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# Are Child-Directed Interactions the Cradle of Social Learning?

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Theorists have proposed that child-directed, ostensive interactions provide a critical point of entry for supporting children's learning from others, either because they render the intentions of a teacher easier to understand (e.g., Barresi & Moore, 1996; Moore, 2010; Tomasello, 1999) or because they mark information as culturally important and generalizable (e.g., Csibra & Gergely, 2009). This article evaluates these proposals in light of data from U.S. and European children, as well as from communities where directed interactions with young children are rare. The evidence reviewed from both bodies of work leave reason to doubt the claim that directed interactions provide automatic and innate informational value for learners. Instead, the value of child-directed teaching contexts likely stems from 2 factors: how these interactions focus children's attention in the moment, and how children learn to reason pragmatically regarding the value child-directed contexts have.

*Keywords:* child-directed interaction, observational learning, social cognition, culture, infancy

Beginning in infancy, children depend on others to learn language, to learn how to act in culturally appropriate ways, and to engage with the physical environment effectively. A great deal of current research has focused on identifying the aspects of social interaction that foster these kinds of learning. Much of this work has highlighted the importance of child-directed interactions, in which the adult directly addresses the child to communicate the relevant information (e.g., the name of an object, or the proper use of an artifact). These interactions, which are relatively common in the lives of middle class European and U.S. children, involve eye contact and joint attention between the adult and child, and child-directed speech and communicative gestures on the part of the adult.

Directed interactions exert proximal effects on children's attention that support social learning. Eye-contact and child-directed speech capture children's attention (Cooper & Aslin, 1990; Farroni, Csibra, Simion, & Johnson, 2002; Kuhl, Tsao, & Liu, 2003; Pegg, Werker, & McLeod, 1992), thereby enhancing attention to the information provided by the adult. Joint attention and communicative gesture direct children's attention to the relevant entities (e.g., the object being named), thereby increasing the likelihood that the message will be successfully conveyed.

Several recent theoretical accounts have argued that the importance of child-directed interactions goes beyond this kind of simple attention focusing. These proposals suggest that directed interactions provide a critical point of entry for supporting early social

learning, either because they render the intentions of the adult easier to understand (e.g., Akhtar & Tomasello, 1998; Barresi & Moore, 1996; Herold & Akhtar, 2008; Moll & Tomasello, 2007; Moore, 2010; Tomasello, 1995, 1999) or because they mark the provided information as culturally important and generalizable (Csibra & Gergely, 2006, 2009, 2011). Because they convey these informational benefits, directed interactions are argued to be the cradle of social and cultural learning.

In this article, our aim is to evaluate these proposals in light of the experimental and observational data that bear on them. We begin by outlining the two proposals, which differ from one another in significant ways, but agree on the hypothesis that directed interactions have automatic, a priori informational value for young learners that go beyond the way the way these interactions focus children's attention in the moment. We then consider the available evidence relevant to this hypothesis. Most of the evidence comes from U.S. and European children, groups that experience relatively frequent directed interactions. We will also consider the more limited evidence available from children in cultural communities in which directed interactions with very young children are relatively rare. Both bodies of work leave reason to doubt the claim that directed interactions provide automatic informational value for learners. Instead, we argue that directed contexts initially act to direct infant's attention, and only later acquire informational value based on children's regular experiences in child-directed contexts.

## Accounts of Child-Directed Interaction and Social Learning

There are two theoretical accounts that argue that child-directed interactions have a priori informational value for supporting children's learning from others. The first, which we refer to as the *intentional understanding account* assumes that the importance of direct interactions derives from the joint attentional focus that occurs during child-directed exchanges (e.g., Akhtar & Tomasello, 1998; Barresi & Moore, 1996; Herold & Akhtar, 2008; Moll &

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Tomasello, 2007; Moore, 2010; Tomasello, 1995, 1999). For example, Moll and Tomasello (2007) argue that

... the nature of infants' attention to the adult and his or her experiences is qualitatively different inside joint attentional interactions [as compared to observed contexts] ... When the infant is truly jointly engaged with another, he or she has formed with that partner some kind of joint goal and joint plans of actions ... In these interactions infants register naturally and readily important aspects of what the partner is experiencing, and they recall naturally and readily what they have jointly experienced. (p. 316)

Barresi and Moore (1996), make similar claims regarding the importance of the shared experiences inherent in child-directed contexts. They state that

... the infant's participation in shared intentional relations with others allows the intentional relation to be represented by integrating the third person information available from the observation of others' behavior and the first person information available for actually being in a intentional relation with an object ... Initially, infants understand these intentional-relations to the extent that they can participate in episodes of shared relations. (p. 117)

In other words, both sets of authors claim that under conditions of joint engagement, children gain a conceptual understanding of the other's actions because they share both their attentional focus and their end goals with a social partner. This mutuality is argued to facilitate the child's understanding of the other individual's communicative intentions and thereby support learning from others.

This account contain the specific prediction that children will be able to learn from observation only after they develop cognitive capacities that allow them to take on the perspectives of others (between 18 months and 2 years of age). As Moore (2010) states, if this account is true, "only toddlers who show evidence of having an objective self and of understanding the subjectivity of others should be able to learn in third party interactions" (p. 61).

A second account of early learning, termed *natural pedagogy*, places little importance on the mutual engagement that occurs during episodes of child-directed interaction. Instead, it is thought that the ostensive signals that occur during child-directed interaction make it essential for learning (e.g., Csibra & Gergely, 2006, 2009, 2011). Eye gaze, ostensive gesture, and child-directed speech are hypothesized to trigger an innate modular learning system in the infant, which

... allows for the acquisition of reliable (shared and generalizable) cultural knowledge without the extended acquisition process that trial-and-error learning and statistical observational learning necessitate ... [this] makes it possible to efficiently convey knowledge with opaque content to others in a single act of demonstration not only because the recipient is prepared to recognize such actions as communicative demonstrations, but also because the addressee has the default expectation that the content of the demonstration represents shared cultural knowledge and is generalizable along some relevant dimension to other objects, other occasions or other individuals. (Csibra & Gergely, 2011, pp. 148–149)

Under this account, "Children also learn from adults and unguided observation and overhearing, but whenever they are directly targeted by ostensive demonstrations, their pattern of learning changes fundamentally ... Ostensive communication does not

only make children pay more attention to the demonstration but they also see it as a special opportunity to acquire generalizable knowledge" (Csibra & Gergely, 2009, pp. 1148–1149).

Thus, although the Intentional Understanding and Natural Pedagogy accounts differ from one another in many ways, both assume directed contexts have a priori informational value that goes beyond the way that these interactions focus children's attention in the moment. In the case of the intentional understanding account, child-directed interactions are inherently more informative to the learner because of their shared intentional structure. In the case of the Natural Pedagogy account, sensitivity to the generalizable information value of child-directed interactions is assumed to be innate and automatic.

However, as we review next, there are several challenges to the assumption that directed interactions provide innate and automatic value. First, the empirical evidence relevant to this hypothesis from European and U.S. middle-class communities is both mixed and incomplete. Second, in many cultural communities, caregivers respond quickly and contingently to babies' physical needs but they do not commonly directly address infants in pedagogical contexts (e.g., de Leon, 1998; Gaskins, 1999; Gaskins, 2006; Gaskins & Paradise, 2010; Lievene, 1994; Ochs & Schieffelin, 1994; Pye, 1986; Rogoff, 2003; Rogoff, Mistry, Göncü, & Mosier, 1993). As we review in more depth below, a pressing question for theorists who argue that child-directed interactions are a critical entry for supporting early learning is how children growing up in such communities learn from others.

In this review we consider these issues while exploring evidence relevant to children's learning in directed and observational contexts. In considering these data, we ask if there is evidence that child-directed interactions support learning independent of their proximal effects on attention. In cases where directed interactions do exert effects on learning, we consider the underlying mechanism, and we ask whether the importance of directed contexts varies as a function of the social and cultural context in which the child lives.

To be clear, the questions we raise concern the hypothesized automatic, a priori, information-value of child-directed interactions. Each of the theoretical proposals we use to focus our discussion highlights other aspects of early social learning that we do not question. The intentional understanding proposal highlights the role of knowledge about others' intentions in informing learning from others (Barresi & Moore, 1996; Moore, 2010; Tomasello, 1999). Indeed, there is a large and robust literature documenting the ways in which 1-year-old children filter their social learning through their analysis of others' intentions (Baldwin & Moses, 2001; Tomasello, Carpenter, Call, Behne, & Moll, 2005; Meltzoff, 1995). The question we raise is whether child-directed interactions are necessary for infants to understand others' intentions and use this information to constrain their learning from others. In addition, both proposals assume that what makes human cognition unique is the fact that cultural tools are transmitted socially, and that children see others as important sources or social and cultural information. Indeed, there is a large literature showing that this is the case (e.g., Baldwin & Moses, 1996; Campos & Sternberg, 1981; Gelman, 2009; Rogoff, 2003; Sterelny, 2012; Vygotsky, 1978). The question we raise is whether child-directed interactions are the critical route for supporting cross-generational transmission of cultural information.

Our review of the literature leaves strong reason to doubt that child-directed interaction provides a priori informational value for young learners. Instead, the evidence we review suggests that the only automatic value directed contexts have is the ability these interactions have to direct infant's attention in the moment. We suggest that directed contexts do hold other kinds of informational value, but these benefits are not automatic or innately specified, and are instead based on children's pragmatic reasoning about the relevance that communicated information has for them. This reasoning is not innate, but likely learned by children based on regularities in early social experiences. Instead of child-directed contexts being a universal and automatic foundation of early social learning, we argue that children's learning from others is a flexible process that is shaped by children's regular social experiences.

### Literature Search

There is a small but growing body of literature that compares young children's learning from child-directed versus observed social actors. In order to explore the hypothesis that ostensive interactions provide a critical point of entry for supporting children's learning from others, we sought out this literature, beginning with our own knowledge of relevant studies and then conducting an electronic search for available evidence in infants and young children. We considered English language, peer-reviewed empirical articles in the PsycInfo database through October, 2014. We used the following search terms as keywords: Overhearing *OR* Pedagogy *OR* Observed *OR* Pedagogical cues *OR* observational learning *OR* Pedagogical *OR* Third party *OR* interactive contexts *OR* observational contexts *OR* eavesdropping *OR* observation *OR* child-directed *OR* child-directed speech *OR* ostensive *OR* ostension, for the following age groups: Infancy (2 to 23 months) *OR* Preschool Age (2 to 5 years).

Because we were interested in assessing when and how child-directed contexts exert effects on children's learning, we sought out studies where children's learning was compared in child-directed and observational contexts. We selected studies that met the following four criteria: (a) the study had to focus on typically developing human children; (b) the study had to compare children's learning from child directed and observational contexts (either third party or noninteractive observation), or had to compare children's learning in these contexts with a baseline measure or measure of chance; (c) the study had to isolate child-directed versus observational variables while equating for other aspects of the learning context; (d) the study had to include at least one outcome measure of learning from a social actor (e.g., comprehending or producing learned information, as opposed to studies that considered only how directed interactions shape attention [e.g., making children attend to object identity over object location or number; see Futó, Téglás, Csibra, & Gergely, 2010; Yoon, Johnson & Csibra, 2008]).

We found 28 studies that met these criteria. The mean age, test items, outcome measures, and results for each of these studies is summarized in Table 1, 2, and 3. In addition to these selected studies, we reference other bodies of literature that do not directly compare children's learning from directed and observed contexts but nevertheless provides relevant information for assessing the claim that directed interactions provide a priori value for young children (e.g., observational studies that consider the relation be-

tween directed or observed input and later learning outcomes). While children learn many types of information from other people, the studies we found focused on children's word learning, and their learning about cultural artifacts, and thus we focus on these two domains in this review. We next summarize the findings from these literatures, and consider how each finding speaks to the mechanism through which child directed interactions might support social learning.

## Child-Directed Engagement and Learning

### Learning Words

Both the intentional understanding and the natural pedagogy accounts predict that episodes of child-directed interaction have automatic importance for supporting children's lexical acquisition, although for different reasons. Learning new words requires that children understand a speaker's referential intent, which the intentional understanding account expects to be easier under conditions of shared focus. Words also represent quintessential cultural forms that require generalization across both speakers and exemplars, which the natural pedagogy account assumes to depend on the presence of ostensive cuing.

Consistent with the view that child-directed interaction provides automatic value for word learning, there are strong correlations between the degree to which U.S. and European children hear child-directed input in their everyday lives and their later vocabulary in children (Barnes, Gutfreund, Satterly, & Wells, 1983; Hart & Risley, 1995; Hoff & Naigles, 2002; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991;). Further, child-directed input *uniquely* relates to later lexical abilities: Speech directed to children, and not overheard speech, predicts both children's later vocabulary (Shneidman, Arroyo, Levine, & Goldin-Meadow, 2013; Weisleder & Fernald, 2013) and their subsequent language processing skills (Weisleder & Fernald, 2013), even for children growing up in large families, where overheard input is commonplace. This holds true even in cultural communities where child-directed input is relatively rare. For example, 14-month-old children growing up in a Yucatec Mayan village hear only about 20% of their total linguistic input in child-directed speech, as compared with 70% for U.S. children growing up in large households (Shneidman & Goldin-Meadow, 2012). Nevertheless, for Mayan children, child-directed, and not overheard input, correlates with children's later vocabulary (Shneidman & Goldin-Meadow, 2012).

There are also relations between the more specific social contexts that are likely to co- occur with child-directed speech and word learning. The extent to which caregivers engage children in episodes of joint attention with objects (Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Tomasello & Farrar, 1986; Tomasello & Todd, 1983), follow in on children's attentional focus when labeling objects (Akhtar, Dunham, & Dunham, 1991; Shimpi & Huttenlocher, 2007; Tomasello & Todd, 1983), and are responsive to children's communicative initiations (Bornstein & Tamis-LeMonda, 1989; Bornstein & Tamis-Lemonda, 1997; Bornstein, Tamis-LeMonda, & Haynes, 1999) all strongly relate to children's later vocabulary. These findings suggest that child-directed interactions, and more specifically, child-directed interactions that involve joint attention and responsiveness, are important for supporting early word learning.

Table 1  
*Experimental Studies Comparing Word Learning in Child-Directed and Observational Contexts*

	Mean age	Training items	Conditions	Outcome measure	Directed learning (compared with baseline/chance)	Observed learning (compared with baseline/chance)	Condition comparison
Floor & Akhtar, 2006	18 months	Object label	Child-directed vs. Confederatedirected	Comprehension	Yes	Yes	No difference
Gampe, et al., 2012	18 months	Object label	Child-directed vs. Confederatedirected (no prior warm up with labeler)	Comprehension	Yes	Yes	No difference
			Child-directed vs. Confederatedirected (no explicit labeling utterance)		Yes	Yes	No difference
Oshima-Takane, 1988	19 months	Personal pronouns	Child-directed vs. Confederatedirected	Production	N/A	N/A	Confederate-directed > Child-directed
Shneidman, et al., 2009	20 months	Object label	Child-directed vs. Confederatedirected	Comprehension	Yes	Yes	No difference
Akhtar, et al., 2001	25 months	Object label	Child-directed vs. Confederatedirected	Comprehension	Yes	Yes	No difference
		Action label	Child-directed vs. Confederatedirected		Limited	Limited	No difference
	30 months	Object label	Child-directed vs. Confederatedirected	Comprehension	Yes	Yes	No difference
		Action label	Child-directed vs. Confederatedirected		Yes	Yes	No difference
Akhtar, 2005	25 & 30 months	Object label	Confederate-directed (with distracting toy)	Comprehension	N/A	Yes	N/A
	25 months		Confederate-directed (embedded in a directive utterance)	Comprehension	N/A	Yes	N/A
Martínez-Sussmann et al., 2011	27 months	Object label	Confederate-directed	Comprehension	N/A	Yes	N/A
O'Doherty et al., 2011	30 months	Object label	Live, Child-directed (no reciprocity) vs. Live, Confederatedirected	Comprehension	No	Yes	Confederate-directed > Child-directed
			Video, Child-directed (no reciprocity) vs. Video, Confederatedirected	Comprehension	No	Yes	Confederate-directed > Child-directed
			Live, Child-directed (with reciprocity)	Comprehension	Yes	N/A	N/A
			Live, Confederatedirected (no reciprocity)	Comprehension	N/A	No	N/A

**Table 2**  
*Experimental Studies Considering Action Imitation Following Child-Directed and Observational Demonstrations*

	Mean age	Training items	Conditions	Directed imitation (compared with baseline)	Observed imitation (compared with baseline)	Condition comparison <sup>a</sup>
Sage & Baldwin, 2011	9 & 12 months	Tool use	Child-directed vs. Noninteractive	Yes	No	Child-directed > Noninteractive
Kiraly, et al., 2013	14 months	Rational and arbitrary actions to achieve a goal	Child-directed vs. Noninteractive	N/A	N/A	Child-directed > Noninteractive <sup>b</sup>
Brugger et al., 2007	15 months	Arbitrary actions to achieve a goal	Child-directed vs. Noninteractive	N/A	N/A	Child-directed > Noninteractive
Hay et al., 1985	18 months	Pretend play actions	Child-directed vs. Confederate-directed	N/A	N/A	No difference
Nielsen, 2006	18 months	Arbitrary actions to achieve a goal	Child-directed vs. Noninteractive	N/A	N/A	Child-directed > Noninteractive
	24 months	Arbitrary actions to achieve a goal	Child-directed vs. Noninteractive	N/A	N/A	No difference
Shimpi et al., 2013	18 months	Arbitrary actions to achieve a goal	Child-directed vs. Confederate-directed	N/A	N/A	No difference
Shneidman et al., 2014	18 months	Arbitrary actions to achieve a goal	Child-directed vs. Confederate-directed	Yes	Yes	Child-directed > Confederate-directed
	25 months	Arbitrary actions to achieve a goal	Child-directed vs. Confederate-directed	Yes	Yes	No differences
Shneidman et al., in press	18 months	Arbitrary actions to achieve a goal (in Yucatec Mayan population)	Child-directed first visit, Confederate-directed second visit vs. Confederate-directed first visit, Child-directed second visit	Yes	Yes	Second visit > First visit
	18 months	Arbitrary actions to achieve a goal (in U.S. population)	Child-directed first visit, Confederate-directed second visit vs. Confederate-directed first visit, Child-directed second visit	Yes	Yes	Child-directed first visit > Confederate-directed first visit
Matheson et al., 2013	19 months	Arbitrary actions to achieve a goal	Child-directed vs. Confederate-directed vs. Noninteractive	N/A	N/A	Child-directed > Noninteractive <sup>4</sup>
	24 months	Arbitrary actions to achieve a goal	Child-directed vs. Confederate-directed vs. Noninteractive	N/A	N/A	No difference
Vredenburgh et al., 2014	25 months	Actions to achieve a goal	Child-directed vs. Noninteractive	N/A	N/A	No difference
Schmidt et al., 2011	36 months	Actions to achieve a goal	Child-directed vs. Noninteractive	N/A	N/A	No difference
Nielsen et al., 2012	48 months	Arbitrary actions to achieve a goal	Child-directed vs. Confederate-directed vs. Noninteractive	N/A	N/A	No differences
Hoehl et al., 2014	63 months	Phase 1: Initial arbitrary imitation of arbitrarily demonstrated means end actions	Child-directed Phase 1, Noninteractive Phase 2 vs. Noninteractive Phase 1, Child-directed Phase 2 vs. Child-directed Phase 1, Child-directed Phase 2	Yes	Yes	No difference in initial imitation
		Phase 2: Perseveration of arbitrary imitation following rational, goal efficient presentation of same means end		Only for Child-directed, then Noninteractive phase order		Child-directed Phase 1, Noninteractive Phase 2: No Phase difference Noninteractive Phase 1, Child-directed Phase 2: Phase 1 > Phase 2 Child-directed Phase 1, Child-directed Phase 2 Phase 1 > Phase 2

<sup>a</sup> While some studies also included measures of emulation (achieving target actions by a different means than demonstrated), only imitation data (achieving target action via the same means demonstrated) is reported here. <sup>b</sup> Of arbitrary as compared with rationally explained actions.

Table 3  
*Experimental Studies Investigating Children's Understanding and Inferences Regarding Cultural Artifacts Following Child-Directed and Observational Demonstrations*

	Mean age	Construct	Conditions	Measure	Condition comparison
Sage & Baldwin, 2011	9 months 12 months	Causal understanding of tool actions	Child-directed vs. Noninteractive tool demonstration	Looking time to possible vs. impossible causal events	No difference (no preference) No difference (preference for possible event across conditions)
Träuble et al., 2014	12 months	Generalization of emotional preference for object (based on functionally consistency) from E1 to E2	Child-directed vs. Noninteractive preference demonstration by E1	Looking time to E2 interacting with E1's preferred vs. Non preferred (function-consistent) object	Child-directed condition: Longer looking Noninteractive condition: No difference in looking behavior
Egyed et al., 2013	18 months	Generalization of emotional preference for object from E1 to E2	Child-directed vs. Noninteractive preference demonstration by E1	Choice of object preferred by E1 when probed by E2	Child-directed > Noninteractive
Vredenburg et al., 2014	25 months	Child's transmission of actions learned from E1 to E2	Child-directed vs. Noninteractive	Production of actions when probed by E2	Child-directed > Noninteractive
Shneidman et al., 2015	31 months	Inference regarding object function/use following demonstration of single object function (U.S. and Yucatec Mayan populations)	Child-directed vs. Noninteractive	Restriction of play to demonstrated function	Child-directed > Noninteractive
Phillips et al., 2012	31 & 43 months	Generalization of object function to new exemplar Memory for object function after delay	Child-directed vs. Noninteractive action demonstrations	Verbal response to probe	No difference No difference
Schmidt et al., 2011	36 months	Interpretation of actions as normatively correct or incorrect	Child-directed vs. Noninteractive	Protest response	No difference
Butler & Markman, 2012	43 months 54 months	Generalization of demonstrated object function to similar exemplars	Child-directed vs. Noninteractive	Attempts to perform demonstrated action with similar exemplars	No difference Child-directed > Noninteractive
Butler & Markman, 2014	50 months	Categorization of object by function (in contrast to shape/color)	Child-directed vs. Noninteractive	Production & Comprehension	Child-directed > Noninteractive
Bonawitz et al., 2011	61 months	Inference regarding object function/use following demonstration of single object function	Child-directed vs. Noninteractive directed vs. (adult) confederate-directed vs. (child) confederate-directed	Restriction of play to demonstrated function	Child-directed & (child) confederate-directed > Noninteractive & (adult) confederate-directed



This body of research is useful for understanding the contexts that support functionally important outcomes in the communities that have been studied, and these findings may be valuable for informing interventions to foster stronger outcomes in populations who are at risk for falling behind in these outcomes. However, ultimately correlational data are not a clear source of information about the mechanisms that link child-directed interactions to language outcomes. One problem is that caregivers who talk more to children, engage children in more episodes of joint interaction, and are generally more responsive to their children's communicative intents, may have other characteristics that could account for the relation between child-directed interaction and vocabulary development (e.g., Hoff & Naigles, 2002). Further, child-directed speech is rich with features that likely foster language learning beyond the joint aspects of the experience or pedagogical cues, and because these features are so highly correlated in natural input, it is difficult to determine which of them matter most for word learning. For example, speech that is directed to children has a low word-token to word-type ratio (Henning, Striano, & Lieven, 2005), contains fewer complex clauses (Phillips, 1973), and is more likely to have object labels positioned at the end of utterances (Messer, 1981) as compared with speech directed to adults. These kinds of simplifications may support children's early word learning (review in Soderstrom, 2007) but have not been dissociated from the directedness of input in observational studies.

Even if child-directed input is important for learning for reasons other than these, it is unclear if this is due to the proximal affects on attention that ostensive engagement may provide, or whether child-directed communication has some informational benefit beyond this. Studies that have found no relation between overheard input and lexical development did not distinguish between overheard instances where children were attending to the relevant interaction and instances when they were not. Because children's attention is constrained by adult participants during episodes of joint interaction, one possibility is that overheard situations are simply more variable than child-directed interactions with respect to the amount of information that children can potentially acquire. Observational contexts require that children exert independent attentional control in order to glean information from the interaction.

Given these issues, a clearer strategy for isolating the potential information value of child-directed interactions is to recruit experimental methods to assess infants' learning from child-directed and nonchild-directed input, under conditions that equate for other aspects of the learning context. For example, children could be introduced to a novel word, presented in identical framing utterances and in the presence of the referent, varying only whether the adult who utters the word is engaged in a child-directed interaction with the infant. If child-directed interactions provide learners with unique insight into the communicative intentions of the speaker, or into the importance and generalizability of the information provided, then they should learn more robustly during child-directed interactions. Laboratory procedures have the added benefit of providing opportunities to closely monitor how infants attend to the information during child-directed versus nonchild-directed events, thereby providing a vantage point on the potential contributions of attention to children's learning in these situations.

A number of studies have pursued this strategy to investigate infants' word learning (Akhtar, 2005; Akhtar, Jipson, & Callanan,

2001; Floor & Akhtar, 2006; Gampe, Liebal, & Tomasello, 2012; Martínez-Sussmann, Akhtar, Diesendruck & Markson, 2011; O'Doherty et al., 2011; Oshima-Takane, 1988; Shneidman, Buresh, Shimpi, Knight-Schwarz, & Woodward, 2009; see Table 1). Across these studies, there is no evidence that child-directed communication, in and of itself, facilitates early word learning. For example, Floor and Akhtar (2006) introduced 18-month-old children to a novel object label in either conditions of direct engagement, in which an experimenter engaged the child in joint attention while providing the label, or indirect access, in which the child observed two experimenters having a conversation and was not part of the interaction. Children were then tested for their comprehension of the novel label. Children demonstrated learning of the label in both the direct and observation conditions, and their learning did not differ across these conditions, indicating that they were able to learn new words from interactions they did not participate in. Recently, Gampe, Liebal, and Tomasello (2012) expanded on these findings by showing that 18-month-old children show equal learning from child-directed and observed interactions even when the overhearing situation is made more complex. Across two studies, children were exposed to novel object labels in either a child-directed or an observed situation. However, unlike the Floor and Akhtar (2006) study, children in these studies were given no prior social experience with the experimenter who was labeling the target object, and, in one study, the object label was embedded in a sentence that was not an explicit naming interaction. These modifications of the original paradigm reduced the likelihood that children saw themselves as participants in the interaction, and eliminated the linguistic frame suggesting a novel object label. Despite these changes in the procedure, 18-month-old infants displayed robust learning in both the child-directed and observed conditions, and their learning did not differ across these conditions.

These findings have been mirrored across each of the studies that have assessed children's word learning from observation (Akhtar, 2005; Akhtar et al., 2001; Floor & Akhtar, 2006; Gampe et al., 2012; O'Doherty et al., 2011; Shneidman et al., 2009). In all cases, children are able to learn new words from observed interaction, and, when child-directed and nondirected input are compared, infants have been shown to learn the new word equally well in both conditions (or in some cases better from observation, see O'Doherty et al., 2011; Oshima-Takane, 1988). Toddlers are able to learn words from observation when they play with a distracting toy during a labeling interaction (Akhtar, 2005), when the labeling utterance is embedded in a directive utterance (Akhtar, 2005), or when they view the interaction on video (O'Doherty et al., 2011). Together, these data indicate that by 18 months child-directed interactions do not confer a special informational benefit for supporting word learning.

On the face of it, these findings are problematic for the theory of natural pedagogy, which posits that children have an innate bias to view only information presented with ostensive cuing as kind relevant and generalizable (Csibra & Gergely, 2006, 2009, 2011). By 18 months, children can learn new words, which represent culturally important, kind relevant information, as readily from overhearing others' conversations as from child-directed input. Even so, a central prediction of the natural pedagogy account has not yet been fully explored. This account posits that generalization of learning should be strongly influenced by the presence of

pedagogical cues, because these cues are taken to mark information that is “culturally universal.” Perhaps differences in learning from child-directed versus nondirected input would be more evident under testing conditions that require the infant to generalize what he or she has learned.

Although the experiments that contrast directed and nondirected input have not explicitly evaluated the extent to which infants extend learning to new instances of the named kind, one of these studies utilized a testing procedure where the person testing the infant was different than the person who introduced the object label (Shneidman et al., 2009). Because under these circumstances children displayed equal learning from child-directed and observed contexts, the findings suggest that directed input is not necessary for supporting the ability to generalize. Nevertheless, future research is needed to fully explore the extent to which infants will generalize information learned from observation to new speakers and new contexts, given that they generalize words taught in direct interactions in each of these ways (Buresh & Woodward, 2007; Henderson & Woodward, 2012; Woodward, Markman, & Fitzsimmons, 1994).

Theorists who believe that child-directed communication supports children’s intentional understanding have hypothesized that early in life, children lack the cognitive abilities to understand other’s communicative intentions in the absence of mutual focus. Thus, these theorists argue that joint attention should be critical for supporting learning at the earliest stages of language learning, and then become less important over the course of development (Carpenter et al., 1998; Moll & Tomasello, 2007; Moore, 2010). This hypothesis has not yet been evaluated. While there are correlational studies that indicate that experience in joint attention from 9–15 months supports early word learning (e.g., Carpenter et al., 1998), there are, as of yet, no studies that experimentally contrast children’s ability to learn from child-directed and observed conversations before 18 months. This work is needed in order to assess whether younger children benefit from episodes of child-directed interaction in ways that older infants do not.

However, other kinds of evidence make it seem unlikely that joint attention is ever a necessary condition for supporting infants’ ability to understand other’s communicative intentions. For example, at 14 months infants who observe an individual addressing a third party and pointing to one of two containers where an object is hidden are able to successfully retrieve that object, demonstrating that these children do not necessarily rely on a shared perspective in order to understand the intentionality of the actor (Gräfenhain, Behne, Carpenter, & Tomasello, 2009). Importantly, infants perform at chance in a control version of this study where the pointing gesture is made to be noncommunicative, suggesting that children are solving this task through an understanding of the communicative nature of the third-party point, and not through a low-level response to the pointing gesture.

Even younger infants seem to understand that words spoken between third parties convey communicative information (Martin, Onishi, & Vouloumanos, 2012; Vouloumanos, Onishi, & Pogue, 2012). For example, Martin, Onishi, and Vouloumanos (2012) familiarized 12-month-old infants to an experimenter who showed a preference for one of two objects. Following this, infants watched as the experimenter (who was now behind a barrier and thus unable to reach either object) either spoke a nonce word to a second experimenter, or coughed. Importantly, neither of the ex-

perimenters directly engaged the child. Infants’ looking time was recorded as the second experimenter handed the first experimenter either the previously preferred object or the nonpreferred object. In cases where the experimenter used the nonce label, infants looked longer to trials where the nonpreferred object was offered to her. This was not the case when the experimenter coughed; in this context infants displayed equal looking to preferred object and nonpreferred object trials. This pattern of results demonstrates that infants understand that a label (but not a cough) conveys communicative information between individuals, even when the infants themselves are not involved in the conversation. Thus, an analysis of others’ intentions may be available to inform infants’ learning even when infants are not engaged in child-directed interactions.

Even if studies at younger ages with more demanding tests of generalization support the hypothesis that child-directed engagement has automatic informational value for supporting word learning, it would be unclear why. One possibility is that middle-class U.S. and European children are more likely to learn from child-directed labeling interactions because they represent a typical form of social experience. In other words, children could come to learn that child-directed interactions are especially useful contexts for learning new words because of their past social experiences in direct labeling situations.

This hypothesis could be tested by exploring word learning across cultural communities where child-directed interactions with children are less common. Many children live in environments where speech directed to children in dyadic contexts is relatively rare, and children receive most early language input from observing multiparty interaction (e.g., Brown, 1998; de Leon, 1998; Pye, 1986; Schieffelin & Ochs, 1986; Shneidman & Goldin-Meadow, 2012).

Indeed, children growing up in many such communities are encouraged to and expected to learn from observing others (e.g., Rogoff et al., 1993), as parental beliefs include a theory of learning that gives agency to children’s seeking of information in shared, noninstructional contexts (Gaskins, 1999; Gaskins & Paradise, 2010). Correlational data from these communities are consistent with data from U.S. populations, child-directed, and not overheard input relates to children’s subsequent language development (Shneidman & Goldin-Meadow, 2012). However, as we have noted, because naturally occurring input is confounded with other factors that may relate to language outcomes, cross-cultural experimental work is needed in order to investigate whether these children demonstrate a greater ability to learn from observation than children growing up in communities where child-directed interaction is commonplace.

While this kind of cross-cultural evidence is, as of yet, lacking, there is evidence that variation in social experience relates to the way children attend to and learn words from others within a culture. We tested the relations between 20-month-old U.S. children’s environmental experiences, their attentional allocation and their ability to learn new words from child-directed and observed situations (Shneidman et al., 2009). In one condition children were introduced to a new object label during an ostensive, joint attention interaction, while in a second condition they overheard the label being used by two experimenters. We also interviewed all children’s parents to determine how often children had opportunities to overhear conversations, that is, how often they were in the company of two or more adults. Children in both conditions

learned the correct object at above chance rates (replicating the experimental findings reviewed above). However, importantly, children's environmental experiences and their attentional allocation in the overheard condition related to their word learning. Children who spent more time with multiple adults were more likely to attend to the relevant aspects of the training event and were more likely to show subsequent knowledge of the new word than were children who spent most of their time with a single caregiver.

These findings indicate that environmental experience can influence the way that children attend to and learn from others. Further, it suggests that children who regularly spend most of their time among multiple individuals, could become highly skilled at learning from observation. Experience in multiparty interaction is a hallmark of early life in many cultural communities (e.g., Gaskins, 2006); thus, one possibility is that the ability to learn words from observation varies across cultural contexts where this form of experience was more or less common.

To summarize the evidence from the word-learning domain, the hypothesis that directed interactions provide a critical point of entry that supports learning has little support. Naturally occurring child-directed input relates to children's subsequent vocabulary; however, when directed cues are isolated in experimental word learning studies, no benefits have been found.

Thus, directed input does not relate to learning because it is directed per se, but likely because children are more likely to attend to child-directed as compared with observed input, or because child-directed input co-occurs with other speech properties that support word learning. While more data with younger children in varying social contexts using more stringent tests of generalization are needed to fully explore the hypothesis that child-directed contexts provide unique information for word learning, the findings at present are consistent with the idea that these interactions convey no special learning benefits beyond their potential to direct attention. Even children at the earliest stages of word learning show evidence of understanding the communicative intentions of other people in the absence of mutual focus, and children do not rely on child-directed input to learn new words, which represent generalized, culturally relevant information. A critical direction for future research is to explore the relations between early environmental experience and the ability to attend to and learn from observed interactions. Children with relatively more experience observing others may be better equipped to learn from observation than children who spend most time in dyadic, one-on-one interactions.

### Learning to Interact With Cultural Artifacts

Learning how to interact with cultural artifacts requires that children acquire information from other people about the instrumental use of tools, as well as knowledge of conventional customs with objects. Social informants are a critical source of information for obtaining this knowledge, as this aspect of learning involves nonobvious, or in some cases causally opaque information about the properties of objects. In the first year of life, children demonstrate robust culturally specified knowledge about artifacts. By 6 months, children make reliable visual predictions to the end states of familiar actions with artifacts, like bringing a cup to one's mouth, and show delayed anticipatory responses when the action

sequences are made to be unfamiliar, like bringing a cup to one's ear (Hunnus & Bekkering, 2010). At 10 and 16 months, infants are more likely to imitate conventional, as compared with unfamiliar, actions with objects (Killen & Uzgiris, 1981) and by 1 year of age, children spontaneously act out conventional actions on objects by performing nonfunctional "recognitory gestures" (e.g., Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). Children also demonstrate early sensitivity regarding the cultural relevance of object interactions. For example, in some cases 14- and 19-month-olds are more likely to imitate actions on objects that are demonstrated by individuals who are part of their in-group (as marked by the language they speak) than actors who are not (Buttelmann, Zmyj, Daum, & Carpenter, 2012; Howard, Hender-son, Carrazza, & Woodward, 2014).

The two theoretical models reviewed above predict that episodes of child-directed interaction provide critical information that enables learning about objects, their uses, and their conventional properties. The theory of natural pedagogy predicts that learning cognitively opaque actions should rely on direct interaction, because in the absence of this communication, children will not automatically generalize across time and across exemplars (e.g., Csibra & Gergely, 2011). The intentional understanding account assumes learning how objects are used requires that children understand the intentions of the actor, which is argued to be dependent on episodes of joint mutual focus. Thus, this account predicts learning from observation should monotonically increase with age as children develop the cognitive capacity to understand the goal directed behaviors of others outside of episodes of joint focus (e.g., Moore, 2010).

While word learning studies have used measures of comprehension to assess differences in learning from child-directed and observed situations, many of the experimental studies exploring children's artifact learning use production measures to gauge learning. In contrast to the language learning work, these studies have uncovered differences in children's responses to direct and observational contexts. We review this body of work by considering two sets of studies: (a) studies that assess children's imitation of others' actions following directed versus observational experience (Brugger, Lariviere, Mumme, & Bushnell, 2007; Hay, Murray, Cecire, & Nash, 1985; Hoehl, Zettersten, Schleihauf, Grätz, & Pauen, 2014; Király, Csibra, & Gergely, 2013; Matheson, Moore, & Akhtar, 2013; Nielsen, 2006; Nielsen, Moore, & Mohamedally, 2012; Sage & Baldwin, 2011; Schmidt, Rakoczy & Tomasello, 2011; Shimpi, Akhtar, & Moore, 2013; Shneidman, Todd, & Woodward, 2014; Shneidman, Gaskins, & Woodward, in press; Vredenburgh, Kushnir, & Casasola, 2014; see Table 2); and (b) studies that consider how children make inferences regarding object properties and conventions following directed versus observational experiences (e.g., Bonawitz et al., 2011; Butler & Markman, 2012; Butler & Markman, 2014; Egyed, Kiraly, & Gergely, 2013; Phillips, Seston, & Kelemen, 2012; Sage & Baldwin, 2011; Schmidt et al., 2011; Shneidman, Gweon, Schultz, & Woodward, 2015; Träuble & Bätz, 2014; Vredenburgh et al., 2014; see Table 3). We consider how each of these bodies of work speaks to the question of whether or not directed interactions have automatic value for young learners.

**Imitation of actions on objects.** A growing body of research indicates that infants and toddlers are more likely to faithfully imitate an individual's actions when they are directly taught as

compared with when they incidentally observe these demonstrations. For example, 8- to 13-month-old infants who are directly addressed prior to viewing a tool use demonstration are more likely to later successfully use the tool than infants who observe a nonengaging actor (Sage & Baldwin, 2011). Similarly, at 14 months, children who are shown a novel action by a demonstrator (a person turning on a lamp by pressing a button with her head) are more likely to imitate this action, as compared to a similar but rationally explainable action (a person turning on a lamp with her head while her hands are occupied), under conditions of ostensive engagement than under conditions of no social engagement (Király et al., 2013). At 15 months children are more likely to imitate the actions of an actor who directly addresses them prior to demonstrating action sequences (like performing nonfunctional flourishes before opening a box) than to an actor who addresses no one (Brugger et al., 2007) and at 18 months children are more likely to imitate actions when directly addressed than when observing a nonsocial actor (Matheson et al., 2013; Nielsen, 2006).

Unlike words, actions can be appropriately modeled outside of social contexts. This kind of nonsocial imitative learning was tested in most of the aforementioned studies (Brugger et al., 2007; Király et al., 2013; Nielsen, 2006; Sage & Baldwin, 2011). Across these studies, the nonostensive model talked into space (not to a communicative partner), leaving open the question of whether or not children would show imitative behavior from a pedagogical and social interaction, but one that did not directly involve them (paralleling the observational word learning studies reviewed above). Studies have tested infants in this kind of paradigm and have yielded mixed results (Hay et al., 1985; Matheson et al., 2013; Shimpi et al., 2013; Shneidman et al., 2014). In some studies, no significant differences were found in children's imitation of social actors in these contexts (Hay et al., 1985; Matheson et al., 2013; Shimpi et al., 2013) while other cases results mirrored those found in nonsocial imitation studies; children in a direct condition were more likely to imitate novel actions than children in an observational condition (Shneidman et al., 2014). Thus, in some, but not all cases children imitate more robustly from child-directed contexts than from observational contexts, even when those contexts involve a pedagogical and social interaction.

Importantly, imitation findings cannot be explained simply by considering children's attentional allocation to child directed and observed contexts. Several studies have found that young children are more likely to imitate actions presented in child-directed interaction than not, even when they allocate equal attention to directed and observed events. (Király et al., 2013; Sage & Baldwin, 2011; Shneidman et al., 2014). This suggests that the benefits of child-directed communication extend beyond proximal attentional focusing.

However, by the time children are 2 years of age, child-directed cuing is not a necessary condition for supporting imitative behaviors. Children older than 2 who observe novel actions performed in child-directed versus observed contexts are equally likely to imitate these actions, even when the actions are causally unrelated to a goal (Hoehl et al., 2014; Matheson et al., 2013; Nielsen, 2006; Nielsen et al., 2012; Schmidt et al., 2011; Shneidman et al., 2014; Vredenburgh et al., 2014). These findings suggest that infants' response to pedagogical cues in imitation contexts shifts over the course of early development.

**Generalization of socially demonstrated information.** As well as influencing toddlers' imitation of object actions, in some cases, directed contexts affect the kinds of generalizations toddlers and older children make about object properties and conventions. For example, Egyed, Király, and Gergely (2013) presented 18-month-old children with displays of a person reacting positively to one object and negatively to a second object. Some children saw this display in a communicative, directed context (the experimenter looked at and talked to the child) while other children saw the display in a noncommunicative context (the experimenter ignored the child and only looked at the object displays). Following this presentation, either the initial (old) actor or a new actor requested the child hand her an object. When the original actor made this request, children handed her the one she had previously shown a positive emotional reaction to. However, when a new actor requested the object, children's responses varied based on whether they had seen the original display in the communicative or in the noncommunicative condition; children in the communicative condition were more likely give the new actor the object that the old actor had positively reacted while children in the noncommunicative condition were less likely to do so (see Träuble et al., 2014 for similar findings). This suggests that the presence of directed cues leads children to infer emotional evaluations will be shared across people.

Child-directed contexts can also, in some cases, affect children's inferences regarding the generalization of object affordances. While 2- and 3-year-olds who view pedagogical versus nonpedagogical demonstrations show equal generalization of demonstrated object properties to similar exemplars, even after a time delay (Phillips et al., 2012), 4-year-old U.S. children who are directly taught that a novel object is magnetic are more likely than children who are not (and who incidentally observe the object being used) to persist in their exploration of perceptually identical (but non-magnetic) exemplars, attempting to use the objects to pick up paperclips, (Butler & Markman, 2012). Similarly, preschool-aged children are more likely to categorize objects by function (instead of by perceptual features like color), when they are directly taught the object function than when they observe the object's use (Butler & Markman, 2014). These findings suggest that directed contexts can shape children's reasoning regarding object categories.

**Inferences regarding object use.** Finally, directed contexts affect children's inferences regarding what they can or should do with objects. After incidentally observing an actor performing a single function on an object, 2-year-old and 4- to 6-year-old children will broadly explore the object, and independently discover many of its other affordances (e.g., Bonawitz et al., 2011; Shneidman et al., 2015). However, when a demonstrator directly addresses, and shows the child the same single action, children restrict their exploration to this demonstrated property. Thus, children may assume that if a knowledgeable demonstrator showed one function of a toy, that object has one, and only one function, or they could infer that if they are shown an object function, that is what they should do with the object. In contrast, they have no such assumptions following incidental observation of the same action.

To summarize these findings, directed contexts display powerful effects on children's interactions with objects. Pedagogical teaching increases imitative behaviors in infants and toddlers, prompts children to infer stability across people and exemplars, and informs

children's inferences regarding object affordances. However, these findings do not necessarily provide evidence that child-directed interactions provide automatic informational value that supports learning about objects. One issue is that, for many of these findings, it is unclear if directed contexts affects what children learn about the actions and objects shown to them or instead influences their motivation to perform a certain way in the situation. Child-directed interactions could be doing no more than making children more comfortable handling objects that are presented to them, giving children the sense that they have permission to operate the objects in a demonstrated manner, prompting children to understand the interaction as a social game with rules that should be followed, or leading children to interpret the demonstrated actions or information to be pragmatically relevant for them in the current situation.

Indeed, several theorists have argued that these kinds of social contextual factors do account for differences in children's response to interactive and noninteractive partners (Hoehl et al., 2014; Nielsen, 2006; Over & Carpenter, 2012; Shneidman et al., in press; Vredenburgh et al., 2014). One argument is that child-directed contexts exert their effects because they affect children's social motivation to sustain interactions with others (e.g., Nielsen, 2006; Over & Carpenter, 2012). For example, Nielsen (2006) tested 18-month-old and 24-month-old children in a task where they viewed a demonstration of a box that was opened with a tool (importantly, the box could potentially and effectively be opened with the hand). Children were either directly addressed by the person demonstrating the box's affordances, or they observed a socially aloof actor open the box. When directly addressed, children tended to imitate both the means (the tool) as well as the goal (opening the box) of the actor's actions. However, when children viewed the socially aloof model, they imitated only the actor's goal (opening the box) but failed to imitate the means (using the tool). At 24 months of age children imitated the actor's means equally across the two conditions. Neilson argues that these patterns of imitation derive not from differential learning in each condition, (children learned to open the box in both conditions), but rather from differing social motivations across the two conditions. At 18 months children could be motivated to sustain a social interaction only when the demonstrator directly engages them. By 24 months of age children may also have a goal to initiate interaction, and thus imitate the actions, of a nonresponsive partner.

In addition to shaping children's motivation to affiliate with others, directed contexts are also argued to affect children's pragmatic reasoning regarding the social relevance or social value of a message (e.g., Shneidman et al., in press; Vredenburgh et al., 2014). For example, Shneidman et al. (in press) tested 18-month-old infant's in a within-subjects study design where infants were directly addressed during one visit to a lab and shown novel actions, and observed an interaction between social partners on a second visit (with the order of visits counterbalanced across children). Overall, infants showed no difference in imitative behavior in the directed versus observed conditions. However, infants who were directly addressed on their first visit showed significantly higher overall imitation rates than infants who observed on their first visit. Infants who were directly addressed on their first visit may have reasoned that the demonstrator had information that was relevant for them, and thus continued to imitate her actions on the second day, even when she was no longer directly addressing

them. In contrast, the infants who were ignored by the demonstrator on the first day may have reasoned that the information she was provided was irrelevant for them, and thus disregarded her actions even when they were eventually directly engaged by her. Thus, instead of automatically responding with increased imitation to child-directed contexts, infants seemed to be using their previous experience in a specific learning context in order to reason pragmatically about which actions to imitate.

Similarly, Vredenburgh, Kushnir, and Casasola (2014), presented 2-year-old children with two experimenters who interacted with novel objects. One experimenter directly addressed the child while demonstrating one affordance on a novel object, while the second experimenter ignored the child and performed a different action on the object. Children were equally likely to imitate the two action affordances following these demonstrations. However, when a new experimenter came into the room and asked the child how the object worked, children spent more time demonstrating the object function that had been directly taught to them, as compared to the action they had incidentally observed. Again, these results suggest that directed contexts are not supporting children's learning about actions on objects per se (children learned equally from the two experimenters), but rather the social value that children put on these actions.

Social affiliation or social pragmatic reasoning can also affect older children's imitation rates in directed and observed contexts. Hoehl, Zettersten, Schleihauf, Grätz, and Pauen (2014) found that 5-year-old children were equally likely to imitate inefficient means end sequences (in order to remove tokens from a box) when they were directly addressed as compared to when they observed a noninteractive actor.

However, following this initial demonstration (Phase 1), children saw the tokens removed in a more efficient manner (Phase 2), and their subsequent responses differed depending on whether they were directly addressed, or they were not in this second phase of the study. Children who received a child-directed demonstration in Phase 2 disregarded their previous inefficient retrieval strategy and performed the more efficient means for retrieving the object (regardless of whether they had been directly addressed or not in Phase 1). In contrast, children who saw the more efficient strategy performed by a noninteractive actor in Phase 2, maintained the inefficient strategy of retrieving the tokens which had initially been taught. These findings suggest that children were not automatically responding to the child-directed context with heightened imitation.

Instead, after being shown two competing strategies for removing the tokens, children may have chosen the strategy performed by the pedagogical experimenter (in cases where the other experimenter had ignored them) because this was the actor they felt the highest degree of social affiliation with (Hoehl et al., 2014), or because they reasoned that that individual had higher social relevance for them.

Together, these findings suggest that the value of child-directed contexts for supporting imitative behaviors is not automatic. Children do not always show more robust imitative behaviors following directed cuing as compared with observational experience. Instead, children's responses likely depend on social motivations to imitate as well as pragmatic reasoning about the relevance that communicated information has for them. This reasoning could account for findings indicating increased generalization and re-

striction of exploration following directed teaching. Children could reason that a person who is teaching them something is providing important, accurate, and complete information about how an object should be used (e.g., Bonawitz et al., 2011; Shafto, Goodman, & Frank, 2012). Based on this assumption they could continue to explore objects that have been shown to have a functional property, even in the face of counterevidence, limit their exploration to the set of properties that have been demonstrated to them, and infer the generalizability of social information. Importantly, directedness is likely only one of many pragmatic cues that can inform children's reasoning in these ways. For example, children who observe an adult demonstrating an action affordance to another child limit their exploration to that particular action, while children who observe an adult demonstrating to another adult do not (Bonawitz et al., 2011). Likewise, 3-year-old children rely on their interpretation of an adult's familiarity with an object, and not on pedagogical cuing, to inform them about the "right way" to interact with novel objects (Schmidt et al., 2011). These findings suggest that cues like social relevance, or interpretations of expertise, can work similarly to directedness in informing children about the usefulness a communicated message has for them. Thus, instead of critically supporting children's understanding of intentionality, or automatically cuing children to treat information as culturally generalizable, directedness is likely one of a myriad of social cues that can be used to inform children's social reasoning and social responding.

A second issue with assuming that child-directed contexts hold a priori informational value for supporting action learning is that it is very possible that children's responses to directed cuing is dependent on experience in directed contexts. Recent evidence suggests that children from a diverse set of cultural communities see others as important sources or social and cultural information, faithfully imitating others' actions when directly engaged (e.g., Callaghan et al., 2011; Nielsen & Tomaselli, 2010). However, children growing up in cultural communities where observational learning is valued are *also* proficient observational learners. These children perform skilled tasks like household chores (Gaskins, 1999; Rogoff, 2003), tortilla making (Gaskins & Paradise, 2010), and weaving (Childs & Greenfield, 1980) despite receiving little or no directed instruction. Moreover, these children show patterns of attentional engagement that reflect experience as active observers of others. For example, Chavajay and Rogoff (1999) compared the attentional patterns of 14- to 20-month-old Guatemalan Mayan and middle-class U.S. children when confronted with situations where there were co-occurring events (e.g., the child was given a toy to explore while at the same time other events were happening in the room).

U.S. children tended to monitor these events by focusing on only one event at a time. Mayan children, in contrast, were more likely to simultaneously monitor multiple events by either rapidly shifting attention between them, or by performing skilled manual actions to one event while visually attending to the other. Attending to events in this way could foster learning from observation by allowing children the opportunity to take away information from interactions that do not involve them.

Indeed, experimental studies have demonstrated that infants and children in communities where observational experience is common respond in fundamentally different ways following directed cuing as compared to children growing up in places where osten-

sive interaction is commonplace (e.g., Correa-Chavez & Rogoff, 2009; Silva, Correa-Chavez, & Rogoff, 2010; Shneidman et al., in press; Shneidman et al., 2015). For example, in one study conducted in both a U.S. and a Guatemalan Mayan community, 5- to 11-year-old children sat in the same room as an experimenter who was teaching another child how to construct an origami figure. The nonaddressed child was later given an opportunity to construct the toy without instruction. Results showed that Mayan children attended more to the observed interaction, and made fewer mistakes when constructing the figure than did the U.S. children, demonstrating that they had learned more from the observed interaction than the U.S. children had (Correa-Chavez & Rogoff, 2009). These findings suggest that children's cultural experiences can shape the way that they attend to and learn from others.

Recently, Shneidman et al. (in press) tested U.S. and Yucatec Mayan infants' imitative behaviors following directed and observational experience. Fifteen to 18-month-old infants were directly taught to use objects on one day, and observed a teaching interaction on the second day. As described above, U.S. children who were directly addressed on their first visit showed significantly higher overall imitation rates than infants who observed on their first visit.

However, while Mayan children generally increased imitative behaviors across the two study days (imitating more robustly on day two than on day one), neither the condition they were in nor the visit order they were assigned to related to their imitation. That is, Mayan children were equally likely to imitate directed and observed actions, regardless of which they saw first in the study. These findings suggest that while directed cues are informative for shaping U.S. children's imitative behaviors, they may be less relevant for shaping behaviors in infants who more rarely experience directed engagement.

This may also be the case for informing children's inferences about the affordances of cultural artifacts following directed and observational experience. Both 2-year-old children growing up in a large city in the United States and children growing up in a Mayan village restrict their exploration of an object to a directly demonstrated function, demonstrating they reason that information presented with pedagogical framing represents accurate and complete information regarding the affordances of objects (Shneidman et al., 2015). However, unlike U.S. children, Mayan children's propensity to restrict exploratory behavior following directed cuing relates to their age. Older Mayan 2-year-olds children are likely to restrict exploration following pedagogical instruction, while younger children explore more broadly following pedagogical instruction. These findings open the possibility that there may be developmental differences in Mayan children's interpretation of pedagogical given information. These differences could correspond to described increases (e.g., Shneidman & Goldin-Meadow, 2012) in the amount of directed instruction these children receive over this age period in development.

In summary, child-directed interactions show a complicated relation to action learning. For middle-class European children and for children from the U.S., child-directed input relates to children's subsequent imitation, children's generalization to new people and new exemplars, and children's inferences about the affordances of objects. However, the situationally contingent nature of these findings suggests that children's responses to directed cues likely reflect children's social motivation and pragmatic reasoning rather

than an innate automatic response to directed cuing. It is not the case that child-directed instruction provides children with unique insight into the intentions of others, as the intentional understanding account suggests, and it is unlikely that directed episodes activate automatic generalized learning, as natural pedagogy suggests. Instead, child-directed input may be one of many pragmatic cues that children can learn to use to inform them about the relevance of demonstrated action information. Importantly, cross-cultural evidence suggests that the social relevance that directed contexts have varies based on children's everyday social experiences. Instead of having a priori informational value, directed input is likely to become meaningful for children growing up in environments where these interactions are commonplace.

### Conclusions

Children grow up in a complex social world, and receive a vast amount of information from others. A critical question for any theory of learning is how children are able to make sense of this input. Both the intentional understanding and the natural pedagogy accounts propose that child-directed interactions provide a priori information that can productively constrain this learning problem. These interactions are argued to critically foster the ability to understand the intentions of others (e.g., Barresi & Moore, 1996; Moore, 2010; Tomasello, 1999) or to prompt children to automatically categorize information as kind relevant and generalizable (e.g., Csibra & Gergely, 2006, 2009, 2011). In both of these ways, child-directed interactions are hypothesized to be an a priori mechanism for constraining children's interpretation of input to what is culturally relevant and important for acquisition. As we have reviewed above, the existing evidence offers reason to doubt these claims. In the domain of word learning, naturally occurring child-directed input relates to children's later vocabulary, but when child-directed cues are isolated in experimental word learning studies, no benefits have been found, suggesting that the relation between directed input and language acquisition is due to attentional factors and to other features of child-directed speech that co-occur with directed input. In the domain of action learning, the relation between child-directed input and learning depends on the social context of the learning interactions. This suggests that the benefits of directed cuing are not automatic, but rather due to children's reasoning regarding what information is relevant for them in particular social contexts. Rather than signaling that child-directed interactions have universal, a priori information value, the empirical record suggests that children learn to see directed interactions as informative in some contexts based on their social experiences.

This review raises several issues that warrant further empirical research, including: (a) What factors support children's factual learning as compared with their learning regarding what is socially relevant or important? (b) What factors support generalized learning, over and above immediate and context specific learning? and (c) Do differences in children's input across cultural contexts correspond to differences in how children learn from others?

### Learning Regularities and Facts Verses Inferring How to Act in the Situation

Our review of the literature suggests that the benefits of directed input likely stem from children's interpretation of the social rele-

vance that a child directed message has for them, and not from heightened learning per se about what words mean or about the causal affordances of objects. In cases where directed contexts do affect children's responses, this response depends on the situational constraints of the learning context, not on an automatic response to directed cues. Thus, directed contexts likely exert their effects because children feel increased social motivation in these situations (see Nielsen, 2006; Over & Carpenter, 2012) or because these contexts inform them about the social or conventional relevance of the presented information (see Herrmann, Legare, Harris, & Whitehouse, 2013; Keupp, Behne, Zachow, Kasbohm, & Rakoczy, 2015; Shneidman et al., 2015a; Vredenburgh et al., 2014).

Taking into consideration the difference between children's factual learning and their learning regarding social relevance can resolve an apparent paradox in the reviewed literature. Namely, why directed contexts generally affect learning in the artifact learning studies we review, but not in the word learning studies. It seems likely that the methods typically used in these studies can explain these differences; word-learning studies have typically used measures of comprehension to assess learning (that may reflect children's factual learning) while action-learning studies have typically relied on productive measures (that may reflect children's social goals or motivations).

More generally, these considerations highlight the question of how and whether children's comprehension of culturally specified information may differ from their production of relevant behaviors. Many aspects of cultural practice and social life involve regularities that infants do not participate in but nevertheless must come to understand. Thus, in order to understand all aspects of social learning, researchers should broaden their focus to consider not just what children produce, but also what they understand, and what processes might support this kind of learning.

### Generalizing From Instances of Social Learning

A central question for developmental scientists is how children take information they learn in one instance and apply it across time and across exemplars. Natural pedagogy's answer is that children automatically generalize information they receive in child-directed, but not in observational contexts. However, a child who relied exclusively on child-directed signaling to inform generalization would miss many learning opportunities. Children encounter a significant amount of social and cultural content outside of child-directed interactions, even in U.S. and European middle-class homes. Moreover, the question of when to generalize is so complex that it likely cannot be answered with a single mechanism that provides a yes or no response, as natural pedagogy proposes. The most important pieces of information to take away from a learning context are likely to vary greatly from one situation to another, and children must learn there are things that some, but not all people do, in some, but not all situations.

There are likely many kinds of social cues besides directedness that signal to children that they are receiving generalizable, factual, or culturally relevant information. Seeing actions performed by multiple people in a conventional way (Herrmann, Legare, Harris, & Whitehouse, 2013), hearing conventional labels for actions (Chen & Waxman, 2013), performing actions following similar contextual cues (Keupp et al., 2015), and observing the actions of individuals who have social relevance to a child (Buttelmann et al.,

2012; Howard, Henderson, Carrazza, & Woodward, 2014; Shimpi et al., 2013) have all been found to increase young children's imitation of others. These factors could, in principle support generalized learning within observational contexts.

Moreover, in cases where children are limited by their own abilities or by social prescription, observation is likely to be primary for supporting generalized learning. For example, theorists have suggested that overheard interactions may be more useful than dyadic, child-directed contexts for developing usage aspects of children's language (Blum-Kulka & Snow, 2002), linguistic forms (Oshima-Takane, Goodz, & Derevensky, 1996), and knowledge of appropriate social hierarchies (Ochs & Schieffelin, 1994) because children are likely to be exposed to linguistic and cultural forms use that they might not encounter in child-directed input.

Further research is needed to evaluate when, and how, children use directed and observed sources to inform not only their decisions about how to act in a context, but also their learning about facts and enduring aspects of the social and cultural environment.

### Cultural Contexts and Observational Learning

A problem for researchers who argue that child-directed interactions are a critical route for supporting early learning is how children growing up in communities where these contexts are rare acquire information from others. These theorists might predict that either: (a) the amount of child-directed interaction some children receive, although small, is sufficient to support early social learning (e.g., Csibra & Gergely, 2009); or that (b) children in communities where child-directed engagement is uncommon obtain some kinds of social knowledge only later in development, once the amount of child-directed input they receive increases or they are able to glean more information from observed interactions. However, we believe it is improbable that a learning system should exist that is unresponsive to a large proportion of the input that children encounter.

Instead, we believe that typical patterns of parental teaching could shape how children effectively learn from others. Children who spend ample time in situations where they are being directly engaged may learn that these situations are most relevant for learning, while children who spend more time observing the actions of others could come to see these interactions as relevant. This kind of culturally specific competence may manifest itself in two ways. First, children could learn which aspects of learning interactions are most important to attend to (and what role pedagogical cues have, or do not have, in signaling this information). Second, children's social motivation to replicate or transmit information could change based on this experience.

Thus, instead of social context being a low-level cue that always prompts, or fails to prompt, learning or generalization, children could learn to use social cues as a markers for what is important to attend to, what is socially appropriate, or what is informationally relevant. Children growing up in contexts where direct teaching is commonplace could come to learn that when someone directly engages them, that person intends to teach a relevant cultural property that should generalize across exemplars. In contrast, children growing up in communities where child-directed interaction is less common could have broader expectations about the kinds of social contexts that count as learning interactions, and

may, indeed, develop other strategies for identifying important information in the social events that they witness.

These ideas are supported by work showing that children growing up in cultural communities where child-directed interactions are rare are more likely to attend to interactions that do not involve them than are children growing up in contexts where these interactions are commonplace (e.g., Chavajay & Rogoff, 1999) and by research showing children in these environments are proficient observational learners (Correa-Chavez & Rogoff, 2009). Nevertheless, future research is needed that compares children's ability to generalize new words and actions from child-directed and observed interactions in varying kinds of social environments (both within and across cultures). If children attend to and learn from ostensive interactions because these are the interactions that they are accustomed to, one might expect cross-cultural differences in the extent to which ostensive communication matters for early social learning. In cultural communities where children experience little child-directed interaction, children may be likely to attend to and learn from others, even when they are not being directly addressed.

### Summary

Several theoretical models of development have suggested that child-directed communication provides automatic and a priori information value for supporting children's early social learning. That is, child-directed interactions have been hypothesized to serve as the cradle of social learning by supporting infants' analysis of others' intentions or by triggering a distinct mode of learning in infants and children. In this article we have argued that existing evidence does not support this view.

Instead, we believe the empirical record shows that child-directed contexts are relevant for children's pragmatic reasoning and social motivation, and that children may come to have more general expectations about the importance of these contexts depending on their prevalence in children's social environments. Future empirical work, both in communities where child-directed interaction is common, and in environments where this type of engagement is rare, is needed to consider the viability of this proposal. Nevertheless, models of social learning should broaden their focus to consider not only what children are directly taught, but also what children effectively learn from the observation of others. Indeed, an exclusive focus on child-directed interactions is likely to obscure many of the mechanisms through which early social learning occurs.

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