically involved DL moving his body closer to the other person to facilitate the transfer or closer contact with the other person. In contrast, particularly with his second object-transfer in Video Obs10, his object-extension does not involve him moving closer towards M and S. Rather, consistent with Bates' (1976, 1979) characterization of intentional gestures, he raises his arm and waits for others to act on his object-extension, indicating that he has developed clear expectations about the outcomes of his action, and so is using it intentionally. In the following home session two weeks later, DL continues to use object-extensions during variations of the peekaboo game with members of his family.

> Video Obs11—11;27. DL is holding a small sheet. He makes eye contact with F and smiles. F responds by saying, "what have you got there, buddy?". DL holds the sheet up towards F while walking towards him. When he reaches F, F takes the sheet from him and DL sits, facing F. M interrupts the interaction by bringing the same sheet as in Video Obs11 and placing it over DL, covering his head. F puts the sheet DL had brought him aside. S walks in and takes the sheet away from DL. M returns and places the sheet on DL's head. DL and M then play multiple rounds of the game where (1) M places the sheet on DL's head; (2) DL removes the sheet from his head, (3) DL vocalizes in a happy, descending tone while he and M look at each other and share their enjoyment. In contrast to Video Obs10, during step (3), DL shifts his gaze to others in the room and smiles at them.

> Video Obs12—11;27. DL is on the floor and finds the same sheet, which is draped over the head of a large toy lion. He looks towards M, who eventually looks back towards him and says, "hello". He smiles and walks towards her with the sheet held out in front of him. As he does so, he slips on the sheet and falls. He continues to hold the sheet out towards M, who makes her way over to him. She takes the sheet from him. He alternates his gaze between the sheet and her eyes. M places

the sheet over her own head, which greatly amuses DL as he laughs and makes his way closer to her. He stands up and grabs the sheet off from her face. M says, "boo!", and they look at each while smiling. Later in the same sequence, DL gives the sheet to M to get the game going again. M obliges and puts the sheet over her head. DL reaches up and pulls it off, and they again shared eye contact and enjoyment. M then places the sheet over DL's head. He takes it off his own head and looks towards me while smiling and vocalizing happily.

In Video Obs11, DL responds to F's question by holding out the object and expressing positive emotions. This has become a typical response to when others ask DL questions about an object that he is holding. DL then uses these moments of others' attention on him to further interact with others. In both observations, DL is attempting to bring the sheet towards an attentive parent. Although it is not certain, it is likely that DL was trying to initiate the familiar game of peekaboo through transferring the sheet, based on shared history with his family. This is how both F and M interpret his actions, though the game is interrupted before F can participate, and in both cases, the game is played with M. In the following observation, DL more clearly uses an object-extensions to initiate an enjoyable routine.

Video Obs13—11;27. F is in the kitchen. DL walks over to him from a separate room, bringing a stuffed animal. He makes eye contact with F and holds the stuff unicorn up to him. F goes to his knees and says, "You sharing with me? Thank you". DL drops the unicorn in front of F, who picks it up and holds it up towards DL, saying "It's a unicorn". DL grabs it back and hugs it, making the same happy, descending tone that he made in Video Obs.5, when DL and M were hugging a stuffed elephant. DL extends the unicorn back out and up towards F, who takes it and says, "You wanna share. Thank you". DL and F continue to exchange the unicorn several times before the sequence ends when DL becomes distracted by a garbage can—which he is not allowed to play with.

This observation illustrates how DL is now clearly initiating triadic engagement through his object-extensions. Additionally, DL's ability to walk now affords him the possibility of bringing objects to others and so gives him even more opportunity to engage with others. Based on F accepting DL's overture, they engage in a routine that DL has engaged in with M from home session 1, involving (1) the pattern of caregiver receives object > caregiver acts on object > infant receives object > infant acts on object, and (2) mutual gaze and emotion sharing. In contrast with previous home sessions (1 and 2), this observation illustrates how DL is using clear object-extensions to initiate the routine and, with the exception of dropping the toy once at the beginning, using clear object-

extensions to play an equal role within the structure of the routine by transferring the unicorn to F. DL's object-extensions have thus become clear means of initiating and participating in shared routines that he was immersed in before the emergence of clear object-extensions. In addition to extended triadic routines, DL's object-extensions have also become brief moments of enjoyable social contact. This can be seen in the following two observations.

> Video Obs14—11;27. DL is sitting on the ground while holding a toy car and looking towards me. F, who is sitting in a chair about 10 feet away, looks towards DL and says "Whadyou got? Whatdyou got there, buddy?". DL shifts his gaze towards F, lifts the toy up in front of him towards F, and vocalizes in a happy, descending tone. F then says, "Want me to drive it for you? If you bring it over to me, I can drive it for you". After a moment, DL crawls over towards F. When he reaches F, he stands up and lifts the car towards F, who responds by putting his palm out and taking it. DL walks away from F towards his brother.

Similar to Diary Obs11, DL responds to F's question by holding out the object and expressing positive emotions and making his way over to F. However, although F begins to wind up the toy car for DL, DL is content with the interaction and turns away. In contrast to previous object-exchanges that involve more object- and emotion-sharing, DL is also content to leave the toy with F, perhaps no longer being interested in playing with it. In the following observation, which took place 1 month later, DL initiates a brief interaction with F through holding out an object.

> Video Obs15—13;02. DL is sitting on the ground, playing with a headband, in front of F, who is sitting on a chair. DL looks up at F and, after a second, extends the headband up towards him while continuing to look at F. F is preoccupied with winding up a toy car. He looks over at the toy and asks, "Is that for me?", and takes the headband from DL. DL looks back towards the headband and, after a second, grabs it back from F and goes back to playing with it as he did before.

In this observation, DL is persistent as he waits for F to notice his object-extension. In contrast to the brief exchange in Video Obs14, soon after F receives the object, DL takes it back. It is not clear why DL is extending the headband towards F. One possibility is that this brief exchange is an abbreviated form of the prior, more extended sequences of object- and emotion-sharing routine that DL engaged in with his caregivers in previous home sessions. If this is the case, then this routine has undergone several significant developments. In the first two home sessions, DL's actions functioned to place the object within a shared space where M would engage with him around the object (Video Obs1,

2, 4, 5, and 6). Next, DL would initiate this routine by bringing his caregivers objects to engage around (Video Obs13). In each observation, the dyad would (1) share emotions and (2) alternate turns manipulating the object. In the current observation, there is no emotion sharing, as DL and F maintain neutral emotional expressions. There is also no manipulation of the object while it is in a shared space. One possibility is that DL is using this object-extension as a means of brief social contact, but which is rooted in these prior, more elaborate sequences.

4.3.2. Infant AM

Next, I will discuss AM, whom I video recorded in 11 sessions, not including the introductory meeting, which took place at 8;18. The recorded sessions took place in the home at 10;06, 10;20, 10;23; 10;27, 11;01, 11;05; 11;15, five weeks later because of vacation and illness at 12;22; 13;05; 13;19; and 14;04. Not every session is reported here, as there were several sessions where there were either no object-extensions or no significant changes from previous sessions. Primarily, these observation sessions involved AM, the father (F), and me (BW), though on some weeks the mother (M) was home. AM was an only child. Both parents are of European background and were born in Canada. F had a Bachelor of Education degree and worked as a high school teacher, and M had a Master of Education (counselling) degree and worked as a therapist. F was on paternity leave for the first half of the study before returning to work. At the beginning of the study, F reported that AM was not using any triadic gestures, nor was he using any object-extensions. AM's first recorded object-extension occurred two months into the study.

> Diary Obs1—10;16. Yesterday, AM was snacking on a cracker. In my right hand, I (F) held some cheese and apple slices, which are things he likes, and which he could see. He reached out with his hand holding the cracker towards my left hand, and I opened it, since it looked like he was giving me his cracker. He didn't, and resumed eating the cracker, and I put my hand back.

> Diary Obs2—10;16. AM was playing with wooden blocks, and he seemed to offer me (F) one. I told him thank you and offered it back to him. He pushed it away and played with other blocks.

> Diary Obs3—10;18. Today, it appeared AM offered an orange peel to my cousin, as they were playing. He was trying to eat an orange peel, and she held out her hand to take it, and he put it in her hand.

AM is beginning to extend objects towards others, though there is no evidence that they are social acts from his perspective, as F notes that AM did not look towards others' faces or show any expressions of positive emotions during or after his object-extensions. In Diary Obs2, it is possible that he sees the affordance of a hand as a storage place. By Diary Obs3, only two days later, an open hand has now become a place for him to put objects. In the following video observation, which took place during the first home session following AM's first object-extensions, I tried to elicit them to see what he would do.

> Video Obs1—10;23. AM and I (BW) are facing each other as I sit on the floor. He's standing up with the support of a chair, which has several toy blocks sitting on it. He's touching one but not holding it. I put my palm up to see if he will put the block in it. He looks at my palm and, instead of picking up the toy, he grabs my hand and walks closer to me. After standing next to me for a bit, he walks back to the chair and grabs one of the blocks. I put my palm up again, and this time he puts the block in my hand. While he puts it in my hand, he is looking at the block, concentrating. He takes the block back after a few seconds.

Throughout the first half of the study, AM was primarily interested in practicing his skills of standing and walking, rather than engaging with objects. F notes that AM's communicative bids to this point primarily centred around getting others to help him stand and walk. This routine, which emerged one month prior, began with F and M lightly holding AM's hands and helping him walk around the room. Days after this routine had been established, AM started to reach his hands outwards towards F's hands, palms facing downward. At first, AM grabbed F's fingers, who helped him stand and walk around. Soon after, F began to anticipate this, and as AM reached out towards F with the same palm-down movement, F held his palms up. In a smooth, coordinated movement, F and AM grasped each other's hands, after which F helped AM stand. Video Obs1 illustrates that the palms-up gesture has several distinct affordances for AM, with his different responses to my palms-up gesture depending on whether he has an object, based on a history of different routines. When AM puts the toy in my hand, his emotional profile is one of concentration and focus, as if he is trying to execute a skill, and so there is still no evidence that he views his object-transfer as a social action. To this point, AM is not using object-extensions as a means to engage in interactions of emotion sharing. However, AM begins to indicate some possible awareness of the social embeddedness of his object-transfers.

Diary Obs4—10;24. AM was playing in his crib with two small blocks of wood. I (F) reached in and put my hand out, palm upward, and asked if I could have the block. He looked at my hand, and carefully put the block in my palm, but didn't let go, and kept looking at the block. After a moment, he lifted the block up, and we repeated this action three times. On the third time, I took the block from his hand and said thank you. He looked up at me and smiled, and I gave him back the block.

Video Obs2—10;27. I (BW) am sitting on the couch, AM is facing me, leaning against the couch for support. I put my hand out and ask for the toy he's playing with. He puts it in my hand and as I say, "Thank you", he looks towards my eyes, back to the object, takes it and smiles.

In Diary Obs4, AM demonstrates that an open palm has a new affordance—namely, placing the object into the hand but not letting go. Throughout, he continues to concentrate on the action of placing the object into the hand. F keeps his hand out, providing space for AM to practice this skill. However, F eventually takes the block from AM, after which he looks towards F's eyes and smiles for the first time after an object-transfer. Based on F's actions, AM begins to coordinate his enjoyment of emotional contact with others with interactions involving his object-transfers. It is still not clear whether AM's object-transfers are social actions from his perspective, or whether he is responding to our "thank you" responses, as his eye contact and smiling only occurred after our responses, similar to Diary Obs4. That is, it is not clear whether he is coordinating his actions with his attention towards us or whether he is alternating his attention based on our responses (Tomasello, 1995). Soon after these observations, AM begins to look at others during some of his object-extensions.

Diary Obs5—10;29. AM was playing with a friend of mine. I (F) showed my friend that if you hold out your hand and ask for something, he'll pass over the toy. She did this, but he didn't have a toy in his hand. He looked at her hand, then into a box of toys, and handed her a block from the box. His eyes stayed on the toy, and he had a serious look. She did it again, and this time, when he handed the toy over, he watched her face, looking serious. She said thank you, and tried to repeat it again, but he moved on to other games.

There are two significant differences between this observation and previous observations. First, as AM becomes increasingly familiar with this routine, he is beginning to look for objects to place in an outstretched hand. Second, this is the first time that AM has spontaneously made eye contact with someone during an object-extension. One possibility is that, based on F's scaffolding actions in Diary Obs4, AM is beginning to anticipate a similar response that he has received in the past (eye contact

and "thank you"), and so is beginning to look towards others' faces in anticipation of this. A second, non-mutually exclusive possibility is that, as AM becomes increasingly familiar and practiced with the routine of placing an object in others' hands, his increased coordination allows him to decouple his gaze more easily from his action with the object, allowing him to shift his visual attention to other relevant aspects of the activity—namely, other people's faces. Regardless, this newfound skill is still tentative, as looking towards others' eyes remains an infrequent part of his object-extensions.

> Video Obs3—11;01. AM is standing with the help of a chair while F sits next to him. AM has a toy block in his hand. F puts his hand out, palm up. AM looks at F's hand and starts to hit the toy against F's palm without letting go. F says, "Thank you", before AM takes the toy back to play with it on the chair. AM never looks up at F's face, nor does he show any positive emotions.

Similar to Diary Ob4, AM repeatedly hits the object against F's outstretched hands. AM's emotional profile continues to be one more consistent with object- rather than person-engagement (Adamson & Bakeman, 1985; Weinberg & Tronick, 1994). In this observation, F responds differently, as he does not take the object from AM. AM, in turn, does not look towards F. One possibility is that whether interactions involving his object-extensions become opportunities for emotional contact is still largely dependent on the other person's scaffolding. However, AM is beginning to take a more active role within sequences involving his object-extensions.

> Video Obs4—10;27. F and AM are facing each other with a coffee table between them with several toys on the table. While AM is playing with one of the toys, F holds his hand out to request it. AM puts the toy in F's hand. AM waits as F puts it up to his own face and then extends his arm to give the toy back to AM, who takes it. AM then places the toy on the coffee table in front of F, who takes the object and gives it back to AM. AM places the toy on the table and swipes it towards F, who again grabs it and gives it back to AM. This last sequence is repeated, and the exchange ends when AM drops the toy on the floor. Based on the camera angles, it was not possible to determine where AM was looking throughout the exchange.

Until this point, object exchanges in the home sessions were brief sequences where F would hold out his hand, palm up, and ask AM for the object that he is playing with. Sometimes, AM would place the object there, looking only to the hand and to the object, never to F's face. AM would quickly try to take the object back and, when he did, would go back to playing with it by himself. Although it is still F who initiates the sequences, AM is beginning to take on a more active role in the structure of the routine, and as a result

they are becoming more elaborate sequences of give-and-take. This can be seen through AM beginning to anticipate F's role in the activity by pushing the object towards F before F requests the toy back. On the same day, F and AM begin to construct another new routine involving objects.

> Diary Obs6—10;27. AM and I (F) were playing on the ground. He was in the sitting position, and I was not far from him, lying on my stomach. We were surrounded by toys. For fun, I put one of his toys, a small book, in my mouth. He thought this was hilarious and started laughing loudly. He reached for the book while looking at me, and then when he had it, he tried to put it back in my mouth. We did this with two more times, and each time he put the toy back in my mouth after he took it. At one point, he found a new object on the ground, hooked it into my mouth, and laughed.

In this observation, AM finds F's unexpected actions with the object funny, and, similar to his active participation in the give-and-take game described in Video Obs4, he shows his ability to anticipate the outcomes of his object-transfers through continuing to place objects in F's mouth in order to keep the routine going. This game becomes a common triadic routine in which AM's object-extensions play an active role in maintaining an ongoing triadic interaction.

> Diary Obs7—10;28. AM and I (F) were playing. I was sitting, and he was standing, holding onto my right hand with his left hand for support. I was putting toys in my mouth, and letting him take them with his right hand, and throw them on the ground. In the middle of playing, I put a block in my mouth. When he grabbed it, I started to look around for another toy to put in my mouth, and then I felt the block in my right hand. I looked up, and he was looking at my hand, having placed the toy there without me requesting it. I put another toy in my mouth, and he did the same thing, placing it in my right hand without prompting, keeping his eyes on the toy.

> Video Obs5—11;01. AM is standing with the help of a chair while F sits next to him. F puts a toy block in his mouth and tries to get AM's attention in order to get the "toy-in-mouth" game going. AM notices and reaches for the toy. As he tries to take it out of F's mouth, F releases it, and it drops. F goes to retrieve the toy. As he is starting to put the toy back in his mouth, AM has found a different block and tries to put that in F's mouth. Throughout this, AM looks either at F's mouth or at the toy. He is also not showing any positive emotional expressions.

In these observations, AM continues to play an active role in the "object-in-mouth" routines that F initiates. He demonstrates an understanding of the role of both F's mouth and F's hands in the routine, as he places objects in both, seemingly anticipating the same outcome of the object ending up in F's mouth. Similar to within their other triadic

routines, eye contact between AM and F has still not become reliably coordinated with AM's object-extensions. Throughout the sequences, AM primarily watches the toy or F's hands or mouth. That is, AM is focusing his attention on locations that are relevant to his goal of maintaining the game, rather than towards F's eyes. To this point, triadic routines between AM and F have not yet begun to involve moments of sharing emotions, which typically become characteristic of shared routines around objects (Adamson & Bakeman, 1985; Messinger & Fogel, 1998; Trevarthen & Hubley, 1978). To this point, AM's positive emotional expressions within the "object-in-mouth" routine have mostly been confined to the first instance of it and might have been due to F's actions violating his expectations. However, the "object-in-mouth" game begins to involve more positive emotional expressions from AM only a few days later.

> Video Obs6—11;05. F and AM are facing each other. F puts a toy block into his mouth. AM notices and smiles. He reaches and grabs the block from F's mouth and tries to put it back but drops it. F puts it back in his mouth. AM tries to grab it again, but as F opens his mouth to let AM take the block, AM drops it. He is smiling throughout this exchange and is only looking at F's mouth. After the second time dropping the toy, he moves on.

> Video Obs7—11;15. F puts a magazine in his mouth. When AM notices, he laughs and walks over to F and grabs the magazine from his mouth. He extends it back towards F's mouth, who bites down on the magazine to take it. Throughout the exchange, AM has been looking at the magazine and at F's mouth. However, when AM lets go of the magazine at this point, he briefly looks up to F's eyes and back down towards the magazine. He also gives a very faint smile. He then takes it back from F's mouth and tries putting it back in again. This time, AM looks more serious. The exchange ends when AM's attention is captured by M.

> Video Obs8—11;15. Approximately one minute after Video Obs10 ends, while AM is busy playing with another toy, F puts the magazine down on the coffee table, next to where AM is standing. F is not paying attention to AM at this point. As F places the magazine down, AM notices it and picks it up. He looks back towards F and extends the magazine towards F. As F turns to look at AM in response, AM looks at M's eyes and smiles. F extends his hand and takes the magazine from AM, who lets go of it and looks intently towards the magazine as F holds it. F extends the magazine back to AM. At this, AM does not take it, but rather maneuvers his way over to F. He vocalizes sharply. When AM makes his way to F, his attention is captured by M, ending this sequence.

These observations illustrate three ways in which AM's participation in the "object-in-mouth" routine are becoming more complex. First, AM is beginning to take a more active role in initiating the game, even seeming to be persistent in trying to get it going when F

misinterprets his initial request for F to take up his role (Video Obs8). Second, AM is beginning to smile more consistently during the sequences, with at least one smile in each of the three observations. Third, AM is beginning to alternate his gaze between F and the toy during the routine. In Video Obs8, although it is brief, AM's gaze alternation is coordinated with his smile and occurs in response to F turning towards him. Soon after Video Obs8, the "object-in-mouth" game begins to become more clearly a shared enjoyable activity for AM. [21]

> Diary Obs8—11;20. AM and M are playing the "object-in-mouth" game with a soft baby book for an extended amount of time while AM is in a car seat. M's face is down at AM's eye level and is very close to AM— within reaching distance. The observation begins with the book in M's mouth, with AM also holding it in one hand. It is not clear who initiated it. During this, M and AM are looking at each other in the eyes. AM has a subtle, but happy emotional expression, with the faintest hint of a smile. The book falls from M's mouth. AM looks towards the book and grabs it. At this, he looks back up at M's eyes, smiles at her, and extends the book back towards her mouth while continue to look at each other. This pattern of AM putting the book back in M's mouth while they smile and look at each other continues for a few more turns. [22]

This observation contrasts with previous observations involving any of AM's object-extensions, including those that involved positive emotional expressions and eye contact. Here, the "object-in-mouth" routine has become an opportunity for AM and M to share emotions and enjoyment with each other in an extended sequence, perhaps as a result of M placing her face on his level with the object directly in between them. From this point in time forward, AM's object-extensions more reliably become opportunities for emotionally enjoyable contact with his caregivers.

> Diary Obs9—11;27. AM was playing with an empty bottle. I asked if he could give it to me (F). He tried to but dropped it. Without further prompting, he picked it up again, and looked at my hand as he handed it over. I pulled the bottle towards myself and said thank you. He made eye contact and smiled, and I gave the bottle back.

> Diary Obs10—12;10. AM has been focused on giving me (F) objects today. In the morning, he was across the room, playing with a cup. He looked at me, and I held out my hand and asked if I could have it. He picked it up and walked towards me. When he handed it over, he looked

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[21] The following diary observations (Diary Obs8 – 12) took place during the five-week gap between home sessions 7 and 8.

[22] This diary observation is my own description of a video taken by of AM while the family was on vacation.

at the cup, and when I took it and said thank you, he looked me in the eye, smiled, and grunted.

Diary Obs11—12;10. This afternoon, while I (F) was talking with M, AM watched me until I looked at him. Then he maintained eye contact and reached for a cup nearby and held the eye contact as he offered me the cup and smiled when I took it. I said thank you and gave it back.

Diary Obs12—12;19. AM has been more inclined to give objects lately. Yesterday, I (F) was lying on the couch, and he had a toy in his hand nearby. We made eye contact, and he smiled and flapped his hands (a sign of excitement), and walked over, offering the toy, and maintaining eye contact with me. I accepted it and said thank you, and he laughed and flapped his hands some more. I offered it back, and he took it, and walked away.

In Diary Obs9 – 10, positive emotional exchanges are becoming a stable feature within interactions that involve AM's object-extensions towards F—particularly after AM gives the objects to F. At this point, these interactions are still initiated by F requesting the object from AM. In Diary Obs11 – 12, AM has started to take an active role in initiating these enjoyable interactions through his object-extensions, showing that he is now anticipating the enjoyment that followed his object-extensions in Diary Obs9 – 10, and so uses the same means to get those same enjoyable interactions going. From this point on, AM's use of object-extensions becomes a frequent means through which he elicits enjoyable engagement with his caregivers, as seen in Diary Obs11 – 12. These functions of AM's object-extensions can be seen in the following observations from home session 8.

Video Obs10—12;22. AM walks to a different room and brings back two new toys. He walks towards F and begins to smile and vocalize excitedly, holding both toys halfway above his head and out in front of him (45-degree angle relative to the floor) while looking at F, who says, "what you got?". At this, AM stops smiling and looks back at the toys. He then turns away and begins to walk back in the direction of the room from which he got the toys. M notices him and says, "Hi Bean!". AM stops and looks towards her and, unprompted, holds out one of the toys towards her, palm up, and walks towards her. M says, "What's that? Can I have it?", and puts her palms up as she crouches down. AM puts both objects in her hands briefly before taking them back and walking away, vocalizing happily.

Video Obs11—12;22. In a later exchange, AM brings toys over to M, who is turned away from him. In his left hand, he is carrying some cups that are stacked up, and in his right, he is carrying a ball. As he walks over, he extends the ball towards M, who attends to him and says, "What's that?". As she responds, he begins to shake his arms up and

down in excitement, causing the stacked cups to fall out and scatter on the floor.

Video Obs10 contrasts with previous observations, as AM stops at a distance from F while holding the toy out, somewhat in the direction of F, rather than transferring the object to F. One possibility is that AM's action represents a holdout gesture where he is only intending to show the object, rather than transfer it (Bates et al., 1975; Boundy et al. 2016). Thus, it is possible that "showing" and "giving" have become differentiated communicative intentions. A second possibility is that AM's holdout towards F was in anticipation of transferring it before something interrupts it (e.g., becoming distracted by the objects), as AM's object-transfers often begin with holding the object out towards others while walking towards them. In the following observation, AM again holds the object above his head while walking towards F. In contrast with Video Obs10, AM does the familiar part of the routine which is to take the object to F and hand it to him.

> Video Obs12—12;22. AM is attempting to throw the ball towards M, who is patiently waiting to receive it. He picks up the ball from the ground and is turned away from M, who is standing nearby. M says "Hey bean! Can I have the ball now?". He turns and walks towards her and puts the ball in her outstretched hand, as she says, "Thank you! Thank you very much!". He waves his arms up and down in a really excited manner, though because of the camera angles it is not possible to see where he is looking. As he does this, he looks up towards her eyes. M says, "Would you like it back?". He grabs it and turns towards F. When AM and F make eye contact, AM immediately holds the ball out and up above his head and begins to walk towards F, vocalizing throughout. F holds out his hand and AM, when he reaches F, puts the ball in F's hand. AM and F make eye contact while AM waves his arms excitedly. F offers the ball back to AM, who takes it.

Sequences involving AM's object-extensions have also started to become more elaborate as he begins to include multiple partners. However, at this point this appears to be only sequential, as he does not alternate his gaze between the different partners involved. Rather, he focuses on one person at a time before moving on to the next person.

By this point, AM's object-extensions have become opportunities for both brief and extended enjoyable social contact with others. These exchanges involve AM both holding out objects towards others as he approaches them and transferring the object to the other person when he reaches them. This continues to be a familiar routine that AM enjoys weeks later .

Video Obs13—14;04. I am following AM as he walks around his house. I follow him to the living room and AM grabs one of the toy cups from his toy box and holds it out to me while walking towards me. He's looking at my eyes while walking towards me and says "Ha" when he hands it over. I take it, and he turns away to get a second toy cup from the toy box. He brings the second one to me and gives me the second one while taking the first one from my hand. He then steps back, looks and me, and gives a brief smile. He then takes the second one from me and walks away to play by himself.

Video Obs14—14;04. AM is holding two toy cups that are stacked. He looks at F, who is across the room, excitedly runs over to him and gives him the toy cups. After a second, AM reaches to take them back and walks away.

This has become a very frequent routine, occurring numerous times during this home visit. These observations follow the typical pattern seen up to this point which involves transferring the object to another person before taking it back. A notable change is that he now sometimes leaves the object with others.

Video Obs15—14;04. AM is standing at his toy box while F is seated on a couch a few feet away. AM grabs a cone-shaped toy (unknown type) and turns towards F. He makes eye contact with F, smiles, and holds the toy up towards F, who puts his hand out. AM puts the toy in F's hand watches F hold it for a couple of seconds before turning and walking away from F, back towards his toy box.

Video Obs16—14;04. AM is on the floor and notices a pair of his sandals. He picks them up, stands up, looks towards F and smiles. Vocalizing happily, he walks them over to F, who is sitting across the room, and gives them to him. F says, "Thank you", and AM quickly moves on, leaving the sandals with F.

The interaction between AM and F in Video Obs15 involves most of the structure of the typical triadic routine that AM engages in with his caregivers, except for the final "turn" of taking back the object. One possibility is that AM leaves the toy with F because he wants F to have it. If this is the case, then "giving" has become an activity differentiated from the typical routine. However, it is also possible that AM leaves the toy with F because he is no longer interested in engaging with it. That is, from AM's perspective, he is engaging with F in the typical triadic routine. In Video Obs16, AM similarly brings an object to F and leaves it with him. In contrast, AM does not seem to leave the sandals with F because he is no longer interested in engaging with them. Rather, the transfer seems to be the activity, rather than part of a sequence involving shared engagement around them. Thus, one possibility is that this sequence represents the beginning of "giving" becoming differentiated from the typical routine involving AM's object-transfers.

Chapter 5.   Discussion

There were two study goals for the current thesis. My first study goal was to provide a longitudinal qualitative description of infants' object-extensions as they develop within three infant–caregiver dyads. The primary purpose of this part of the study was in service of the second study goal, which was to use these descriptions to trace the development of object-extensions within these dyads. Both study goals were informed by Mead's distinction between forms of meaning, according to which intentional (i.e., significant) gestures are rooted in prior shared ways of acting (i.e., conversations of gestures). This involved describing the shared activities within which the infants' object-extensions played a role and tracing those forms of object-extensions to later forms that suggest that they have become intentionally communicative gestures.

Consistent with previous research, for both infants, object-extensions began to emerge within the first year (Bakeman & Adamson, 1986; Bruner, 1983; Cameron-Faulkner et al., 2015, 2021; Masur, 1990; Moreno-Núñez et al., 2020; Trevarthen & Hubley, 1978), prior to the development of pointing (Bates, 1979; Bates et al., 1975; Carpenter et al., 1998), and became more frequent throughout the course of the study (Bakeman & Adamson, 1986; Cameron-Faulkner et al., 2021). At the beginning of the study, neither AM (8;18) nor DL (9;29) were using object-extensions in ways that suggested that they had a social goal. By the end of the study, both AM (14;04) and DL (13;02) were using intentionally communicative object-extension gestures in several distinct ways. Throughout the course of the study, both dyads coordinated their activities into several distinct routines within which the infants' object-extensions played a role, either in initiating a routine or maintaining it.

For the majority of these routines, the role that infants' object-extensions played changed from occurring within an ongoing routine initiated by caregivers to initiating that routine. I will discuss the two exceptions—both of which occurred in the diary study— below. AM and his caregivers developed two main routines involving his object-extensions. The first routine involved the following core structure: AM's father requests an object from AM, typically through a palms-up gesture as well as verbally, AM hands him the object, after which his father typically says, "thank you". Later in the study, AM would bring objects to his caregivers, unrequested, and hand them over. I will refer to

this as the *core routine* between AM and his caregivers for two reasons. First, several variations seemed to emerge from this core structure, including more elaborate sequences of give-and-take. Second, by the end of the study, AM was using object-extension gestures to initiate these shared routines. The second routine that AM and his father developed was an "object-in-mouth" game. AM's father would initiate this routine by placing an object in his mouth and drawing AM's attention. AM would then play an active role in the ongoing activity through placing the object in his father's mouth or his hands. Some ambiguity regarding whether AM is initiating or maintaining an ongoing game can be seen in Video Obs7 – 8. Here, it is not clear whether AM is initiating the activity or is responding to his father placing the magazine—which had just prior been part of this routine—in front of AM. However, AM would not begin to reliably initiate triadic routines through object-extensions for another few weeks.

The most prominent and consistent routine that DL and his mother developed involved shared engagement on an object in DL's possession, consistent with Bakeman and Adamson's (1986) *coordinated joint engagement*, as it involved DL alternating his gaze between his mother and the toy situated in a shared space. This routine would begin when DL was holding an object and he made eye contact with his mother, who would respond by saying something to the effect of, "What's that?", sometimes holding out her hand, palm-up. From there, both participants would coordinate their actions so that they were making physical contact, with the object between them in a shared space. From there, DL's mother would engage with him around the object. I will refer to this as the *core routine* between DL and his caregivers. Similar to AM, there were several variations around this core structure, often depending on the specific object assimilated to the routine (e.g., stuffed elephant; Oball Rattle). After the object was in a shared space, his mother would typically try to take the object from DL, usually successfully. In her attempts to take the object, DL would vary in degree to which he would permit his mother to take the object. This ranged from refusal, as with the playing cards in Video Obs6, to seemingly no reluctance, as with the stuffed elephant at one point in Video Obs5. In home session 1 (Video Obs1-2), DL's reluctance was intermediate between the two observations from home session 2. Once his mother took the Oball Rattle and began to act on it (e.g., through shaking it), he turned his attention towards her actions and then towards his mother's face as they shared emotions. However, in home session 1, he did not intentionally transfer the object to her. Rather, it was facilitated by his

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mother's actions in response to placing the object between them, which was in response to her attention. Later in the study, DL would initiate this routine through bringing objects to others and placing them in a shared space without their attention on him first. Thus, similar to AM, DL's actions in his core routine—placing the object in a shared space—developed from playing a role within the activity to being used to initiate the activity.

In both infants' core routines, I found no evidence that their object-extensions were initially used as intentionally communicative actions. By the end of the study, both were using object-extensions to initiate the activity, suggesting intentionality from a Meadian perspective (Carpendale & Carpendale, 2010; Carpendale et al., 2013; Clark, 1978; Mead, 1934). Between these two points, there was considerable ambiguity in how each infants' object-extensions worked from the infants' perspectives. Early in his core routine, AM became proficient in the *physical* skill of giving in response to his father's request. Similarly, in the object-in-mouth routine, AM maintained the game through deftly placing the object in his father's mouth. However, as Hay and Murray (1982) and Carpendale et al. (2021) note, giving is not just a physical skill but a social act imbued with significance. The awareness of the social significance of his actions seemed to develop gradually for AM as he became familiar with the routines, consistent with Carpendale and Carpendale's (2010) Meadian theory regarding the development of communicative pointing. The ambiguity of AM's object-extensions thus stemmed from the difficulty in ascertaining when they became a social act from his perspective.

The ambiguity in DL's object-extensions was more complex than that observed in AM's object-extensions. Additionally, the ambiguity in each infant's object-extensions was, in one notable way, a mirror image of the other's ambiguous object-extensions. Whereas AM's actions were clearly object-transfers, but were not clearly social from his perspective, DL's early object-extensions in his core routine were clearly social but were not clearly object-extension gestures. The social nature of his early object-extensions can be gleaned from the fact that, in the early home sessions, they were always in response to his mother's attention, whether they were produced during an ongoing shared activity or during the initial co-orienting that precipitated further engagement. A general characteristic of DL was that he enjoyed others' attention on him while he had an object. In home sessions 1 and 2, he would sometimes respond to my attention or his mother's attention by holding the object in his hand up above his head and shaking it while maintaining eye contact and smiling. Additionally, in home session 1 (Video Obs4),

he responded to his mother's attention by holding the object up to her face while shaking it. A similar action was seen during his holdouts in home session 2 (Video Obs6), when he held the playing cards up to his mother's face while continuing to manipulate it.

These actions share significant characteristics with Boundy et al.'s (2019) *object as an attentional tool*, which they define as the infant holding up an object towards a partner while maintaining eye contact and acting on the object (e.g., waving, dropping, or banging it). According to Boundy et al., these are distinct from holdout gestures, in that they are used by infants to gain attention to the self, rather than to share attention on the object. Boundy et al. thus sets up a clear divide between using objects to draw attention to the self and trying to draw attention to the object. From the current action-based perspective, according to which social skills develop gradually within interaction (Bibok, 2011; Bibok et al., 2008; Carpendale et al., 2013), it is not obvious that there should be a clear divide between the two. According to Bates and her collaborators (Bates, 1976; Bates et al., 1975; Bretherton & Bates, 1979), as well as Reddy (2003), infants draw their caregivers' attention to foci that are increasingly distanced from the self, developing from attention the self, to the self's actions, to objects in the self's possession. The transition between these latter two "stages" has not been studied in detail. Indeed, according to this perspective, studying the transition between these two stages would be equivalent to studying the development of non-instrumental object-extension gestures. One possibility is that DL's ambiguous object-extensions, which are consistent with Boundy et al.'s (2019) toy as attentional tool, illustrate a lack of differentiating between drawing attention to the self and drawing attention the object. That is, these object-extensions might be *transitional* forms between the two. However, to my knowledge, this possibility has not been studied in any detail.

Both infants' caregivers did respond to their infants' ambiguous actions. Thus, these actions functioned as communicative. More specifically, they functioned in predictable ways within shared routines as responses to a previous action (e.g., palm-up gesture; mother's attention) and as a stimulus for a further response (e.g., "thank you!"; "what's that?"), which itself served as a stimulus for further response (e.g., smiling at their caregiver), and so on. According to Mead (1934), these actions are part of a conversation of gestures within which infants can develop expectations and so anticipate what is coming up next. At this point, the infants' actions are not intentionally communicative. However, through experience within these conversations of gestures,

infants can come to anticipate the role that their object-extensions play and so can use these actions to initiate that routine. Through this process, the infant's actions can become intentional (i.e., significant) gestures. The current analysis suggests that the development of object-extensions for both infants, particularly within their core routines, is consistent with Mead's framework. Both infants' object-extensions functioned in specific ways within a routine before each infant used object-extensions to initiate those same routines. The ambiguity observed in each infants' actions suggests that the development between these forms of meaning can take place gradually, and thus that the development of object-extension gestures might be a more protracted process than is typically described in the literature (Bates, 1976, 1979; Bates et al., 1975; Carpenter et al., 1998). This suggests that the typical methodologies used to investigate infants' object-extensions, including those that use a longitudinal studies design, which typically consists of observing infants in one- to three-month intervals (e.g., Bakeman & Adamson, 1986; Carpenter et al., 1998; de Barbaro et al., 2013), might be inadequate to properly capture the development of object-extension gestures as important transitions might be missed.

These findings are also consistent with sociocultural approaches (Bakeman & Adamson, 1984, 1986; Bruner, 1983; Moreno-Núñez et al., 2017; Vygotsky, 1978), according to which caregivers scaffold triadic forms of engagement before infants are able to play an equal role within the shared activity. Both infants' caregivers played a greater role than the infant in initiating and maintaining their respective core routines at first. Caregivers' scaffolding thus likely played a role in providing the space for their infant to become familiar with, and thus anticipate, the different structural elements of the routine. For example, AM's core routine first involved AM handing an object to someone else and not getting it back. In Diary Obs4, as AM is placing the object into his father's hand without letting go, his father takes the object from him and says, "Thank you". He then hands it back to AM. This was the first observation that involved the turn-taking structural element that would come to comprise AM's core routine. At this point, the turn-taking was still scaffolded by the father. However, this observation precipitated the development of more elaborate give-and-take sequences in which AM began to take an active role in the turn-taking element of the routine only a few days later (Video Obs4). Indeed, both caregivers were observed facilitating the infants' role in their respective

core routines early on by taking the object from their infant and subsequently playing out their own role (e.g., "Thank you").

These findings are broadly in line with Bruner's (1983) handover principle, according to which (1) shared routines are initially structured by the caregivers; (2) infants take on an increased role in maintaining the routine through acting out their role; and finally (3) infants begin to initiate the routine. However, two findings in the current study suggest that there is an important role for caregivers following in on their infants' actions in the development of object-extension gestures, consistent with recent research on communication development (Cameron-Faulkner et al., 2015; Kettner, 2021; Kettner & Carpendale, 2018), and with a Meadian approach to gesture development (Carpendale & Carpendale, 2010; Carpendale et al., 2013; Mead, 1934). First, the ambiguity in both infants' early object-extensions suggests that that, even after infants have started to take an active role in the routine, the development of these actions into object-extension *gestures* is facilitated by their caregivers continuing to respond in predictable ways, thus allowing infants to continue to develop expectations regarding the outcomes of their actions.

Second, both infants' first object-extensions observed in the study—which were recorded by caregivers in the diary study—were spontaneous, rather than the result of a caregiver directly facilitating them (e.g., through taking the object). AM first extended and transferred objects into his father's hands when his father was not requesting them (Diary Obs1 – 2). Similarly, DL first held up an object towards his mother's face outside of joint engagement with the object (Diary Obs1). I found no evidence that either infant's object-extensions were intentionally communicative. However, in both cases, caregivers responded to their infants' object-extensions. For DL, based on his mother's response, this developed into a routine that was repeated days later, again through DL's spontaneous object-extensions (Diary Obs3). For AM, this was the beginning of his core routine, as his father started to anticipate AM placing the object in his hand through using a palm-up gesture.

In both cases, it is possible that these initial object-extensions were the result of each infant initiating a routine that was first structured by the caregivers, consistent with Bruner's (1983) handover principle. In the case of AM, this possibility is unlikely, as it would not be for weeks until AM would initiate the routine. In the case of DL, it is more

difficult to say, as he did initiate this routine again only days later. Thus, it is possible that this object-extension represents DL assuming the initiating role of a previously scaffolded routine. However, his initial object-extension did not involve any of the characteristic emotion sharing that accompanied his triadic joint engagement with his mother from home session 1 onward. In contrast with home session 1, during Diary Obs1, DL remained serious and went back to engaging by himself with the object. One possibility is that this represents an action without a specific communicative intent, and thus is not intended by DL to initiate a familiar routine. However, DL and his mother did co-construct a new routine, based on his mother's response. Thus, these findings suggest an important role for caregivers in following in on their infants' actions for the development of at least some new meanings of object-extensions. That is, these observations illustrate one way in which infants' actions can create the context within which new meanings are constructed, based on how caregivers respond.

By the end of their first years, interactions involving object-extensions for both infants had become opportunities for mutually enjoyable emotion sharing characteristic of face-to-face engagement (Hobson, 2002; Stern, 1977, 1985; Trevarthen, 1979; Tronick, 1989). Further, emotion sharing was a consistent feature of both infants' core routines before and after infants began to initiate their respective routines through object-extension gestures. By the end of the study, both infants were using object-extension gestures for moments of brief social contact with others that involved either briefer emotional expressions or no emotional expressions.

The current findings suggest that emotion sharing might have to become coordinated with infants' object-extensions, at least for some infants. Further, they suggest that there might be different pathways through which this coordination might happen. For DL, emotion sharing was a constituent of his core routine starting in home session 1. DL and his mother would share emotions after the object was exchanged and acted on. However, as noted, these early object-transfers would be facilitated by the mother. Additionally, they would share emotions after DL noticed her attention on him, during which he would hold the object either up above his head or towards his mother and shake it. DL's object-extensions thus developed within already established routines involving emotion sharing. In contrast, AM's early object-extensions were accompanied by a focused emotional profile that is more characteristic of object- rather than person-engagement (Adamson & Bakeman, 1985; Weinberg & Tronick, 1994). AM's object-

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extensions only gradually became coordinated with his positive emotional expressions as he became familiar with the routines involving his object-extensions and began to distribute his attention to different relevant foci—namely, to other people's faces. Once this happened, in both his core routine and the "object-in-mouth" routine AM began to smile as he briefly looked towards others' eyes.

However, it was not until his mother situated her face on his level with the object directly in between them that routines involving AM's object-extensions involved extended emotion sharing and multiple instances of gaze alternation. This was a characteristic of both mothers, as DL's mother would move her head so that her face was next to the object while he explored it. Throughout, she would comment either on the object or on what he was doing with the object. This differed from how AM's father acted in these routines, at least in the home sessions, as he would be attentive and available but would not situate his face close towards AM's. These findings suggest the possibility that, through placing their faces in the same shared proximal space as the objects, caregivers—particularly mothers—might be scaffolding these triadic routines in ways that more easily allow infants to look towards their caregiver's face. Through this, caregivers might be facilitating the coordination of triadic routines with previous forms of dyadic, face-to-face engagement that already involves emotion sharing (Hobson, 2002; Stern, 1977, 1985; Trevarthen, 1979; Tronick, 1989). Infants might then begin to anticipate enjoyable emotion sharing in response to their object-extensions, and so begin to use objects as new means of eliciting enjoyable engagement with their caregivers. This represents one pathway through which infants' object-extensions might become coordinated with emotion sharing.

For both infants, bringing objects to others became reliable means through which they could engage in mutually enjoyable interactions with others involving emotion sharing. Although the current findings suggest that there might be different pathways through which object-extensions become coordinated with emotion sharing, for both infants this coordination was already evident within interactions initiated by their caregivers before infants began to use object-extension gestures to seek out this emotional contact. These findings are thus consistent with perspectives that emphasize a foundational role for mutual joy taken in engagement in the development of object-extension gestures and communication more broadly (Bates, 1976; Bates et al., 1975; Broesch & Carpendale, 2022; Reddy, 2003), and build on these perspectives by

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suggesting possible pathways through which object-extensions become opportunities for mutual joy.

It could be argued that the current findings are consistent with the cognitivist theory of Tomasello and his collaborators in two ways (Carpenter, 2009; Carpenter et al., 1998; Tomasello, 1995, 1999, 2008; Tomasello et al., 2005). According to this theory, triadic gestures begin to emerge after nine months from the coordination of infants' "intention-reading" skills with their motivation to share psychological states with others. First, despite the variability in their experiences, both infants began to use object-extensions in ways that could be characterized as declarative or for sharing attention and emotions (Bates, 1976, 1979; Bates et al., 1975; Boundy et al., 2019; Cameron-Faulkner et al., 2015; Carpenter et al., 1998). This is consistent with Tomasello's claim that infants are motivated to share psychological states with others and use gestures as a means to do so. However, Bard et al. (2022) argue that infants developing in WEIRD cultures (Henrich et al., 2010) begin to use object-extensions for sharing attention based on the fact that these forms of engaging with infants are what is culturally valued. The current study is consistent with Bard's characterization of WEIRD cultures, as both caregivers typically treated their infants' object-extensions as opportunities to engage with their infants around the object, rather than as a social act of "giving". Further, within these interactions, both infants' mothers worked to incorporate face-to-face engagement into the triadic routines. The current findings suggest that, through doing so, caregivers provide one means through which emotion sharing can become incorporated into triadic routines. It is also possible that, through placing their face in a proximal space, caregivers are further facilitating the development of shared attention, as is suggested by Fogel et al. (2006). Thus, based on culturally valued ways of engaging with infants, the ways in which caregivers—particularly the mothers—responded to their infants' object-extensions constituted a reliable part of the system within which these functions of object-extensions developed. This is consistent with the relational approach of Carpendale and Lewis (2006, 2020), according to which similar developmental outcomes can emerge despite different developmental circumstances based on a typical developmental system, rather than through being genetically determined. However, because the current findings are based on only two infants within broadly the same culture, they cannot speak to what other sorts of variations in infants' experiences might

lead to similar or different developmental outcomes in the functions of infants' object-extension gestures, either within or across cultures.

Second, from approximately 11 months (Diary Obs4—11;05), DL's object-extensions began to become more clearly intentional from a Meadian perspective (Carpendale & Carpendale, 2010; Carpendale et al., 2013; Clark, 1978; Mead, 1934). Simultaneously, he began to use object-extensions in multiple ways to achieve specific goals or initiate and maintain triadic routines. Additionally, in some cases (e.g., Video Obs10), DL's object-extensions took on a more ritualized form that appeared designed for the other person to act on his gesture, consistent with Bates' (1976, 1979) criteria for an intentional gesture. Similar changes were observed in AM, though these occurred while AM's family was away for five weeks, around his first birthday. During these weeks between home sessions, AM began to initiate enjoyable routines through object-extensions and began to incorporate multiple objects and people, similar to DL. Based on the relative suddenness of these changes, particularly with DL, it could be argued that these changes are consistent with Tomasello's (1995, 1999, 2003, 2008, 2019) theory that triadic gestures represent new social and communicative skills that are discontinuous with previous skills, based on the development of a qualitatively new understanding of other people as intentional agents.

I offer two counterarguments. First, as I have argued, the theoretical claims of cognitivist approaches such as Tomasello's rest on problematic metatheoretical grounds which are not based on, nor subject to adjudication by, empirical findings such as those found in the current study (Bibok, 2011; Carpendale et al., 2013; Gallagher, 2007, 2008; Jopling, 1993; Overton, 2015; Racine, 2011; Racine & Carpendale, 2007). Thus, the current findings cannot support nor directly counter Tomasello's use of infants' understanding of others as intentional agents as a causal factor. However, I have followed several others (Carpendale et al., 2013; Racine, 2011; Racine & Carpendale, 2007; Reddy, 2003, 2011, 2018) in arguing that this explanation rests of a problematic split between mind and body. Further, I have argued that this explanation does not account for the development of meaning, which is crucial from a relational perspective (Canfield, 1995, 2007; Carpendale et al., 2013; Clark, 1978; Mead, 1934; Wittgenstein, 1953/2009). This leads to my second counterargument.

Drawing on Mead's (1934) distinction between forms of meaning, I have argued through the current analysis that several of the uses of DL's and AM's object-extensions after the changes that occurred around their first birthdays were rooted in prior forms of engaging with others triadically that involved object-extensions, and thus the meaning of the gestures had been established based on these prior routines. However, tracing these forms of meaning is only possible by changing the way infants' object-extensions are typically conceptualized and defined. Rather than conceptualizing infants' object-extensions as categorical and individual behaviours, as is typically the case (Bates, 1976, 1979; Bates et al., 1975; Boundy et al., 2016; Carpenter et al., 1998), the current analysis illustrates the utility of casting a wider net over infants' actions with objects than is typical for research into infants' object-extensions by specifically looking at how infants' actions *function* to elicit a particular response from others. This resulted in my inclusion of several forms of ambiguous object-extensions displayed by AM and DL as part of the current analysis.

Because of their ambiguous nature, these early object-extensions might be dismissed as unimportant, and thus overlooked, in the development of object-extension gestures. However, overlooking or ignoring these ambiguous forms leads to a methodological circle (Danziger, 1985), as the resulting sudden emergence of intentional gestures seems to require the development of a qualitative new underlying mechanism to explain their sudden appearance. Rather, from the current action-based perspective, these are examples of ambiguous actions which might function to get a response from others, and thus are crucial to incorporate into our empirical investigations into the development of object-extension gestures and their functions. Crucially, according to the current analysis, DL's and AM's later intentional object-extensions functioned to get the same activities going that were first initiated through caregivers responding to their ambiguous object-extensions. These findings suggest that infants' object-extension gestures are not discontinuous with previous skills and activities, but are rather rooted in them, in contrast with the theory of Tomasello and his collaborators (Carpenter, 2009; Carpenter et al., 1998; Tomasello, 1995, 1999, 2008; Tomasello et al., 2005). The current findings are thus consistent with the current action-based approach, according to which communication develops from the coordination of activity within shared routines (Carpendale et al., 2013; Carpendale & Carpendale, 2010; Carpendale et al., 2021). Communicative intentions are emergent from this social process, rather than a

prerequisite for the development of object-extensions, as is assumed by cognitivists (Clark, 1978; Carpendale et al., 2013).

Thus, in researching the development of object-extension gestures, I argue that the goal should not be to demarcate intentional and unintentional communicative actions, nor attempt to identify distinct communicative intentions early on, as this will necessarily lead to ignoring ambiguity, thus leaving the field vulnerable to a continuing methodological circle. Rather, researchers should engage with the complexity and the ambiguity of infants' early actions in describing and tracing the development of object-extensions and their functions, as these ambiguous object-extensions might represent forms that are transitional between Mead's (1934) forms of meaning. Opening up the range of infants' actions for investigation also necessarily entails incorporating the caregiver as key to the process of development, as it is through others that infants learn the meaning of their actions. That is, object-extensions gestures should be treated as developing within a zone of proximal development (Vygotsky, 1978), or within a space of second-person intentionality (Andrén, 2010, 2014).

5.1. Limitations and Future Research

There were several limitations to the current thesis. First, it is not a question of whether I affected the way infants and their parents engaged, as I was a direct participant in the home sessions. This can be seen as a weakness of the study, taking away its validity as a naturalistic study of infants' object-extensions. However, there was an unintended consequence of this choice, which I argue is a strength of the study. Parents were not given any specific instructions regarding what to do in the home sessions. This led to a diverse range of contexts within which the infants' developing communication skills could be observed, both between and within sessions. This was a result, in part, of my direct participation. In the home sessions of both dyads, the parents and I spent a significant proportion of the time was spent in casual conversation while their infant was around. Sometimes, this would take place while one or both of us was engaged with the infant. Other times, the parents' attention would be on me, rather than their infant. As a result, both infants were observed in diverse of contexts which ranged from interactions where the parent was fully engaged with him to other times where the infant had to work to engage and get the attention of their parent.

One major limitation of the current study is a result of my inability to anticipate that certain details might be important in capturing the development of object-extension gestures. I will list three key pieces of information that I did not ask about. First, in the diary methodology, I asked parents to pay attention to gestures, including "giving" and "showing". This resulted in diary observations that focused almost exclusively on interactions that were the result of the infant's object-extension, rather than how their infants might use object-extensions within ongoing interactions. This likely led a skewed picture of their role in everyday life towards infant-initiated sequences. Additionally, I did not have a "baseline" for some of the infants' skills at the beginning of the study through which to make sense of their developing skills. Second, in the diary instructions, parents were asked to note whether their infants were showing signs of enjoyment, such as smiling or laughing, during the observations. As Reddy (2019) and Hammond and Drummond (2019) argue, a key emotion for motivating interaction is *interest*, not just joy. This dimension of infants' emotionality was not captured in the diary observations. It was also not a focus of my analyses of the videos from the home sessions. In addition to the role that mutual joy plays in the development of object-extension gestures, future research would benefit from investigating the role that mutual interest plays in the development of object-extension gestures. Third, parents were asked to record their infant's gestures, and were not explicitly instructed to write observations about their infants' actions that might be ambiguous with respect to whether it was a gesture. As can be seen in the home sessions, there were plenty of observations of ambiguous holdouts and object transfers. This limits what can be gleaned from the diary observations as a whole, as they likely underreport infants' use of object-extensions that are ambiguous, but still might result in interactions based on caregivers responding to these actions. One potential solution to this problem that future researchers using a diary methodology might employ is to ensure that caregivers are instructed, and perhaps trained, to observe and record object-extensions which (1) are ambiguous; and (2) take place within an ongoing activity. However, a drawback to this solution is that, by providing such instructions, researchers might influence how parents interact with their infants.

Despite these limitations, the diary component still provided plenty of rich observations that could not have been collected otherwise. From caregivers' diary observations, it was possible to better contextualize and track changes that were taking

place between home sessions. It was also possible to capture relatively sudden changes. For example, between Diary Obs1 – 3, which took place over the course of six days, DL began to coordinate his enjoyment of engagement with his mother with his object-extensions. Further, it was also possible to capture early interactions initiated by the infants' object-extensions, something which did not take place within the home sessions for another month. Developmental research has been criticized for overlooking what takes place in infants' everyday lives (Dahl, 2017). It is possible that, because of the typical practice of observing infants for a short period of time each session, research has underestimated the importance of infants' actions in creating contexts within which object-extension gestures develop. This is something that can be remedied by incorporating diary study methodologies into future studies into the development of object-extensions.

An additional limitation of the current study is that "life happened". With both infants, there were gaps of approximately one month between sessions, due to family vacations and illnesses. Although these were in many cases unavoidable, they limit what can be described within those periods. For AM in particular, in the five intervening weeks between any home or diary observations, there were significant changes in how he engaged triadically with others. This is a trade-off that comes with focusing on a small number of infants. That is, this method allows for a more detailed description of each infant's development, but it is more sensitive to losing crucial data as a result of such life circumstances.

It is also not possible to generalize beyond the two infants and their contexts. There are two responses to this point. First, as noted above, there are trade-offs in working with a small number of infants as well as with a large number of infants. As Carpendale and Carpendale (2010) argue, working with large samples typically results in (1) average across infants, thus overlooking important differences in what is taking place within dyads; and (2) few observational sessions to describe how development is occurring. Focusing on a small number of infants is ideal for overcoming both of these limitations of more typical methodologies. This case study method also has a rich history in developmental research (Bruner, 1983; Piaget, 1953; Fogel et al., 2006; Trevarthen & Hubley, 1978), and has gleaned significant insights into processes of development as well as variability among infants and dyads. Second, from the current action-based perspective (Carpendale & Carpendale, 2010; Carpendale et al., 2013;

Carpendale et al., 2021), communication develops within dyads, and so it is only possible to explain communication by reference to what is experienced within these dyads. Thus, the goal of the current study was not to explain the development of object-extension gestures for all infants. Rather, the goal was to apply a theoretical framework, and the methodology that follows from that framework, to describe the development of object-extension gestures within the dyads that participated in the study. Thus, following the arguments of Carpendale and Carpendale (2010), I argue that the way forward for explaining the development of object-extension gestures is a broader application of the current theoretical framework and methodology to describe a broad range of dyads in diverse contexts, both within and across cultures.

Finally, it is a general pattern that researchers interested in studying infant gesture development focus their attention on infants who are 9 months and older (for an in-depth discussion, see Moreno-Núñez et al., 2017). This was essentially the case as well for the current study. This made it difficult to trace some of DL's early object-extensions. In the first home session for DL, he was already participating in triadic forms of interaction that involved object-extensions. This was likely not the first time he had acted this way and thus DL was likely already participating in several triadic forms of interaction in which he played an active role before the start of the study. From the current action-based perspective, gestures emerge from previous ways of acting together. However, what must also be described is how these previous ways of acting together develop. Thus, it is important to capture how these earlier forms of triadic engagement emerge and to trace them forwards to the development of object-extension gestures. I argue that the current process-oriented method, grounded in an action-based theoretical framework, would be fruitful for investigating the emergence of these earlier forms of triadic engagement that form the context within which object-extension gestures develop.

5.2. Conclusion

The current thesis aimed to describe and trace the development of object-extension gestures longitudinally within two infant–caregiver dyads. It was found that both dyads organized their activities into mutually enjoyable shared routines within which infants' object-extensions played a role before infants were using object-extensions intentionally as gestures. Further, around their first birthdays, both infants' object-

extensions became means through which infants elicited these prior routines. Additionally, between these two time points, it was found that caregivers reliably responded to their infants' object-extensions and typically did so in predictable ways, according to previous routines. Finally, infants' object-extensions outside of familiar routines created contexts within which new triadic routines were co-constructed, based on how their caregivers responded. These findings are consistent with Mead's (1934) theory of gesture development, according to which intentional gestures develop as infants learn to anticipate the response to their unintentionally communicative actions within a shared routine. Taken together, these findings thus suggest that object-extension gestures develop within enjoyable shared routines as infants learn the significance that their actions have for others, consistent with the current action-based approach to the development of communication (Carpendale & Carpendale, 2010; Carpendale et al., 2013; Carpendale et al., 2021).

The current thesis contributes to the literature by illustrating the value of applying Mead's (1934) distinction between forms of meaning for illuminating the processes through which object-extension gestures develop. Adopting this distinction draws empirical and theoretical attention towards how infants' actions function to communicate, rather than towards conceptualizing gestures as individual and dichotomous, present/absent skills. Methodologically, this entails (1) treating the dyad as the appropriate level of analysis for the development of object-extension gestures; and (2) not overlooking the potential role that infants' ambiguous actions might play in their development. By longitudinally describing infants' object-extension within two dyads according to this theoretically-grounded methodology, the current thesis was able to suggest possible pathways to the development of object-extension gestures for non-instrumental purposes. My hope is that the current thesis can serve as an illustration of what new insights might be gleaned from, and new questions raised by, the application of this theoretical framework and its concomitant process-oriented methodology.

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Appendix A.

Diary Study Information

Thank you for your interest in our study! We are interested in the development of early communicative development, and more specifically the development of gestures within interactions between you and your baby.

We are looking for general descriptions, specific examples, as well as notes on changes in the target behaviors described below. It is not necessary for you to record observations on a fixed schedule. As a result, you may find yourself writing several shorter notes on some weeks and one or two longer observations on other weeks.

Observations can be sent in e-mails, posted on blogs, or sent as an attachment in a Word document. We will compile all observations into one Word document that will be kept on password protected computers.

Several early interaction patterns and skills are related to early social communicative development; therefore, we are interested in the following types of entries:

An initial introductory write-up about your infant, including his or her general temperament, likes and dislikes, everyday routines you engage in with him or her, how much time your baby spends with each of her or his caregivers, and anything else you are comfortable sharing and that you think might be relevant for the study.

We are interested in observations of the following behaviors:

- Requests – how do you know when your baby wants something?

- Attention seeking – how do you know when your baby wants your attention?

- Giving, receiving, and showing – extending the arm and hand with an object in hand

- Pointing – arm and index finger extended or all fingers curled

Please include as much detail as possible about the following:

- Gaze direction (does your baby look at you, the object, alternating, other)

- Vocalizations (e.g., cries, fussing, word-like sounds, words & timing of vocalizations)

- Body position (e.g., leaning, sitting straight, turning)

- Arm position (e.g., extended, by the side, raised up)

- Position of fingers (e.g., all extended, index finger extended – rest of fingers curled, all fingers curled)

- Whether there is an object or objects involved and in what way (pointing at object, holding object in hand, requesting object)

- Your response to the infant's behavior

- Your infant's response to your response (e.g., satisfied or persistent)

- Your interpretation (e.g., why do you think your infant looked at you or pointed?)

Some questions that might help in getting started:

- Does your baby do things that you understand as a request?

- Does you baby do things that you understand as attention seeking?

- Does your baby have any unconventional gestures that is associated with a specific meaning that only your family understands? I.e., does your baby have gestures that he or she seems to have made up?

- When your baby is not satisfied with your response, how do you know?

- How do you know when your baby does not want something?

Thank you again for your interest in our study!

Appendix B.

Sample Observations

Names have been changed for the protection of identity. The first example is an observation of a specific situation. It is a good observation because it has lots of detail about the infant's gaze direction, vocalizations, and body and arm position, as well as the mother's response and the baby's response to the mother's response.

> August 12, 2014: Wesley was in the exerciser coughing for my attention as I was watering some plants. He was looking up at me and stretching out his arms towards me. I looked down at him and I told him to wait and I would be right there to pick him up. As I walked by him to put the watering can down he grabbed my sweatpants and tugged on them all the while continuing to make his coughing sound and looking up at me.

The following is an example of a more general observation:

> Dec 24, 2009: Over these past few days I have noticed that Isabel is really starting to direct her attention toward specific things and she is reaching for objects of interest much more deliberately. For example, if she sees something she wants she will try and reach out for it with her arm and fingers outstretched. If you turn her to face away from the object she wants, she will twist her body around and try to lean toward the object, again with her arm and fingers outstretched. Her grasping has also improved. She can now reach out and grasp a toy that is held out to her with little hesitation.