Emblematic Origins of Pragmatic Shrug Gestures in Early Childhood

PREPRINT

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Introduction and Literature Review

Children begin using communicative gestures between 8 and 12 months of age, frequently before they speak their first words (Bates, 1976, 1979). Early production of co-speech gestures often precedes, predicts, and facilitates early milestones in verbal language development (Iverson & Goldin-Meadow, 2005; Özçalişkan et al., 2014; Özçalışkan & Goldin-Meadow, 2005; Rowe & Goldin-Meadow, 2009). While co-speech gestures serve critical pragmatic functions in everyday conversation, developmental research on gesture has primarily focused on referential *topic* gestures, like deictic pointing and representational iconic gestures, and their role in lexical and syntactic development.

There is less research exploring the role of non-referential[1] *pragmatic* co-speech gestures in communicative development. Children produce rhythmic beat gestures to highlight prosodic prominence and add emphasis in the pre-school years (see Vilà-Giménez & Prieto, 2021 for a systematic review), and gestures like shoulder shrugs and palm-up gestures are some of the earliest gestures children produce (Acredolo & Goodwyn, 1985; Bartz, 2017; Graziano, 2014a; Harris et al., 2017). These same gestures do sophisticated interactional work in everyday conversation between adults, such as metaphorically handling topics, holding the floor, and taking discourse stance (Bavelas & Chovil, 2000; Bavelas et al., 1992; Dimitrova et al., 2016; Ferré, 2012; Kendon, 2004; McNeill, 1992). Pragmatic gestures like shrugs will become critical supports for pragmatic aspects of everyday language use, but of course – like any part of language learning – infants' shrug gestures do not carry the communicative sophistication of adults'. Rather than commenting on interaction, they are frequently used as emblematic stand-ins for phrases like "all gone" and "don't know".

[1] Following the distinction from Bates (1976), here "non-referential" means the gesture lacks an entity referent and not that it does not perform a referring action.

In order to better understand how children learn to blend gesture and language to efficiently coordinate conversation, we must ask how pragmatic gestures emerge in early productive communication and how these gestures develop from lexical to interactive functions. Given the early appearance and dramatic functional transformation of shrug gestures between toddlerhood and adulthood, we take the shrug gesture family as a starting point for better understanding how communicative gestures fit together with other emergent pragmatic skills as part of fundamentally multimodal processes of language development.

Multimodal Epistemic Expression over Development

Research into the development of metacognition has shown that children are not consistently able to accurately assess and communicate knowledge states with words until the school-age years. Infants begin using cognitive state words around their second birthday (Bretherton & Beeghly, 1982) but do not accurately report total ignorance until age 3, and even then tend to overestimate their own knowledge (Rohwer et al., 2012; Ruffman & Olson, 1989; Wimmer et al., 1988). Children verbally overreport their own partial knowledge states until age 6 (Rohwer et al., 2012; Sodian & Wimmer, 1987).

However, these findings only reflect children's ability to explicitly and verbally communicate total or partial ignorance. Looking at nonverbal communication, it is clear that infants' meta-awareness is more advanced than indicated by their words alone. Before age 2, infants use gestures to signal ignorance (Bartz, 2017; Harris et al., 2017) and opt out of answering questions when they lack sufficient knowledge (Goupil et al., 2016). Similarly, young children communicate accurate self-assessment of partial knowledge or uncertainty through gestures, filled pauses, and prosody before they do so in speech (Hübscher et al., 2019; Kim, Paulus et al., 2016).

By taking a multimodal perspective, these studies give a more comprehensive understanding of early epistemic expression. What is not yet clear is how epistemic co-speech gestures specifically, rather than broadly defined "nonverbal communication," factor into early interaction.

Although children are able to communicate full and partial ignorance states in nonverbal channels in the second year of life, their use of nonverbal epistemic resources like shrugs and pauses does not appear adult-like even in late childhood (Krahmer & Swerts, 2005). This extended trajectory is characteristic of pragmatic development more generally, including the development of epistemic expression in speech. Young children acquire the vocabulary for verbs of thinking and speaking very early but do not initially use them for highly contextualized and interactive meanings, like marking politeness and deference, hedging uncertainty and disagreement, and differentiating fact and opinion (Bassano, 1996; Bretherton & Beeghly, 1982; Shatz et al., 1983). If gestures play an active and systematic role in pragmatic development alongside speech, there may be a similar mapping shift. That is, a gesture form initially taking a singular epistemic meaning may later appear with variations of that form taking variations of that meaning.

Shrug Gestures

In this study, we focus on one pragmatic gesture – the shrug composite – to ask whether we find a simplified epistemic form-meaning mapping in early pragmatic gesture, complementary to early speech. Shrugs are uniquely suited for this purpose for a few reasons. First, children produce the shrug form very early, often preverbally, and it remains extremely common in adult conversation (Beaupoil-Hourdel & Debras, 2017; Debras, 2017). Second, shrugs are highly variable in form. The shrug family of gestures includes multiple component forms (e.g., palm-up gestures, shoulder raises, head tilts) which may be combined or used in isolation. Third, shrugs serve both emblematic and pragmatic functions in adults' conversation, sometimes simultaneously (Debras, 2017; Morris, 1994/2015). Many meanings are epistemic, but by no means all. Shrugs' early productive onset in children's communication and their

flexibility and variation of use allows many plausible mappings of form and meaning to emerge and reshape over development.

Developmental data is key for illuminating how the shrug gesture's many forms and meanings come to interrelate. For example, if interactive and pragmatic functions grow outward from a first "kernel" emblem, this would support the idea that these complicated relationships arise from changes in form-meaning mapping as the capacities for epistemic expression and stance-taking in discourse develop, rather than the convergence of multiple unique gestures onto a shared set of forms.

The extreme variability in both form and meaning in adult speech as well as the high frequency of production make it difficult to tease apart emblematic and pragmatic use in adult conversation alone. If the shrug's ultimate developmental destination is a gesture made up of one or several formal features used for one or several simultaneous pragmatic meanings, what might its developmental point of origin be?

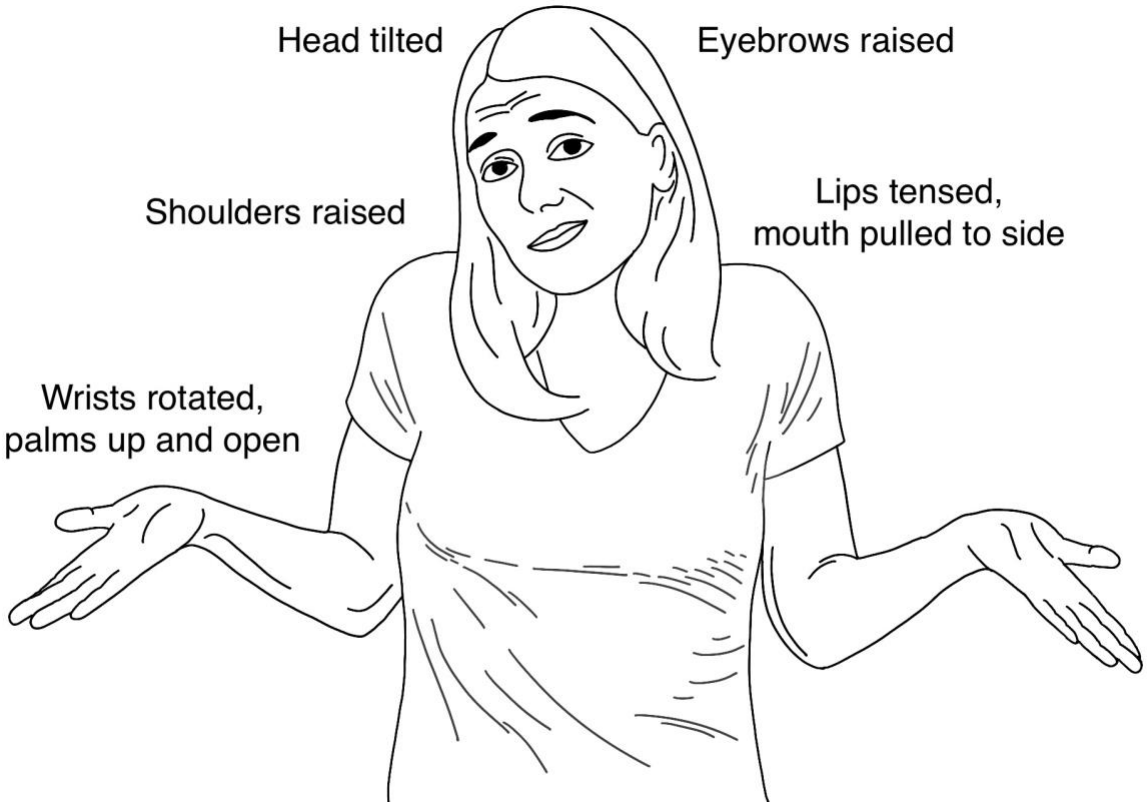
In order to better understand the many-to-many mapping between form and meaning in adult interaction, we can examine what this mapping looks like in the earliest stages of communicative development. If the shrug's form-meaning mapping grows from a core emblem, children might rely heavily on this conventionalized kernel gesture before acquiring the pragmatic skills necessary to use the gesture interactively.

Shrug forms

The shrug gesture may be more accurately described as a family of gestures or *shrugging composite* (Givens, 1977) – also referred to as the shrug *complex* (Morris, 1994/2015) or *compound enactment* (Streeck, 2009) – comprising component gesture forms from the head, shoulders, face, and hands. **Error! Reference source not found.** is reproduced below, depicting common form features in the shrug family.

Figure 1

Component forms of the shrug composite gesture. Frequently referenced component forms include the shoulder raise, palm-up gesture, head tilt, brow raise, and mouth tension.



In this study we limit analysis to two form components, the shoulder raise and the palm-up. We include the shoulder raise because it is central to the concept of a shrug gesture. It is arguably the most distinctive feature of the shrug composite, colloquially synonymous with the word "shrug." The palm-up gesture has been a topic of interest as a gesture in its own right (see Cooperrider et al., 2018 for a review). We include the palm-up as a form feature of interest because it is one of the earliest gestures produced by children (British English: Beaupoil-Hourdel & Debras, 2017; American English: Harris et al., 2017; Catalan: Hübscher et al., 2019; Italian: Graziano, 2014b), it is frequently produced with a shoulder raise (Chu et al., 2014; Jehoul et al., 2017), and it conveys the same set of meanings as shoulder raises (Debras, 2017; Ferré, 2012; Jehoul et al., 2017; Müller, 2004).

Shrug meanings

Shrugs are used in linguistic communities across the globe for a wide array of communicative intents in everyday conversation, even seemingly contradictory ones (Table 3). For example, an American English speaker may use a shrug to express either ignorance ('I don't know') or certainty ('obviously'), either investment ('I mean it!') or disinterest ('whatever'), and either affiliation ('me too') or distancing ('you're on your own!'). The commonality among all these meanings is not immediately apparent, but gesture researchers have proposed several candidates for a core meaning. Notably, Cooperrider et al. (2018) suggest ignorance as the kernel meaning for the palm-up gesture; in their words, meanings grow from an 'absence of knowledge' and expand to other metaphorical absences, such as certainty, ability, or concern. Others propose openness (Müller, 2004), incapacity (Darwin, 1872/1998), and submissiveness (Boutet, 2018; Givens, 1977) as core meanings of shrugs and palm-ups.

One commonality among many of the shrug's meanings is the intention to express epistemic information. Cooperrider et al. (2018) propose ignorance as a kernel meaning for the lateral palm-up and suggest other meanings grow from this core, even referring to this form as the "palm-up epistemic." Absence of knowledge extends to absence of ability or concern then grows outward to uncertainty, obviousness, hypotheticals, and interrogatives, and finally to exclamatives.

Given the significance of nonverbal signals, including shrug gestures, in children's earliest epistemic expression, we might find evidence for a core epistemic meaning in early interaction. Moreover, shrugs' flexible many-to-many form-meaning mapping may arise from a core mapping. A kernel meaning may be tied to a kernel form, creating a kernel emblem. Because children's use of shrug gestures to mark ignorance is well established, we pursue "absence of knowledge" as a strong candidate for the shrug's kernel meaning, following Cooperrider and colleagues' suggestion regarding the palm-up form.

Present Study

The present study uses an annotation scheme for speech and gesture based in principles of to explore how young children integrate verbal and non-verbal channels interactively. We use a longitudinal corpus of spontaneous caregiver-child interaction to examine whether the forms and meanings of children's shrugs support the claim for a shrug kernel emblem. If such an emblem exists, we should expect shrugs to have a dominant form-meaning pairing in early communication, particularly when unaccompanied by supporting meaning in speech. Alternatively, if the shrug "family" is really a convergence of multiple gestures, there should not be an association between primary form and primary meaning. We use a developmental lens to further our understanding of both the shrug gesture itself and the multimodal developmental trajectories of epistemic expression and meta-awareness in interaction.

Previous work has established that young children express epistemic state multimodally through speech, gesture, and behavior (Hübscher et al., 2019; Kim et al., 2016). However, it remains unclear how gestures – in particular "uncertainty gestures" like shrugs – contribute to early epistemic communication. We ask two primary research questions to address how shrug gestures fit into a multimodal model of early epistemic expression and add to our understanding of how these pragmatic skills emerge and function at the earliest developmental stages of discourse-pragmatics.

First, do shrug gestures produced by young children suggest a kernel form or meaning? Although co-speech shrugs can easily take on a wide range of forms and meanings, shrugs without speech carry the full communicative burden of the act. The form must be recognizable and the meaning interpretable using social, physical, and other environmental contextual information outside of the speech context itself. Because children often produce their first shrugs at the pre-lingual stage or shortly thereafter (Beaupoil-Hourdel & Debras, 2017; Harris et al., 2017), early caregiver-child interaction is a rich context for identifying a kernel gesture given the abundant opportunity for children to use both co-speech gestures and gesture-only, "no-speech" communicative acts.

Second, are the forms of shrug gestures in early childhood associated with differences in pragmatic and emblematic function? When a gesture is closer to a conventionalized core form, it should be more easily recognized as an emblem and so more restricted to a corresponding core meaning. If we identify a kernel form and meaning separately and they together make up the kernel shrug emblem, we should expect a strong association between them in early interaction. In particular, following Cooperrider et al. (2018) the *palm-up gesture* may be critical to delineating a kernal form and *ignorance* ('absence of knowledge') may act as a core meaning.

Methods

Participants

Analyses were performed using video and transcript data from the Language Development Project corpus of caregiver-child interaction. Subjects were a subset of families participating in an ongoing longitudinal study of language development at the University of Chicago, which includes 64 typically-developing children and their families. Participants were recruited from the greater Chicago area through mailers to targeted zip codes and advertisements placed in a free, monthly parenting magazine. Responding parents were interviewed for background characteristics and to confirm a monolingual, English-speaking household. The final sample was demographically representative of the greater Chicago area, as reported in the 2000 U.S. Census, in terms of race/ethnicity, household income, and parent education. See Rowe (2008) for additional information regarding participant recruitment and demographics of the full sample.

Capitalizing on annotation from prior research, these analyses are limited to a subsample of 18 children (8 girls). This cohort was first selected by Cartmill, Hunsicker, and Goldin-Meadow (2014) to maximize range of early verbal skill. Inclusion was determined by averaging children's mean length of utterance (MLU) across the first five observations (between 14 and 30 months), then selecting the 6

subjects with highest MLU, (M = 2.04 $\pm$ 0.10; 3 girls), lowest MLU (M = 1.22 $\pm$ 0.06; 2 girls), and median MLU (M = 1.52 $\pm$ 0.06; 3 girls).

The subsample of families was diverse in terms of household income, parent education, and race and comparable to the larger sample of 64 families (Table 4). The participants included 11 White Non-Hispanic, 1 White Hispanic, 4 Black/African-American, and 2 children of mixed/other race. Household income was reported in six brackets and ranged from less than $15,000 to more than $100,000 per year. Based on the bracket midpoints, approximate average yearly household income was $74,000. Maternal education ranged from less than 12 years (no high school diploma or equivalent) to more than 18 years (advanced or professional degree). The most commonly reported education level was completion of a Bachelor's degree.

Data Collection

Families were visited in their homes every 4 months when children were between 14 and 48 months of age. At each of the 12 home visits, 90 minutes of spontaneous interaction between children and their primary caregiver(s) was captured with audio and video recording. Families were instructed to behave as usual, as though the experimenter was not there. The videos capture a wide range of typical day-to-day activities from early childhood, such as reading books, playing with toys, doing jigsaw puzzles, watching television, and eating meals. One family did not complete the home visit at 50 months. The remaining 17 families completed all 12 early childhood sessions.

Annotation

Base transcription and gesture annotation

Annotation for this study was conducted using existing transcripts with base gesture annotation. For the original transcripts, all spontaneous speech by participant children and primary caregivers was transcribed in Microsoft Excel. Speech was transcribed verbatim but not phonetically and included conventionalized communicative sounds (e.g., "mmhm", "ouch"). In the EC visits, caregiver speech

directed to other adults was not transcribed unless the child was clearly attending to it. Speech was transcribed at the utterance level, with breaks between utterances decided by multiple criteria including pause length, grammatical structure, and intonational contour. To ensure high inter-coder reliability, agreement was calculated for both word units and utterance boundaries. Before independently transcribing videos, coders were required to reach 95% agreement with model transcripts for word and utterance metrics. Approximately one-third of transcripts were partially double-coded by a second expert transcriber. Transcripts with less than 90% agreement on either metric were rejected and re-transcribed until satisfactory agreement was reached.

Transcribers simultaneously annotated communicative gestures from both caregivers and children alongside speech transcription. This first-layer gesture annotation including codes for form (e.g., "point", "thumbs up", "iconic", "beat"), body part(s) and side(s), and approximate gloss. Agreement for gesture annotation followed the same procedures as transcription reliability described above. See Huttenlocher et al. (2010) for full transcription procedures and reliability and Rowe and Goldin-Meadow (2009) for first-level gesture coding procedures and reliability.

Pragmatic gesture annotation

From transcripts with the base annotation described above, children's shrug gestures were additionally coded for formal and functional features. A full coding manual is provided in the supplemental materials. The analyses in this study use four of these codes:

1. *Palm-up presentation:* the form "completeness" of palm-up gestures, when present (adapted from Hundertmark, 2016). A palm-up was coded as complete when it was produced with a full 180 degree rotation of one or both wrists and a momentary or extended "freeze" in this position. A palm-up was coded as reduced if neither wrist fully rotated or if the palm-up was produced with a single smooth or flicking movement.
2. *Sequential positioning:* the act's sequential positioning in a turn sequence. Acts were determined to be in the first position of a turn sequence if they sought or received a response from the listener and in the second position if they provided a relevant response.
3. *Request sequence type:* the interrogative or imperative form of the first-pair part of any request sequence. Requests were closed if they expected an answer from a limited set of responses,

such as yes/no and multiple-choice questions. Requests were open if they expected an answer without a closed set of possible responses, such as *wh*-questions. Finally, requests were imperatives if they issued a command or directive using imperative syntax.

4. *Pragmatic meaning:* the shrug's primary meaning or pragmatic function in the conversation. Options included ignorance, investment, disinvestment, affiliation, disaffiliation, and absence.[2] To distinguish between seeking knowledge and asserting knowledge state, acts that fell in the first position of a closed or open request sequence were assigned the meaning of inquiry in place of the manually coded meaning.

Results

Analyses are limited to child-produced gestures. Although caregivers' non-verbal input undoubtedly influences children's gesture and may help explain the processes by which shrugs emerge and develop, we focus on child-produced gesture to ask whether a shrug kernel emblem is identifiable and how it is employed by young children rather than the mechanisms behind acquisition.

Inclusion

Sessions were excluded from analyses if the caregiver was not present for most or all of the session, since children had few opportunities to gesture and the meaning of these gestures was usually ambiguous. Nine of the 216 sessions were excluded due to extremely low caregiver participation, which resulted in a total of 9 gestures excluded (see supplemental materials for specific session exclusion criteria). Individual gestures were excluded from analyses if the transcript lacked sufficient context to determine sequential positioning or meaning, typically due to unintelligible speech, poor audio or visual quality, or the absence of an interlocutor.

[2] A seventh possible category of meaning, directing turn-taking, was not observed in these data. All shrug gestures that met inclusion criteria were coded with one of the seven meaning categories with no option for "other."

Identifying Kernel Meaning and Form

We performed a simple descriptive analysis of all child-produced shrug gestures in the corpus to identify a plausible kernel form and meaning for shrugs. Here we describe proportional frequency of use for shrug meanings and forms, separating gestures co-produced with a spoken utterance from gestures produced without speech, making up a complete non-verbal communicative act. This division between "co-speech" and "no-speech" shrugs allows us to compare gesture production driven by differences in the contextual availability of information. Co-speech gestures add, reinforce, disambiguate, or complement meaning already present in the speech channel. When communicative acts have the potential to simultaneously encode meaning verbally and nonverbally, the burden of effective communication is shared between both modalities. On the other hand, no-speech gestures must communicate meaning in the nonverbal modality alone. These gestures carry the full communicative burden of the act; there is no speech context to provide redundant or complementary information.

Although adult speakers easily make pragmatic inferences from contexts outside concurrently produced speech, such as complex social relationships, shared knowledge, and verbal information provided much earlier in the discourse, children in the earliest stages of pragmatic development are less adept incorporating these varied contexts into interaction. Infants and toddlers performing entirely nonverbal communicative acts have motivation to produce gestures which are recognizable in form and predictable in meaning, independent of subtle extralinguistic contexts. If pragmatic shrugs grow from a kernel emblem, children's no-speech shrugs are more likely than co-speech shrugs to function emblematically, where a predictable form-meaning pair communicates a direct verbal translation in the absence of speech.

Meaning

Shrug meaning was determined by annotation for gloss, sequential positioning, and request type. The meaning 'inquiry' was assigned to communicative acts that initiated or attempted to initiate a

turn sequence with either a closed or open request. The meaning of all other acts was determined by the gloss annotation described above, resulting in seven categories of meaning.

These categorical divisions in meaning are primarily motivated by the proposal from Cooperrider et al. (2018) that ignorance or "absence of knowledge" is the kernel meaning for the palm-up lateral form component and the most commonly observed meanings for shrug gestures in language communities across the globe.

Literal absence

One distinctive category of meaning for child-produced shrugs is literal absence, communicating that an entity is not present or that an activity is not occurring.[3] American English-learning infants and their caregivers often use the palm-up form to emblematically represent the phrases "all gone" or "all done" as well as simple "where?" questions about the immediate context, frequently accompanied by the parallel speech. These early emblems are not consistently included in analyses of shrug and palm-up gesture function. Cooperrider and colleagues (2018) omit these gestures entirely in their theoretical discussion of the palm-up.

One reason for such an exclusion is that there is little evidence suggesting literal absence is a cross-linguistically pervasive meaning. Even within language communities where the absence meaning is observed, it seems to be relatively uncommon in conversation between adult speakers. There is an

[3] Although absence of entity and completion of an activity are not precisely the same concept, they are often used interchangeably by young children and parents. Completion of activities in toddlerhood often goes hand in hand with literal absence. Lunchtime ends when lunch has been eaten, a puzzle is complete when there are no pieces remaining, coloring time is over if there are no pages left in the coloring book, etc.

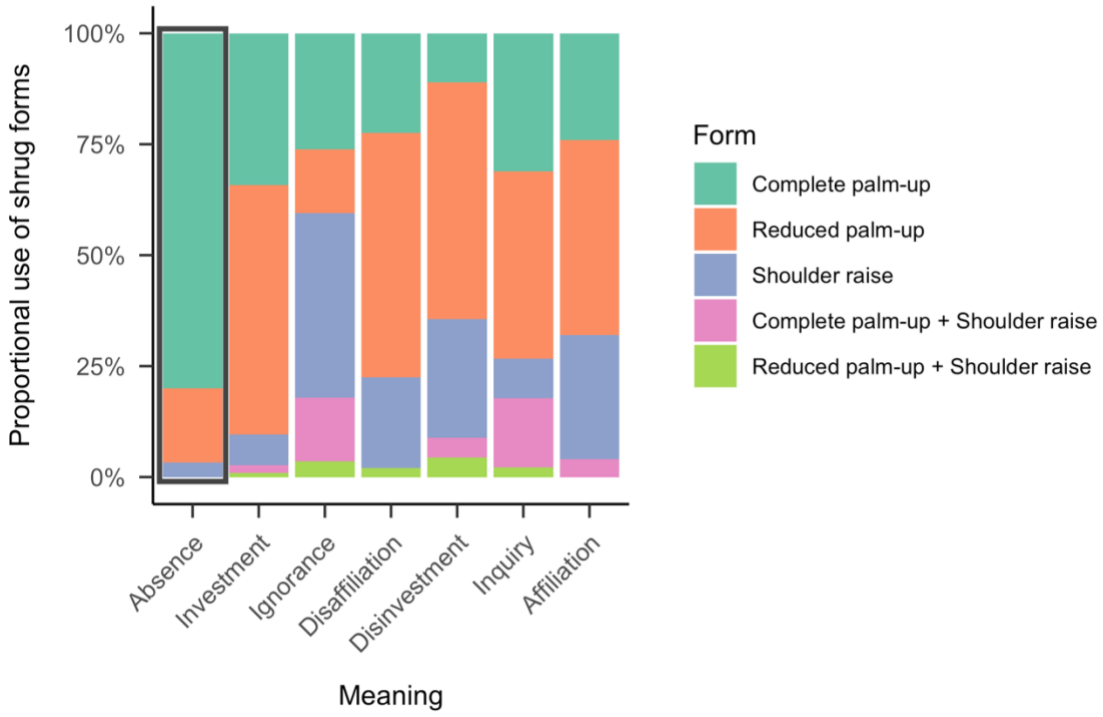
intuitive assumption that these gestures are more common in infants' communication along with the verbal analogs "all gone" and "all done," but this possibility has not yet been explored empirically.

Before addressing whether epistemic "absence of knowledge" is the shrug's kernel meaning, we examine how children produce shrugs to indicate literal absence or activity completion. These initial analyses allow for the possibility that absence of knowledge grows out of a deeper "absence of entity" kernel meaning. They also offer empirical justification for either including these shrugs in the analyses that follow or excluding them as a culturally defined nonverbal emblem distinct from pragmatic shrug gestures.

Ultimately, absence shrugs stand apart from other shrugs in these data in three ways: consistency of form, skewed use by a handful of children, and decreasing frequency of use over time. First, absence shrugs are overwhelmingly produced using the complete palm-up form without a shoulder raise (**Error! Reference source not found.**). Of the 30 observed absence shrugs, only one used a shoulder raise. All others were produced as a palm-up gesture, and 23 of these were complete palm-ups. Literal absence was the only category of meaning with no observed cases of children combining a shoulder raise and palm-up form.

Figure 2

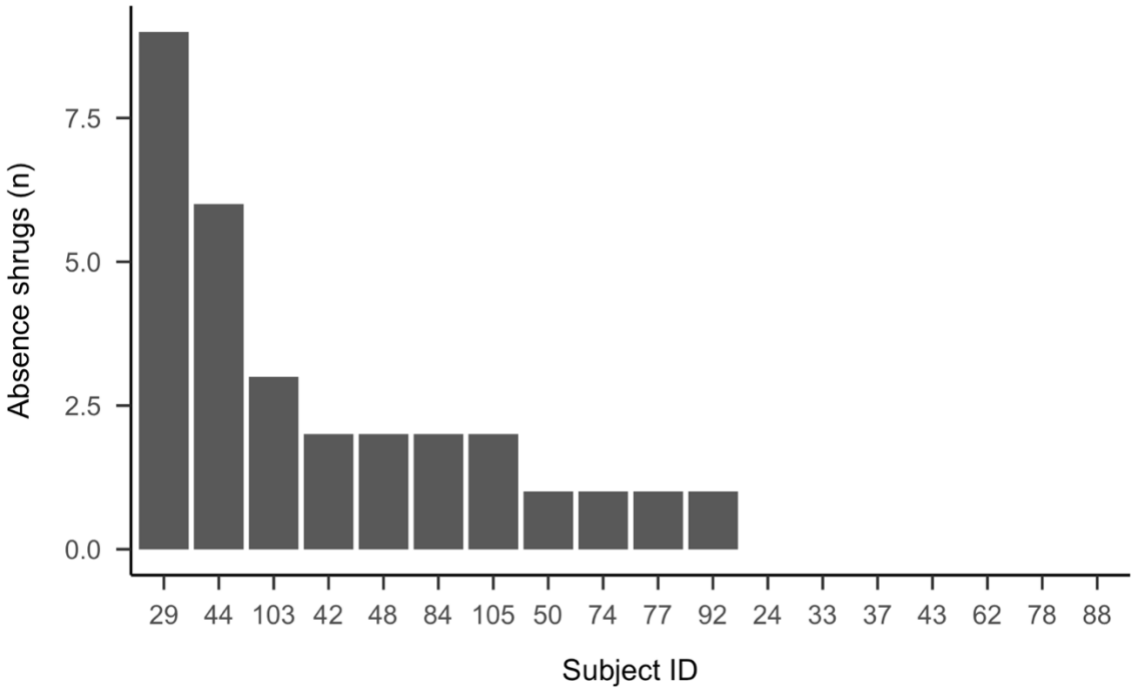
Proportion of shrug forms for absence vs other meaning. Absence shrugs primarily take complete palm-up form without a shoulder raise.



Second, although shrugs indicating literal absence were not significantly less common than some other meanings, they were primarily produced by only a handful of children. In fact, fully half of these shrugs were produced by just two of the 18 subjects. Seven children never produced a shrug expressing absence or completion (Figure 3).

Figure 3

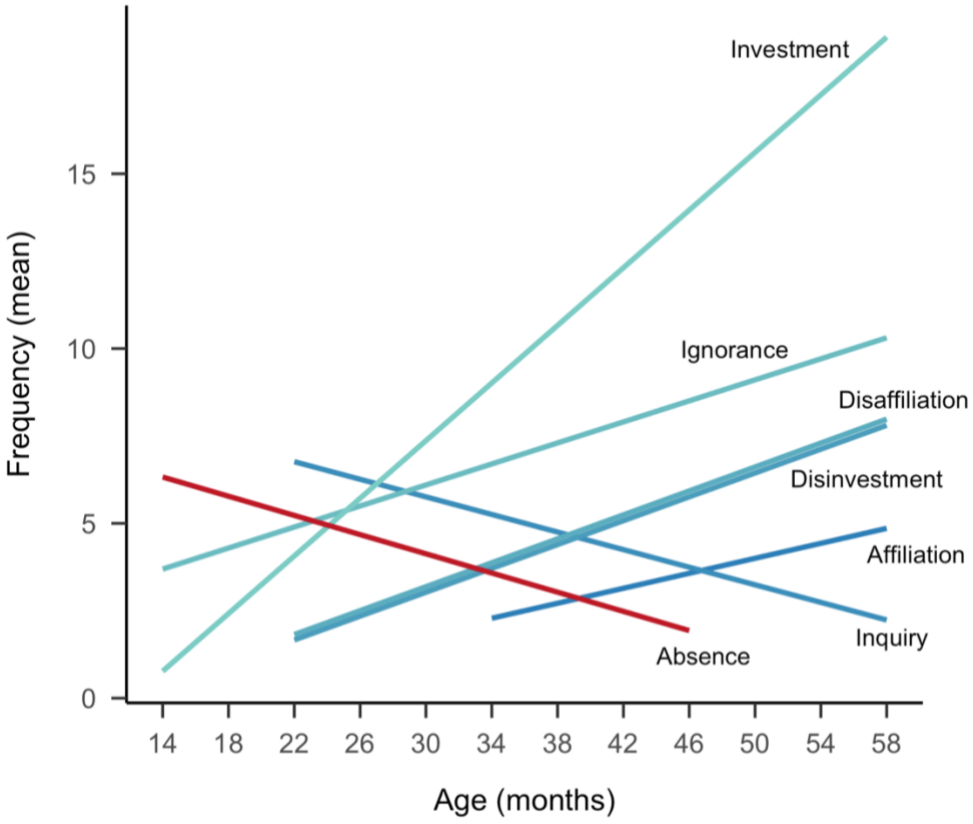
Distribution of absence shrugs by subject. Most subjects rarely or never produced absence shrugs.



Third, absence shrugs were unique in their frequency trajectories across the observational period. While most categories of meaning were observed more frequently as children grew and produced more language overall, absence shrugs were common in the earliest visits and decreased in use over time, the last observed at the 46-month session (**Error! Reference source not found.**).

Figure 4

Production of absence shrugs over time. Absence shrugs decreased across development and were not produced after 46 months.



Taken together, these observations support the decision to treat young children's "all gone" and "all done" shrugs as a separate phenomenon. This category of meaning displays a distinctive emblematic function, set apart from the diverse range of meanings used by adult speakers cross-linguistically. Although some other categories of meaning did tend to have a primary form, use of the complete palm-up form for absence shrugs was uniquely dominant. The skewed production of shrugs by just a few children was also present for shrugs expressing affiliation, the least commonly produced meaning. Unlike absence shrugs, however, affiliative shrugs did not have a dominant form and emerged both later in development and with increasing frequency. The general decrease in frequency of use over development was also observed in shrugs expressing inquiry, but inquiry shrugs did not use one primary form, were not predominantly produced by a small number of subjects, were not observed at the earliest visits, and were used even at the final 58-month visit.

Ignorance

Having ruled out literal absence as a candidate for the kernel meaning of shrugs, we return to pursuing ignorance or "absence of knowledge" as a kernel meaning. A Chi-square Test of Independence revealed a significant relationship between shrug meaning and presence of co-produced speech (X^2(5, N = 362)) = 135.40, p < .001). Ignorance was the only category of meaning more often associated with no-speech shrugs than co-speech shrugs, both proportionally and in raw frequency (Figure 5). Additionally, the vast majority of no-speech shrugs communicated ignorance (72.37%) while ignorance was rarely the meaning of co-speech shrugs (10.14%, Table 1). Post-hoc Chi-square analyses with Bonferroni adjustment confirmed this significant negative association between ignorance and presence of speech (Std. residual = -11.42, p < .001).

Table 1

Distribution of shrug meanings by speech presence, early childhood

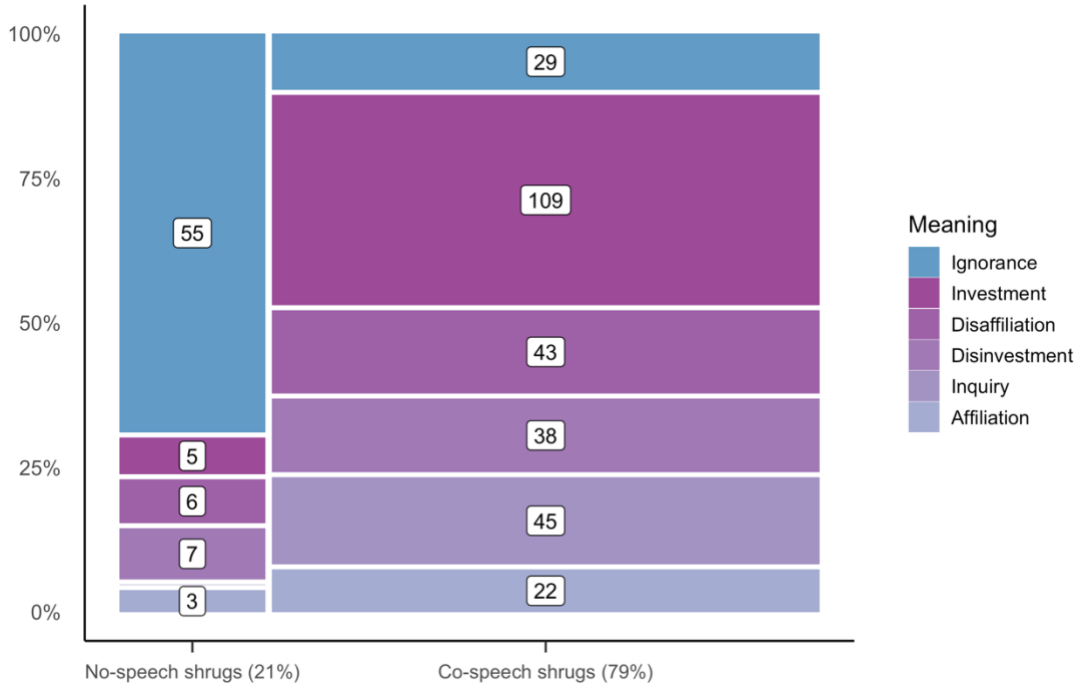
	Co-speech shrug	No-speech shrug
Ignorance	10.14%	72.37%
Investment	38.11%	6.58%
Disaffiliation	15.03%	7.89%
Disinvestment	13.29%	9.21%
Inquiry	15.73%	0.00%
Affiliation	7.69%	3.95%
Sum	100.00%	100.00%

Figure 5 depicts the relationship between presence of co-produced speech and shrug meaning. Unlike a bar chart depicting proportions for a single dimension, in this mosaic plot both axes are percentage scales. Presence of speech for all shrugs is represented on the x-axis, where shrugs are more frequently produced with speech (79%) than without (21%). Gesture meaning as a proportion of co-speech and no-speech shrugs *separately* is represented on the y-axis. As a whole, the mosaic plot is a visual depiction of the contingency table above (**Error! Reference source not found.**), where the area of

each cell represents proportional production of shrugs with the corresponding relationship between co-produced speech and shrug meaning. Overlaid numerals report the raw frequency of use for each box in the mosaic, out of 362 total shrug gestures in the corpus. As a visual reminder that ignorance is the proposed kernel meaning, shrugs communicating ignorance are presented in blue and other meanings in shades of purple.

Figure 5

Distribution of shrug meanings by speech presence in early childhood. Shrugs are more frequently produced with speech than without. Co-speech shrugs infrequently express ignorance and do not have one primary meaning. No-speech shrugs express ignorance in a majority of cases. Boxes label raw frequency (N=362).



In sum, when children's shrugs made up a full communicative act without supporting meaning from co-produced speech, there was a strong tendency toward just one predictable meaning: ignorance. When children's shrugs were produced with speech, carrying less of the communicative burden, this tendency disappeared. In line with Cooperrider et al.'s (2018) proposal of "absence of knowledge" as a

kernel meaning for the palm-up gesture, these data suggest ignorance may be the kernel meaning of the shrug family of gestures.

Form

Identifying a kernel meaning is not enough to establish the existence of a kernel shrug *emblem*. Emblematic gestures are the nonverbal equivalent of a word, where a linguistic or cultural community conventionalizes an otherwise arbitrary mapping between some form and meaning. If the pragmatic shrug gesture arises from an emblematic shrug there must also be a kernel form.

While there is strong theoretical motivation to predict ignorance as a kernel meaning for the shrug, it is less clear what a kernel form might be. The literature offers several hypotheses. As previously discussed, many researchers identify the palm-up form as a gesture in its own right that happens to be frequently co-produced with the distinct shoulder shrug gesture (Cooperrider et al., 2018; Müller, 2004). By this reasoning, the palm-up may be the form with a conventionalized link to the ignorance meaning. Alternatively, if the palm-up is a kinesthetic consequence of shrugging the shoulders (Boutet, 2008, 2018), the shoulder raise component may be the kernel. A third possibility is that children's earliest shrugs operate within the physical constraints of early motor development. This might result in young children tending to produce simpler or smaller movements, like using a reduced palm-up or omitting hand involvement entirely in favor of a shoulder raise. Yet another possibility is precisely the opposite; children may acquire the emblem by mimicking their parents and so first produce the exaggerated complete palm-up forms that are particularly salient in their caregivers' communication.

Lacking a single strong hypothesis about an emblematic form, we repeat the exploratory analysis performed above to identify a plausible kernel from the same criteria that determined a plausible kernel meaning.

Shrug form was annotated for presence of shoulder raises and both presence and presentation of palm-up gestures resulting in five possible composite forms. A Chi-square Test of Independence showed a significant relationship between shrug form and presence or absence of co-produced speech ($X^2(4, N = 362) = 46.02$, $p < .001$).

In a simple comparison of forms between co-speech and no-speech shrugs, shrugs that did not include a reduced palm-up component (complete palm-up, complete palm-up with shoulder raise, or shoulder raise alone) were produced proportionally more often when unaccompanied by speech (the parallel effect observed for the ignorance meaning). Conversely, shrugs with a reduced palm-up component, with or without a shoulder raise, were more likely to be produced as co-speech gestures than no-speech gestures (Table 2).

Table 2

Distribution of shrug forms by speech presence, early childhood

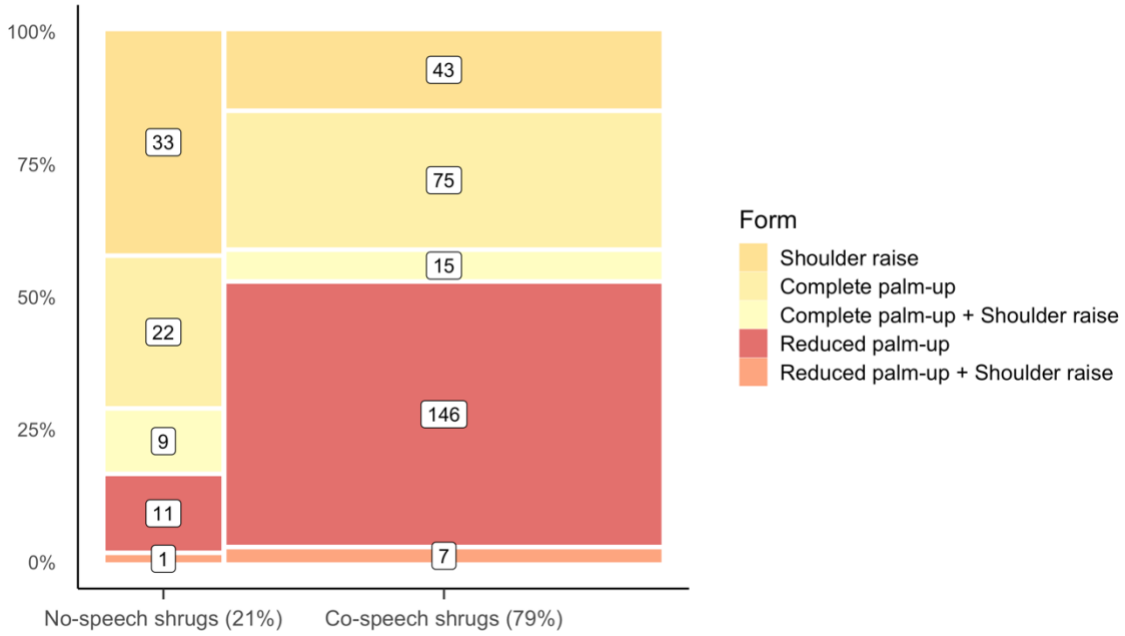
	No-speech shrug	Co-speech shrug
Shoulder raise	43.42%	15.03%
Complete palm-up	28.95%	26.22%
Complete palm-up + Shoulder raise	11.84%	5.24%
Reduced palm-up	14.47%	51.05%
Reduced palm-up + Shoulder raise	1.32%	2.45%
Sum	*100.00%*	*100.00%*

These differences in form across co-speech and no-speech gestures were considerably smaller than the differences observed for meaning. In post-hoc Chi-square analyses with Bonferroni adjustment, only two of the five relationships between form and presence of speech were significant. There was a significant negative relationship between isolated shoulder shrugs and presence of speech (Std. residual = 5.40, $p = .399$) and a significant positive relationship between isolated reduced palm-ups and presence of speech (Std. residual = -5.72, $p > .999$).

The mosaic plot in Figure 6represents proportional production of shrugs by both presence or absence of speech and shrug composite form and may be interpreted in the same manner as Figure 5 above. To visually highlight the difference between shrug forms positively and negatively associated with the presence of speech, shrug forms without a reduced palm-up (proportionately less often produced with speech than without speech) are presented in shades of red. Those forms with a reduced palm-up (more often produced with speech than without) are presented in shades of yellow. Again, overlaid numerals indicate raw frequency.

Figure 6

Distribution of shrug forms by speech presence in early childhood. Shrugs that include a reduced palm-up component are more often produced with speech than without. Shrugs without a reduced palm-up are more often produced without speech than with speech. These effects are significant for reduced palm-ups (without a shoulder raise) and shoulder raises (without a palm-up). Boxes label raw frequency (N=362).



As demonstrated in the Chi-square test above, there is a relationship between presence or absence of speech and shrug form. Precisely what aspect of form drives this relationship is less clear. Forms with reduced palm-ups tend to appear with speech and forms without reduced palm-ups tend to

appear without speech, suggesting kernel form is related to "completeness." On the other hand, given that the only significant associations in post-hoc analysis emerged with isolated shoulder raises and isolated reduced palm-ups, it may be that the presence or absence of a shoulder raise is at the core of the kernel form, easily recognized and salient without speech.

Teasing apart these two possibilities requires additional data. Going forward in this exploratory study, we follow the reasoning supported by the non-significant associations. That is, we define the proposed kernel form as any "unreduced" shrug which does not include a reduced palm-up component, or those forms that tend to be produced more often in no-speech communicative acts.

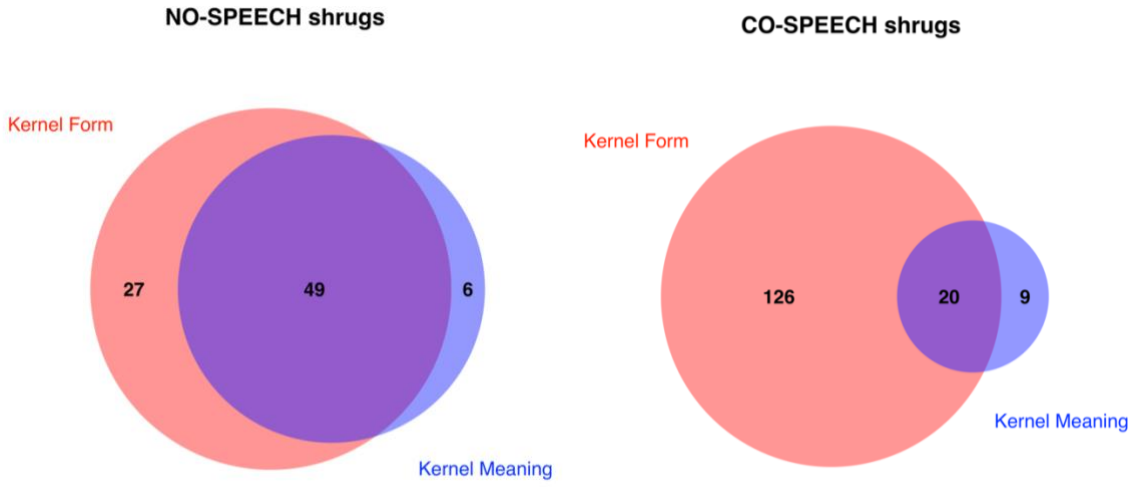
Form-Meaning Association

To determine whether the proposed kernel form and meaning together constitute a kernel shrug emblem, we built a mixed-effects logistic regression with gesture meaning as a factorial dependent variable (kernel ignorance meaning/other meaning). We included three predictors of theoretical interest: gesture form (factorial; kernel unreduced form/other reduced form), gesture-speech relation (factorial; co-speech shrug/no-speech shrug), and subject's age in months (numeric). The model additionally included random effects with random slopes for child's age in months by subject. The inclusion of an interaction between gesture-speech relation and child's age did not result in a model with significantly better fit and so was omitted from the final model. This regression showed a significant positive effect of kernel form on kernel meaning (β = 1.06, SE = 0, p < .001) and significant negative effect of co-produced speech on kernel meaning (β = –2.86, SE = 0, p < .001). There was no significant association between age and shrug meaning across the early childhood observations (14-58 months). An alternative model using meaning to predict form showed similar effects. There was a significant positive effect of kernel meaning on kernel form (β = 1.19, SE = 0.38, p = .002) and significant negative effect of co-produced speech on kernel meaning (β = –1.25, SE = 0.40, p < .001). Full models and tables are included in supplemental materials.

Error! Reference source not found. includes two Venn diagrams depicting the relationship between kernel meaning (ignorance) and kernel form (unreduced) both co-speech and no-speech shrugs. Critically, these figures show that the association between kernel meaning and form is not simply reflecting that both tend to be produced more with no-speech shrugs. For both co-speech and no-speech shrugs, shrugs with the kernel meaning of ignorance are more often produced with the kernel unreduced form than with a reduced form.

Figure 7

Associations between kernel form and meaning in early childhood. Kernel form is associated with kernel meaning in both no- and co-speech contexts. Labels report raw frequency (no-speech N=82; co-speech N=155).



Discussion

Cooperrider and colleagues (2018) have proposed that the kernel meaning of the palm-up gesture is 'absence of knowledge' and that other 'absence' meanings extend outward from this kernel, like absence of certainty or concern. This study pursued the authors' suggestion to look for this theoretical kernel meaning in young children's gesture. After finding descriptive evidence to support this proposed kernel ignorance meaning for the shrug family of gestures, we used the same descriptive analysis to propose a kernel "unreduced" shrug form (i.e., the shrug does not include a reduced palm-

up). Kernel form and kernel meaning were associated above and beyond associations with presence or absence of speech, which may reflect children initially incorporating a shrug emblem into their gesture lexicon before using shrugs with the pragmatic flexibility of adults.

To identify a plausible kernel form and meaning, we compared children's shrugs produced with and without speech. Because children have clear lexical and syntactic limitations in the first few years of life, young children's interaction with caregivers is rife with opportunities for communicative gestures both with and without co-produced speech. We hypothesized that early in pragmatic development children would use shrugs differently in these two gesture-speech contexts, since they are less able than older children or adults to incorporate extralinguistic contexts into their communicative acts. If the shrug has emblematic origins, children could be more likely to use this predictable "verbal translation" with a reliably recognizable form when producing shrugs without speech. No-speech shrugs carry the full communicative burden of the conversational turn, while turns with co-speech shrugs can share meaning between the verbal and nonverbal modalities.

Children's no-speech shrugs were significantly associated with the ignorance meaning, while co-speech shrugs more often signaled investment, uncertainty, and other non-ignorance meanings. These findings not only support Cooperrider and colleagues' (2018) proposal of 'absence of knowledge' as the kernel meaning for the palm-up gesture, they further suggest ignorance is the kernel meaning for the shrug composite gesture.

Using the same reasoning, these results also suggest a kernel form. Children's no-speech shrugs were infrequently produced with a reduced palm-up. Instead, when the shrug gesture carried the full communicative burden of the conversational turn, it was produced with a shoulder raise and/or a crisp, visually salient palm-up gesture.

Separately identifying the form and meaning of shrugs children tend to produce without speech does not mean these shrugs are functioning emblematically. A shrug emblem requires a

conventionalized mapping between form and meaning, which does not necessarily follow from the observation that unreduced form and ignorance meaning independently tend to appear in children's no-speech shrugs.

A closer look at the relationship between unreduced shrug form and ignorance meaning reveals the form-meaning mapping we would expect for a shrug emblem. A mixed-effect logistic regression showed a significant association between the unreduced form and ignorance meaning controlling for speech presence. The kernel meaning of ignorance was predicted not only by absence of speech but also by the proposed kernel form without a reduced palm-up. Likewise, unreduced form was predicted by both absence of speech and ignorance meaning.

Identifying an emblematic origin for the shrug allows us to look more closely at how adults' pragmatic use of shrugs develops, with flexible mapping between many forms and many meanings. There are several clear differences between how children in this study produced shrugs and how the literature has described adults' shrugs. Children's shrugs tended to communicate ignorance, but adults' shrugs more frequently communicate obviousness or certainty (Jehoul et al., 2017). Müller (2004) has suggested the core meaning of palm-ups is metaphorical handling of information (the exposed palm requests and presents information in speech) but information-handling meanings (e.g., inquiry, affiliation) were less common than epistemic meanings (e.g., ignorance, uncertainty) in these data. Palm-ups are often used by adults to hold, open, and pass the floor (Bavelas et al., 1992), but children in this sample never used a shrug gesture for turn-management.

It is not typical of emblems to see major shifts in form-meaning mapping over development. A toddler uses a thumbs-up to mean 'good' and a finger pressed to the lips to mean 'quiet'; an adult does just the same. What explains this developmental transformation from emblematic to interactive functions?

One possibility has to do with children's ability to produce variations of the shrug form. If patterns of gesture use were merely an artifact of motor development, we would expect an early abundance of reduced palm-up forms with later production of more dexterously demanding complete palm-ups with full wrist rotation and frozen motion at the gesture's peak. Instead children produced complete (N=145) and reduced palm-ups at comparable rates (N=170).[4] This is especially clear in shrugs that communicate literal absence or completion. Absence shrugs were most common at the earliest sessions and decreased steadily before disappearing entirely after 46 months, but 80% were produced with a complete palm-up form. An increasing rate of reduced palm-ups might reflect a tendency for children to produce generally "sloppier" gestures as they become more comfortable using co-speech gestures, but this pattern was not observed with pointing gestures in other research with this same corpus and cohort (Hundertmark, 2016).

Another possibility is that the shrug gesture is functionally changing as part of pragmatic development. The shrug's kernel meaning of ignorance and the high frequency of other epistemic meanings position shrugs as a non-verbal analog to modals and verbs of cognition. Children initially use verbs of thinking and speaking to assert their perceptions of the world, later use them to express an assessment of their own thoughts and knowledge, and eventually use these verbs to serve a variety of discourse functions with only loose or metaphoric ties to knowledge or acts of cognition, like marking politeness (e.g., Abbeduto & Rosenberg, 1985; Harris et al., 2017; Hickmann et al., 1993; Shatz et al., 1983).

[4] Because the question of whether children are able to physically produce a gesture form is unrelated to gesture meaning, these frequencies include shrugs meaning absence or completion.

Shrug gestures develop similarly to epistemic linguistic and paralinguistic features. Like modals and verbs of cognition, form and meaning are initially bound together and gain flexibility across early communicative development. Like in speech, children's earliest epistemic expression with shrugs is typically outright ignorance. However, like other non-verbal resources such as prosody, young children also use shrugs as uncertainty markers to indicate partial knowledge. Children's tendency to map a kernel epistemic meaning onto a kernel form, regardless of modality, may be rooted in communicative intent rather than having the form in their verbal or gestural lexicon.

For young children, like adults, the shrug gesture communicates information comparable to and compatible with speech. Speakers can construct their turn with speech only or gesture only, can reinforce speech with a gesture matching spoken meaning, or can use meaning in gesture to supplement meaning in speech. Children's tendency to use no-speech shrugs emblematically suggests that at some level they treat the gesture as a lexical item interchangeable with its verbal gloss ('I don't know'). At the same time, children's co-speech shrugs frequently served interactive or pragmatic functions. In combination with speech, they conveyed meanings without a direct lexical gloss, like non-ignorance cognitive states, affect, and (dis)affiliation.

This study focused on the distinction between no-speech and co-speech gestures, those that substitute for speech and those that are somehow integrated with meaning in speech. These analyses cannot speak to more specified relationships between speech and co-speech gesture (e.g., reinforcing, supplementing), but the difference in usage between no-speech shrugs and co-speech shrugs indicates that children are sensitive to at least some aspects of gesture-speech context in constructing conversational turns.

Describing the developmental use of shrugs not only offers insight into multimodal pragmatic development, it also encourages a multi-functional perspective on the shrug gesture more broadly. Critically, although there is evidence for a kernel form-meaning mapping, we do not suggest that shrugs

should be universally classified as emblems. Quite the opposite we find even very young children use shrugs for many of the same kinds of pragmatic functions that adults do. We argue that children's variable use of form and meaning across speech contexts demonstrates it is inadequate to bin shrugs together with other emblems, with beats, with metaphoric conduit gestures, or with interactive gestures. Shrugs are a powerful communicative tool for both children and adults, but we cannot fully understand how shrugs operate so fluidly and flexibly in everyday conversation without recognizing the multiple functions they perform and how these functions change over development.

This study faces several important limitations. While these results suggest interesting parallels between the development of verbal and non-verbal epistemic expression, this analysis is limited to gesture alone. We can only speculate on the broader relationship between speech and gesture in pragmatic development. Future research should ask whether a relationship between the developmental trajectories of both modalities is present at the level of the individual.

Additionally, we describe only children's use of gesture in parent-child interaction. Focusing on child-produced shrugs helps us understand the earliest functions of a complicated communicative resource and how children are mapping form to meaning as they construct their turns. Questions about mechanisms of acquisition or what drives developmental change cannot be addressed without, at a minimum, analyzing how parents gesture with their children.

Finally, these data are exclusively from interaction in the early childhood stage. Although young children use shrug gestures very frequently (second only to pointing gestures in these data) these patterns of use are far from adult-like. Like many aspects of pragmatic development, we should expect the formal and functional use of pragmatic gesture to continue developing into adolescence. While age was not significantly associated with form-meaning mapping in the model, this only describes patterns of use in the earliest years of life. Age will unquestionably be a factor across a longer developmental period.

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Supplemental Materials

Table 3

Observed meanings of shrug gestures

Meaning	Verbal equivalent	Citations
ignorance	"I don't know."	Barakat, 1973; Brookes, 2004; Calbris, 1990; Chu et al., 2014; Debras, 2017; Debras & Cienki, 2012; Graziano, 2014; Johnson et al., 1975; Jokinen & Allwood, 2010; Kendon, 2004; Payrato, 1993; Sparhawk, 1978
uncertainty	"I'm not sure.", "Maybe."	Barakat, 1973; Chu et al., 2014; Debras, 2017; Debras & Cienki, 2012; Ferre, 2012; Gawne, 2018; Graziano, 2014; Jokinen & Allwood, 2010; Payrato, 1993
obviousness, shared or common knowledge	"Obviously!", "As you know..."	Bavelas et al., 1992; Debras, 2017; Debras & Cienki, 2012; Graziano, 2014; Jehoul et al., 2017; Johnson et al., 1975; Kendon, 2004; Muller, 2004
disinterest, indifference	"Who cares?", "Whatever."	Calbris, 1990; Debras, 2017; Ferre, 2012; Streeck, 2009; Jokinen & Allwood, 2010; Payrato, 1993; Sparhawk, 1978; Streeck, 2009
agreement, affiliation	"Exactly right!", "Don't you agree?"	Bavelas et al., 1992; Calbris, 1990; Creider, 1977; Debras & Cienki, 2012; Streeck, 2009
disagreement, disaffiliation, distance	"That's not how I feel.", "I don't agree."	Barakat, 1973; Bavelas et al., 1992; Calbris, 1990; Debras, 2017; Debras & Cienki, 2012; Ferre, 2012; Muller, 2004; Streeck, 2009
submissiveness, incapacity, non-responsibility	"Don't ask me!", "Not my problem."	Bavelas et al., 1992; Debras, 2017; Debras & Cienki, 2012; Ekman & Friesen, 1972; Gawne, 2018; Givens, 1977; Graziano, 2014; Kendon, 2004; Muller, 2004
investment, certainty, committment	"Of course!", "I'm sure."	Barakat, 1973; Calbris, 1990; Ferre, 2012; Jokinen & Allwood, 2010; Muller, 2004
absence	"I have nothing."	Brookes, 2004
inquiry, interrogatives, requests	wh-questions	Chu et al., 2014; Creider, 1977; Gawne, 2018; Kendon, 2004; McNeill, 1985; Rector, 1986
transferring or handling information, conduit metaphor	"For example...", "Let me tell you..."	Bavelas et al., 1992; Chu et al., 2014; Graziano, 2014; Gawne, 2018; Muller, 2004; Parrill, 2008; Streeck, 2009

beats, emphasis, exclamation	"Wow!", "It took for-ev-er."	Kendon, 2004; Ferre, 2012; Rector, 1986
turn-taking, floor negotiation	"Go ahead.", "Let me interrupt..."	Bavelas et al., 1992; Muller, 2004; Streeck, 2009

Table 4

Participant demographics.

Subject	Sex	Race/ethnicity	MLU group	Household income	Maternal education
42*	M	White, Non-Hispanic	Low	$15,000-$34,999	Some College or Trade School
48	M	White, Non-Hispanic	Low	>$100,000	Advanced Degree
77	F	Black	Low	<$15,000	Some High School
78	M	White, Non-Hispanic	Low	$35,000-$49,999	Advanced Degree
84	M	White, Non-Hispanic	Low	>$100,000	Some College or Trade School
105	F	White, Non-Hispanic	Low	$50,000-$74,999	Bachelor's Degree
24	F	Black	Middle	>$100,000	Advanced Degree
33	M	Black	Middle	$50,000-$74,999	Some College or Trade School
37	F	White, Non-Hispanic	Middle	$75,000-$99,999	Bachelor's Degree
62	M	White, Non-Hispanic	Middle	>$100,000	High School or GED
74	F	White, Non-Hispanic	Middle	>$100,000	Bachelor's Degree
88	M	White, Hispanic	Middle	$75,000-$99,999	Advanced Degree
29	F	Mixed/other race	High	>$100,000	Advanced Degree
43	M	White, Non-Hispanic	High	$50,000-$74,999	Bachelor's Degree
44	F	Black	High	$35,000-$49,999	Some College or Trade School
50	M	White, Non-Hispanic	High	$50,000-$74,999	Bachelor's Degree
92	M	White, Non-Hispanic	High	>$100,000	Bachelor's Degree
103	F	Mixed/other race	High	$75,000-$99,999	Bachelor's Degree

Note. Subject 42 completed 11 visits. All other subjects completed all 12 visits.

Table 5

Post-hoc Chi-square residuals, meaning and speech

Meaning	Speech presence, resid.
Ignorance	-11.423***
Investment	5.260***
Disaffiliation	1.617
Disinvestment	0.957
Inquiry	3.695**
Affiliation	1.144

** p<0.05, **p<0.01, ***p<0.001*

Table 6

Post-hoc Chi-square residuals, form and speech

Form	Speech presence, resid.
Reduced palm-up + Shoulder raise	0.596
Reduced palm-up	5.718***
Complete palm-up + Shoulder raise	-2.054
Complete palm-up	-0.476
Shoulder raise	-5.400***

** p<0.05, **p<0.01, ***p<0.001*

Table 7

GLMM, kernel form and meaning

Dependent		Estimate	Std. error	z value	Pr(>|z|)
Kernel meaning	(Intercept)	-0.039	0.003	-14.034	<0.0001
	kernel_form_YNTRUE	1.059	0.003	383.136	<0.0001
	cospeechCo-speech shrug	-2.863	0.003	-1035.279	<0.0001
	age_months_c	-0.222	0.003	-80.312	<0.0001
kernel_form ~ kernel_meaning + cospeech + age_months + (1 + age_months|subject)					
Kernel form	(Intercept)	0.961	0.396	2.423	0.015
	kernel_meaning_YNTRUE	1.188	0.378	3.141	0.002

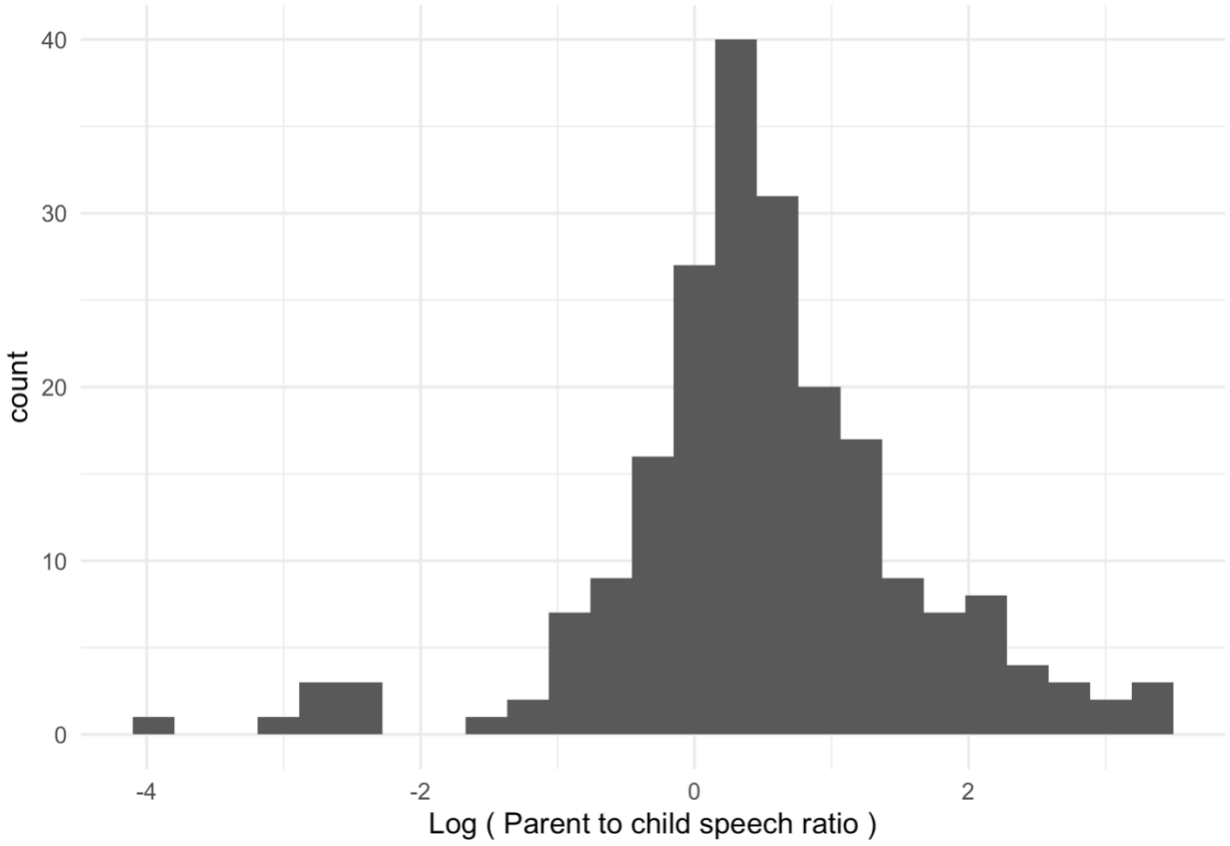
	cospeechCo-speech shrug	-1.253	0.398	-3.151	0.002
	age_months_c	-0.242	0.203	-1.192	0.233
kernel_form ~ kernel_meaning + cospeech + age_months + (1 + age_months|subject)					
kernel_form ~ kernel_meaning + cospeech + (1 |subject)					
Kernel form	(Intercept)	1.118	0.270	4.147	0.000
	kernel_meaning_YNTRUE	0.387	0.599	0.646	0.518
	cospeechCo-speech shrug	0.138	0.475	0.291	0.771
kernel_form ~ kernel_meaning + cospeech + (1 |subject)					

Home Visit Exclusions

Home visits were excluded from analyses if there was very low parent speech. In these sessions (*N*=9) the primary caregiver typically was not present for most or all of the session, leaving the child to talk with other familiar adults whose speech was not transcribed or to the silent experimenter. In these cases transcripts provided only the child's half of the interaction, leaving insufficient context to reliably annotate pragmatic gesture or sequence organization. Sessions were excluded if a log transformation of the ratio of parent utterances to child utterances was less than -2.

Figure 8

Log transformation of parent-to-child speech ratio for early childhood visits. Outlier sessions with a log-ratio less than -2 were excluded from analyses.


40
30
20
10
0
count
-4
-2
0
2
Log (Parent to child speech ratio)

Interaction Coding Manual

Pragmatic Gesture

Inclusion

1. Code gestures that serve interactive functions.
2. Do not code deictic, emblematic, or representational (iconic, metaphoric) gestures unless they take interactive forms.
3. Code gestures produced during spontaneous interaction. Do not code gestures produced while a speaker is reading directly from a prompt.

Code	Description	Other remarks
	FORM	
nod	head up/down	
shake	head side to side	
tilt	head tilt to shoulder	does not include nods or shakes tilted slightly
pug	palm-up gesture	also code canonicity; one or both palms
shrug	shoulder raise	one or both shoulders
point	extended index finger	for points with interactive functions only; addressee-indicating
beat	punctuated or rhythmic movement	
other	other forms with interactive meanings	usually forms similar to palm-ups
	GLOSS	
invest	commitment to proposition, obviousness, certainty	I'm telling you, obviously, clearly, I'm sure, I feel strongly about this, as we all know, of course
disinvest_0	ignorance, inability	I don't know, I can't answer that, how should I know?, can you help me?
disinvest_1	uncertainty, unwillingness; distance, lack of commitment, non-responsibility, disinterest	I'm not sure, I think so, I guess so, maybe, I'm no expert, if I had to guess, I don't care, whatever, it doesn't matter
disinvest_2	absence, completion	all gone, all done
align	agreement, acknowledgment, following	ok, me too, I understand, I agree, you're right, I'm following, keep going, we're on the same page
disalign	disagreement, confusion, not following	I disagree, I don't like what you're saying, I'm confused, you're wrong, I'm not following you
affirm	affirmation, confirmation	yes, correct
negate	negation, disconfirmation	no, incorrect
turn_0	claiming turn; negotiate turn taking	I'll talk next, I'm not done yet, don't interrupt, let me interrupt

Code	Description	Other remarks
turn_1	ceding turn; negotiate turn taking	go ahead, what do you think?, I'm done talking, feel free to interrupt me
exclude	pragmatic forms taking non-pragmatic meaning	e.g., pugs metaphorically representing contrast ("on the one hand..."); pugs and head nods that are unconventional points/deictics
	RELATION	
add	add meaning not present in text or audio	aka supplement
rf	reinforce meaning found in either text or audio	
da	disambiguate unclear or incomplete meaning in speech	aka complement; typically deictics DA pronouns, rare but possible for shrugs
sub	substitute gesture for speech	communicative act is gesture only or "no-speech"
con	contradict meaning in speech	e.g. adding investment to an utterance that contains clear hedging or words indicating uncertainty
		RM
l	lexico-syntactic	uncertainty/ignorance epistemic state words (think, believe, bet); hedges and fillers (um, well); question syntax; directing turn transition "you go now"
p	prosodic	try-marking
f	facial	mouth/eyebrow shrugs
	PALM-UP FORM	
np	non-canonical presentational	forward, addressee-indicating
cp	canonical presentational	
nl	non-canonical lateral	
cl	canonical lateral	
no	non-canonical other; unclear	may point to something other than addressee; may be angled between addressee and lateral
co	canonical other	theoretically possible but not expected to appear

Gesture Form

These gesture forms may serve interactive functions. Do not code deictic, emblematic, or representational (iconic, metaphoric) gestures unless they take these forms *or* they have a clear meaning from among the interaction gloss codes.

- nod: vertical head movement
  - sharp single downward movement of the chin OR both an upward and a downward movement
- shake: horizontal head movement

- tilt: head tilts toward one shoulder
    - code head tilts only when they have communicative intent; do not code head tilts with a functional purpose, e.g., comfort, looking at interlocutor, fidgeting, etc.
    - must have clear start and stop
- PUG: palm-up gesture
    - canonically, an outward rotation of the wrist so the open palm faces upward and fingers extend away from the body either laterally in neutral space or forward toward the addressee
    - more commonly produced non-canonically as "reduced" or "incomplete" rotation/extension
- shrug: one or two shoulders raised toward the ears
- point: one finger indicating the addressee when serving an interactive function
    - conceptually similar to an extremely reduced PUG
    - most pointing gestures are *not* interactive!
- other: gestures that seem to perform interactive functions but do not take any of the above forms
    - unlike referential gestures (points, iconics, emblems, etc), the meanings of these gestures clearly match the interaction gloss codes
    - often may be similar to a PUG, but missing an essential element; for example there is not wrist rotation, the palm faces down, the palm/fingers do not open, or the hand is holding an object
    - includes gestures that take the form of a point to the addressee when serving an interactive (rather than deictic) function; similar to extremely reduced presentational PUG
- beat: punctuated or rhythmic movement
    - must be combined with one of the above forms
    - produced to emphasize a word or syllable, with at least *some* prosodic prominence on that word/syllable as well
- unclear: gesture is generally recognizable as one of the above forms but not clear enough to make informed judgments about
    - camera angle makes it impossible to see the whole gesture
    - an object or person blocks the camera's view temporarily

Form notes

1. Forms can be combined with "+", but do not include more than one head movement in a gesture form. Code the most prominent head movement.
2. Do not code beat-like gestures produced while reading that serve to follow text, such as rhythmically pointing to each word on the prompt.

Gloss

- invest: commitment to the proposition
    - "here's what I'm telling you"
    - "obviously"
    - "clearly"

    - "I'm sure"
    - "I feel strongly about this"
    - "as we all know"
    - "of course"
    - "here's a clear example"
    - "well duh"
    - "have to" / "must be"
- disinvest: distancing from the proposition
    - disinvest_0: ignorance, non-response, inability
        - "I don't know"
        - "I can't answer that"
        - "I have nothing to say"
        - "can you help me?" (inability)
    - disinvest_1: uncertainty, non-responsibility
        - "I'm not sure"
        - "I think/guess so"
        - "maybe"
        - "I'm not an expert"
        - "if I had to guess"
        - "I don't care"
        - "whatever"
        - "it doesn't matter"
        - "not my fault"
        - "I can't help it"
        - "oh well"
    - disinvest_2: literal absence
        - "all gone"
        - "all done"
- align: agreeing or affiliating with someone (typically the addressee, can be a non-present topic of talk)
    - "I agree"
    - "me too"
    - "I understand"
    - "you're right"
    - "I'm following"
    - "good idea"
    - "fine with me"
    - "we're on the same page"
    - "you know the rest"
    - "that's a good point"
    - "can I?" (ask permission)
    - "you can" (grant permission)
    - "know what?", "guess what!" (seek engagement)
        - "what?" (offer engagement when sought)
- disalign: disagreeing or disaffiliating with someone (typically the addressee, can be a non-present topic of talk)
    - "I disagree"
    - "I don't like what you're saying"

    - "I'm confused by what you're saying/asking"
    - "you're wrong"
    - "I'm not following you"
    - "I misunderstood you"
    - "bad idea"
    - "on the other hand" (i.e. disaligning with self)
    - "you can't" (refuse permission)
- affirm: affirming/confirming the proposition
    - "yes"
    - "correct"
    - can be "no" when confirming a negative proposition, e.g. "you didn't notice that?" "no."
- negate: negating/denying the proposition
    - "no"
    - "incorrect"
    - "not so"
    - can be "yes" when negative a negative proposition, e.g. "you didn't notice that?" "yeah I did notice."
- turn: negotiating turn taking
    - turn_0: claiming the floor
        - "I'll talk next"
        - "I'm not done talking yet"
        - "don't interrupt"
        - "let me interrupt"
    - turn_1: ceding the floor
        - "go ahead"
        - "what do you think?"
        - "I'm done talking"
        - "feel free to interrupt"
- other: non-interactional meaning for a target form

Gesture-Speech Relation

How does this gesture contribute meaning to the utterance? Consider the utterance to be the full speech signal, including syntax, word choice, and prosody. Judge relation based on the gesture gloss.

- add: provides new, additional meaning not present in the utterance; aka "supplement"
    - includes mid-act or act-final gestures that occur during pauses
    - gesture is supplemental; act is comprehensible without gesture
- rf: reinforces meaning already present in the utterance
- da: disambiguates meaning in the utterance; aka "complement"
    - gesture is necessary for full comprehension
    - this is very rarely the case for interactional gestures!
        - occasionally occurs when the gesture serves as a "word" mid-utterance, e.g. "she asked and I was like -- [shake head] -- because that's gross."
        - can occur when giving directives, disambiguating the intended recipient (the spoken or implied "you")

- con: contradicts meaning present in the speech
    - e.g. nod adding *investment* to an utterance containing hedges or cognitive state words that suggest *disinvestment* "I mean, yeah, because they probably want them to learn --"
- sub: substitutes for speech *entirely*; the gesture is the entire "utterance"
    - Examples of what is NOT substitution:
        - gestures produced with "mmhm" or "mmMMmm" (prosodic "I don't know) as speech
        - gestures that *immediately* precede or introduce speech without a pause
        - gestures that hold the floor mid-utterance
        - gestures that *immediately* follow an utterance, including when the speech trails off and the gesture concludes the speech act

Palm-up Form Completeness

For gestures with a PUG component, determine whether the gesture is canonical ("complete") or non-canonical ("reduced") and presentational or lateral. All gestures should take the form of a two letter code. Letter 1 indicates canonical/non-canonical PUG form. Letter 2 indicates presentational/lateral direction.

- PUG form (c/n)
    - c: canonical/complete PUG
        - one or both wrists rotate outward
        - palm faces upward
        - at least two fingers fully extended exposing palm
        - movement "freezes" (may be extremely brief, but perceivable at full speed video)
    - n: non-canonical/reduced PUG
        - outward rotation is small or incomplete
        - palm may face outwards rather than upwards
        - one or more fingers stretch outward but may not fully extend
        - handshape may be more similar to a point than a palm
- Direction: (p/l/o)
    - p: presentational
        - extended fingers point toward addressee
    - l: lateral
        - extended fingers point outward in neutral space
        - may coincidentally point toward an object or person in the space but is not a deictic reference to it
        - may be more "neutral" than lateral, especially for very small movements
    - o: other (any of the following)
        - direction is unclear
        - points to *and indicates* an object or person other than the addressee
        - movement is so small the direction cannot be determined

- hand is resting on the body or another surface and does not take a clear direction
- extended fingers point directly forward but not towards the addressee

Response Mobilization

What response mobilizing features are present in the communicative act? This does not include all RM features identified by Stivers and Rossano (2010). Use multiple codes if applicable, e.g. *lpf* where all three features are present.

- l: lexico-syntactic
  - interrogative syntax
  - epistemic uncertainty words: think, believe, guess, don't know, etc.
    - *except* when explicitly discussing opinions, beliefs, cognitive states; e.g., "I think Joe is worse for stealing" in response to "who do you think is worse?"
  - hedges, fillers, & modals: maybe, possibly, might be, could be, well, um, uh
- p: prosody
  - try-marking, rising intonation with declarative statements
  - elongation, e.g. "wellllll"
  - prosodic emphasis on epistemics, hedges, modals
  - extended pauses
- f: facial expression
  - eyes rolling or wide
  - mouth, nose, and brow scrunching/shrugging
  - tight or thin lips

Sequence Organization

Code	Label	Description
		POSITION
1	first-pair part	receives a response
2	second-pair part	includes responding to questions in the prompt that are read silently or read aloud by the same speaker
3	no-transition	act neither offers nor receives a response
4	backchannel	feedback of acknowledgment, understanding, or agreement that does not take the turn
0	unclear	
9	scripted exception	experimenter not free to respond naturalistically; addressee is not transcribed; speaker is reading from task prompt
		REQUEST

1	closed request	turn-initial act uses interrogative syntax or rising intonation and has given or implied set of responses; "which of these" questions; affirming questions
2	open request	turn-initial act uses interrogative syntax; most wh-questions
3	imperative	turn-initial act issues a command or directive with imperative syntax
NR	non-request sequence	sequences that do not meet any of the above criteria are not coded for request type
		INTENT
1	scenario	comments on behavior in the immediate scenario, announces next action, narrates pretend play, does not present fact or opinion
2	objective	presents (dis)provable claim, objective facts, may be correct or incorrect
3	subjective	presents (dis)agreeable claim, subjective opinions, assessment, announcements of cognitive or emotional state
4	rote	ritualized interaction (rare)
		PREFERENCE
1	preferred	SPP or backchannel in preferred format; affirms, acknowledges, agrees, accepts
2	dispreferred	SPP or backchannel in dispreferred format (other than ignorance); negates, ignores, disagrees, rejects
3	ignorance	SPP or backchannel giving dispreferred response, ignorance as non-answer but not answers with marked uncertainty
		ACT FEATURES
repair	sequence attempts to correct a problem with hearing or understanding	code 1 if present, else blank; self- or other-initiated
interact	sequence directs interaction, manages turn, offers backchannel feedback	code 1 if present, else blank; includes all acts coded as position 4
report	utterance contains reported speech, direct or indirect quotes	code 1 if present, else blank; communicative intent and format of speaker's utts may not match intention of the quoted speech (e.g. "she said 'are you going?' - reported speech is a request but C's utterance is not); character embodiment

Inclusion

Annotate sequence organization for children's shrug and palm-up ("flip") gestures already, with or without speech. Annotation is at the level of the communicative act; utterances with multiple gestures are considered one communicative act.

Position

All target gestures are coded for sequential positioning. Use numeric codes rather than descriptive names. An utterance may be in the first (1) or second (2) position of an adjacency pair; prompting a response from the listener or providing a response. Utterances that are not responses and do not receive a response are coded outside of a turn transition sequence (3). Addressee backchannel feedback does not interrupt the turn sequence (4). Unintelligible speech and other utterances where meaning is indecipherable from the transcribed context are coded as unclear (0). In experimenter-child sessions, it is impossible to determine the "true" positioning of an act due to the artificial limitations of the experimenter's script (9).

- 1: first-pair part (FPP)
  - non-contingent
  - initiates a turn sequence AND receives a response
  - may or may not directly request a response
- 2: second-pair part (SPP)
  - contingent
  - act closes a turn sequence AND offers a response
- 3: no transition
  - non-contingent
  - does not receive or offer a response
  - may be a failure to mobilize response
- 4: backchannel feedback
  - offer contingent feedback but do not take the conversational form
  - gives listener feedback of (mis)understanding or (dis)agreement without taking the turn
  - often accompanied by "yeah" or communicative sounds like "mmhm" or "uhhuh"
- 9: scripted exception (must not meet any of above coding criteria)
  - followed by experimenter's scripted response
  - impossible to tell if the act would have received a response in natural conversation without the experimenter's artificial constraints
  - the child is reading the prompt aloud *AND* does not receive a response from the addressee
- 0: unclear (any of the following)
  - unintelligible speech
  - camera or other technical issues

A.2.2.1 Position notes

1. Scripted exceptions are acts which should not be coded due to format constraints of visit or transcript protocol. For example, when data collectors are instructed to remain silent (as in early childhood visits) or follow a script (as in adolescence visits) they may not respond naturalistically to children's acts directed toward them. In such cases it is "impossible to know" whether the child's utterance would have elicited a response in unrestricted interactions, and the act should be excluded from analyses
2. Acts that provide a satisfactory response to a turn-initial request are second-pair parts whether or not the act then receives a follow-up/third-position response.
3. Prioritize first-pair parts for serial requests. Responding to a question with another question is not a relevant or satisfactory response.
4. Turn transitions may span more than two utterances.
5. In cases where speakers initiate a turn sequence but do not clearly provide the opportunity for a response, the distinction between FPP and no-turn-transition is dependent on whether the addressee attempts a response, indicating an attempt to complete the turn.

Request Form

Code adjacency pairs that request information, confirmation, or action; do not code non-request sequences that do not meet the criteria below. Code both the first pair parts (the requests/questions) and the second pair parts (the responses/answers). These categories are mutually exclusive. Requests that are ambiguous in form (can be interpreted as either open or closed) are determined by the response.

- 1: closed
  - FPP initiates a closed question; interrogative syntax or intonation
  - yes/no questions
  - multiple choice questions
  - does not require word search to answer
- 2: open
  - FPP initiates an open question; interrogative syntax
  - *wh*-questions
  - requires word search to answer
- 3: imperative
  - FPP issues a directive; imperative syntax
  - commands, offers, instructions

Request form notes

1. Always code based on request form if possible. When form is ambiguous (e.g., "Do you remember what that's called?" takes closed syntax but seeks an open-ended response) code based on addressee's response.

2. For the phrases “how about” and “what about”, use the listener’s response to determine whether the request was looking for some kind of confirmation (closed) or description (open).
3. Do not treat acts that follow requests but do not provide a contingent response as part of the request sequence.
4. Request-response pairs may span more than two utterances.

Intended Effect

Intended communicative effect of an act is coded as commenting on the current behavior or scenario, objective/observable information, or subjective/unobservable information.

- 1: scenario
  - comments on the immediate scenario
    - does not include comments about the physical environment (e.g. locating or describing present objects) - these are *objective* propositions that can be disputed/disproven
  - announce actions, decisions, wants, and needs regarding immediate context (e.g., “I want to go upstairs”)
  - ask or grant permission
  - make, grant, or refuse requests and offers
  - narrate ongoing events
  - (meta)comments on the immediate interaction
- 2: objective
  - assertions of objective or observable information
  - discussion of locations, visual descriptions, facts about the world
  - open to epistemic positioning
  - disputable, disprovable
  - responses to test questions
  - reasoning about objective, observable, or mechanical causes
- 3: subjective
  - assessments and evaluations
  - statements of opinion or belief
  - open to (dis)agreement but not (dis)provable
  - open to (dis)affiliative alignment
  - wants and needs outside immediate context (e.g., “I want to be an astronaut”)
  - reasoning about subjective, unobservable causes; personal motivations
- 4: rote
  - spelling, counting
  - labeling
  - social scripts (e.g. apologies, greetings, gratitude)
  - sound effects during play (e.g. “choo choo”, “meow”)
    - exception: sounds/onomatopoeia produced in response to objective questions (e.g. “what sound does a cat make?” “meow.”

Intended effect notes

1. Discussing wants and needs can have either scenario or subjective intent, depending on whether fulfilling the want/need would affect the immediate context. Rarely, wants/needs may have objective intent if they describe something inanimate or incapable of subjectivity.
2. Simple exclamations (e.g. wow, uhoh, oh no, yay) may have subjective or scenario intent, depending on whether they comment on something in the immediate context or a decontextualized/abstract topic.
3. Speakers may use objective statements to support larger subjective arguments. Code at the level of the turn construction unit, taking into consideration how the listener interprets the intent and responds.

Preference

Only SPP and backchannel acts are coded for preference.

- 1: preferred (all of the following):
  - response takes relevant form
  - confirms, agrees, accepts
- 2: dispreferred (any of the following):
  - response does not take relevant form
  - non-response (except ignorance)
  - disconfirms, disagrees, refuses
  - inability to provide a preferred response <u>*not*</u> *due to lack of knowledge*
- 3: ignorance:
  - special case of dispreferred response
  - inability to provide a preferred response *due to lack of knowledge*

Preference notes

1. Code for preferred *format* rather than preferred *action*. For example, although a speaker may hope their addressee declines their polite offer, an acceptance is still the preferred response format.
2. Basic preference principles for American English (Pomerantz & Heritage, 2012) are listed here in a plausible order of importance, with rules that are strictly about *form* being most important and rules that take into account preferred *action* being less important.
   a. Provide a relevant response, i.e. appropriate response type/form.
   b. Confirm, agree, and accept.
   c. Be truthful.
   d. Avoid self-praise.
   e. Avoid burdening others.
   f. The selected next speaker should respond.

Other Codes

These codes are not mutually exclusive. Code each with a 1 if the feature is present, otherwise leave empty. These codes are intended to be potential post-hoc filters to catch likely coding disagreements and complicated or interesting cases to come back to in a later analysis.

- REPAIR: indicates problems with hearing or understanding
  - includes upgraded backchannels; speaker did not have a problem with hearing or understanding but initiated a "repair" to show interest or encourage the interlocutor to continue
  - does not include self-repair
- INTERACT: serves *only* to direct the conversation
  - attention-getters: "see?" "Mom!"
  - pre-expansions and standardized prompts: "guess what./what?" "oh hey -- / yeah?"
  - backchannel feedback (including upgraded backchannels also coded as repairs)
  - "meaningless" and affective exclamations: "oh man!" "wow!" "oh no!"
  - sequence closings and minimal expansions: "well ok then"
  - performative acts: "sorry" "bless you" "thanks"
    - note: performative acts or social scripts are usually coded as intent 4 (rote speech) in addition to being marked as interact
- REPORT: reported speech
  - directly or indirectly quotes another speaker
  - quoted speaker may be present, absent, or imaginary/hypothetical
  - may be the entire utterance or contained within a larger utterance

Early Childhood Session Notes

Code using context. These codes are based on *interaction* rather than singular communicative acts. In most cases, you should use the surrounding rows of transcript to make coding decisions rather than sticking to hard and fast rules based on just the gesture or utterance.

A.3.1 Exclusion criteria

1. *Insufficient context.* Neither the co-produced utterance or the surrounding contextual utterances provide enough information to make reasonable assumptions about the gesture, typically due to either unintelligible speech or conversation with an interlocutor who is not transcribed and/or unable to freely participate in the interaction.
2. *Single gestures represented in multiple utterances.* Transcription conventions dictate that single gestures formed or held over multiple utterances be coded for all relevant utterances and noted as continuations. Code only the first appearance of these gestures and treat the following utterances as particularly relevant context for coding decisions.
3. *Non-interactive pointing.* All *potential* interactive gestures are pulled for coding, including all deictic (points, palms) gestures indicating the addressee (PCG). In most cases points to PCG are not interactive. Only code these pointing gestures if they serve clear interactive functions

(Bavelas et al., 1992). Add a 1 to the *skip* column to indicate the act has been intentionally excluded.

4. *Response mobilization coding is limited.* It is not possible to code facial expressions without access to the video, so the RM column should never contain an "f" code. Prosodic RM should be based on the transcriber's decision to use a question mark.
5. *Ignorance of location vs absence.* "Where" questions primarily for missing information. When co-produced speech is 1) present and 2) structured as an interrogative, this communicates ignorance and should be coded as disinvest_0. When a gesture 1) responds to a "where" question and 2) does not explicitly contain "all gone" speech, this is an ignorance response. Only utterances/gestures that implicitly or explicitly declare "all gone" should be coded as disinvest_2 (i.e. the speech is not a question or there is no co-produced speech). Acts coded as literal absence are necessarily commenting on the here-and-now and should be coded as scenario communicative intent.