

MOTHERESE AND MOTIONESE: DO THEY TRAVEL
TOGETHER?

by

ZOEY CANTOR

A THESIS

Presented to the Department of Psychology
and the Robert D. Clark Honors College
in partial fulfillment of the requirements for the degree of
Bachelor of Arts

May 2023

An Abstract of the Thesis of

Zoey Cantor for the degree of Bachelor of Arts
in the Department of Psychology to be taken June 2023

Title: Motherese and Motionese: Do They Travel Together?

Approved: Dare Baldwin, Ph.D.
Primary Thesis Advisor

The primary aim of this thesis was to assess how motherese (infant-directed speech) and motionese (infant-directed action) interface with one another in caregivers' communication. Specifically, this thesis sought to determine whether motherese and motionese "travel together" in caregivers' interactions, and if so, the extent to which this might be unique to their interactions with infant partners. A secondary question of interest concerned whether observers differed in their ability to detect infant-directed modifications in speech versus action. Two hundred and fifty college-age participants rated the infant-directedness of audio (speech) and silent video (action) for caregiver demonstrations of novel objects to either infant or adult partners. Observers' judgments of caregiver infant-directedness were significantly positively related for speech and action, but this was not unique for interactions involving infant partners. Additional analyses suggested that observers more readily distinguished between infant- versus adult-directed interaction in the context of speech than action. Together, these findings paint a complex picture of the motherese/motionese relationship. On the one hand, that motherese and motionese tended to travel together regardless of interaction partner points to a common underlying driver for these two phenomena that supersedes the particular modality – speech versus action – in which information is expressed.

On the other hand, the fact that infant-directedness was better detected in speech than action points to ways in which infant-directedness indeed is shaped by the modality in which it is expressed.

Acknowledgements

First and foremost, I would like to thank Dr. Dare Baldwin for being an amazingly supportive and inspiring mentor. Thank you for encouraging me to believe in myself and for helping me complete the difficult thesis process. This would not have been possible without you. I would also like to thank Dr. Jessica Kosie for not only serving on my Thesis Committee but for providing knowledge and guidance throughout the entirety of this project. Thank you to the Clark Honors College donors who funded the Mentored Research Program award. Your generosity allowed me to pursue research about which I am passionate. Lastly, I would like to give a profound and sincere thank you to my parents. You are my greatest role models, and I am eternally grateful for the ways in which you have shaped me into the woman I am today.

Table of Contents

Introduction	7
Literature Review	8
Motherese	8
Motionese	11
Motherese and Motionese	15
Present Study	16
Methods	19
Participants	19
Materials	19
Procedure	21
Results	23
Motherese and Motionese Travel Together	23
Individual Caregiver Correlations Corroborated Overall Findings	26
Repeated Measures Analysis of Variance	27
Discussion	29
Limitations	30
Broader Implications and Future Directions	32
Conclusion	35
Appendix A	36
Appendix B	39
References	41

List of Figures

- Figure 1.* Infant interaction partners: Observers' judgments of caregivers' infant-directedness for speech and action. 23
- Figure 2.* Adult interaction partners: Observers' judgments of caregivers' infant-directedness for speech and action. 24
- Figure 3.* Speech: Observers' ratings of caregivers' infant-directedness with infant and adult interaction partners. 25
- Figure 4.* Action: Observers' ratings of caregivers' infant-directedness with infant and adult interaction partners. 26
- Figure 5.* Observers' mean level of endorsement for infant-directedness when clips of action versus speech were derived from interactions with an infant versus an adult partner. 28

Introduction

The ability to understand human language and action is a challenging and impressive developmental achievement. As adults, we have mastered this skill, readily finding structure and meaning within complex, rapidly unfolding sound and motion. Think about a newborn baby, however. How do infants get started at making sense of the complex sensory stream that human language and action present? There is reason to believe infants have assistance in coping with this challenge. That is, when interacting with infants, adults tend to provide special forms of speech, often called “motherese” (more formally referred to as infant-directed speech), and action, called motionese (or infant-directed action), that appear to assist infants in identifying structure within the dynamic stream of information that language and action exemplify.

Motherese and motionese both involve modifications to speech and action that show high levels of repetition, simplification, and exaggeration (Fernald, 1984; Brand, Baldwin, & Ashburn, 2002). These characteristics appear to assist infants in finding structure and meaning within the stream of sound that language creates (e.g., Kuhl, 2004), and the stream of motion that action produces (e.g., Levine et al., 2019). Yet much remains unknown about the details of how such learning assistance in fact occurs. As well, relatively little is known about how motherese and motionese might operate together to scaffold infants’ learning about language and action. This latter question was the specific focus of my thesis research. As an additional and exploratory focus of my thesis, I sought to determine whether observers are more readily able to detect infant-directed modifications in speech versus action. In the following, I will first review the literature regarding motherese, as it has long been a focus of investigation, leading to a range of discoveries. Later, work on motherese was broadened to include inquiries of other ways adults modify their behavior to support infant learning, such as motionese. I will review this body of

work in turn, and then consider available evidence that speaks to how motherese and motionese might be related to one another.

Literature Review

Motherese

The use of infant-directed speech was recognized and remarked upon at least as far back as the Roman Empire (Weinstein & Baldwin, 2022). Over the years since, hundreds of anthropologists, linguists, and psychologists have investigated and written about the phenomenon (e.g., Ferguson, 1964; Sapir, 1921; Fernald et al., 1989). Yet, the term “motherese” was not established until 1975, with Dr. Elissa Newport’s doctoral dissertation research at the University of Pennsylvania (Newport, 1975). Motherese, in comparison to adult-directed speech, is characterized by a variety of modifications to language, including shorter and simplified expressions, longer pauses between words and phrases, higher pitch and pitch range, and greater pitch variability (Fernald, 1984). Despite what the term “motherese” seems to imply, these speech modifications are not confined to mothers; rather, interacting with a human infant is known to elicit such alterations from fathers as well as mothers (e.g., Fernald et al., 1989) and even from young children (e.g., Shatz & Gelman, 1973). At the same time, it is important to note that motherese appears to vary considerably across cultures; the specific nature and causes of such cultural variation remains a topic of current investigation (e.g., Hilton et al., 2022; Weinstein & Baldwin, 2022).

Newport’s (1975) empirical characterization of motherese sparked a large movement in psychology to discover more information about the phenomenon. One direction of research sought to examine whether infants preferred motherese over adult-directed speech (Fernald, 1985). Although previous studies had addressed infants’ preference for their own mother’s

speech over adult-directed speech, Fernald was the first researcher to examine whether motherese from an unknown mother would be attractive to infants. Fernald hypothesized that infants would indeed prefer the “general acoustic characteristics” of motherese, and results confirmed this prediction. Fernald considered many reasons for this finding. Infants could be drawn to the “simplified lexicon” provided by infant-directed speech. Additionally, infants might find the prosody of motherese engaging. Perhaps the varying pitch and rhythm of motherese allowed infants to process language in a way that adult-directed speech does not, therefore capturing the attention of infants.

Related to whether motherese allowed infants to process language came the central question of what function motherese serves in language development (Kemler Nelson, Hirsh-Pasek, Jusczyk, & Cassidy, 1989). Psychologists adopted several different views on this topic, one being how prosodic features in infant-directed speech provide a means for infants to break down language and understand it. Kemler Nelson et al. (1989) examined this viewpoint by investigating whether infants differed in their ability to identify structure in motherese or adult-directed speech. This study presented infants with both infant-directed and adult-directed coincident voice clips (with pauses between complete clauses) and non-coincident voice clips (with pauses interrupting clauses). Results showed that whether the speech was infant-directed or adult-directed affected infants’ preference for coincident versus non-coincident clips. In other words, in the infant-directed condition, infants indicated a preference for coincident clips over non-coincident clips. Conversely, in the adult-directed condition, infants showed no preference for either clip. Kemler Nelson et al. (1989) attributed these findings to the prosody embedded in motherese, which provides an “especially salient” way for infants to break down speech into

smaller parts like clauses. They proposed that once infants gain the ability to identify clauses, they can begin to acquire language and grammar skills.

Later research built on the findings of Kemler Nelson et al. (1989), showing that prosodic elements within motherese also allow infants to segment words within fluid dialogue (Thiessen, Hill & Saffran, 2005). Thiessen et al. (2005) tested infants' ability to discriminate between complete words and syllable sequences that crossed typical word boundaries in infant-directed and adult-directed speech conditions. Infants were only able to successfully do so in the infant-directed condition. Crucially, the language spoken in this experiment was entirely artificial. Natural infant-directed speech often provides infants with more information through simplified structure and word choice, therefore facilitating their learning. In this experiment, however, both infant-directed and adult-directed conditions shared precisely the same linguistic structure and only differed in terms of prosody, with the infant-directed condition featuring exaggerated rhythm. The infants were able to segment words because of the prosodic features of infant-directed speech. Thus, motherese, and more specifically prosody, appears to facilitate language acquisition.

In addition to identifying important linguistic structures, motherese, specifically its prosodic elements, carries key information about the intent of the speaker (Fernald, 1989). Intonation is one of the defining features of motherese, used by caregivers to express intent when communicating. Particularly, a falling pitch is used to soothe, a rising pitch is used to capture attention, and a bell-shaped pitch is used to retain attention. Hence, Fernald (1989) hypothesized that when rating the intent of infant-directed speech versus adult-directed speech, research participants would more accurately rate the intent of motherese. This prediction was supported in Fernald's results, regardless of participants' level of experience with children. In fact, four times

the number of individuals correctly identified speaker intent in the infant-directed condition versus the adult-directed condition. Although these results were demonstrated in adult participants, they carry important implications for infants. Because preverbal infants cannot rely on the semantic meaning of language, they have to rely on prosody to understand their caregiver. Motherese assists infants in this feat with the embellishment of intonation, providing an important window of insight for the infant. In other words, motherese assists infants in extracting meaning from others' utterances. As Fernald (1989) aptly phrased it, for infants on the cusp of language, "the melody is the message."

Motionese

In the 1980s and 1990s, there was already a well-established body of literature on motherese. However, other elements embedded in interactions between caregivers and children had not yet been thoroughly examined. Of particular interest to researchers during this period was how mothers used gestures in communicating with their infants (Iverson et al., 1999). Previous research showed that, when interacting with children, mothers utilized simplified gestures, omitting more fluid movements that typically occur within adult communication. Iverson and colleagues sought to further investigate this phenomenon specifically in Italy which is a "gesture-rich" culture. Iverson and colleagues discovered that mothers are more likely to employ speech and gesture together, as opposed to gesture alone. Notably, these gestures were often noncomplex and deictic, meaning they worked to indicate or show something to the infant. This type of deictic gesturing seemed to parallel the mother's speech. In other words, mothers used simplified gestures to reinforce and strengthen verbal messages. These results directly contrasted with the way gesture is utilized when two adults are communicating. Thus, it appears

that mothers systematically adjust their gestures when interacting with infants, suggesting a type of “gestural motherese”.

Building off of the idea of gestural motherese came the discovery of “motionese” (Brand, Baldwin, & Ashburn, 2002). Three years after the Iverson et al. (1999) study, Brand et al. (2002) proposed that within interactions with infants, adults alter their *actions* (with increased exaggeration and repetition, for example) in a form known as motionese. Critically, the idea of motionese was completely separate from language. To test this, raters coded several object demonstrations between mothers and their infants and mothers and an adult. As expected, interactions directed toward these two different types of partners (infants vs. adults) differed on multiple dimensions. When communicating with their infant, mothers showed “significant amplification” of the following interaction dimensions: simplification, repetitiveness, closer proximity to interaction partner, interactiveness, enthusiasm, and range of motion. Moreover, mothers who were expressive in one feature were also expressive in other features. These results carry several important implications for how caregivers interact with infants. Mainly, infant-directed communication modifications are not limited to motherese. Additionally, motionese likely enables infants’ learning by helping them break down actions into separate units, an ability of which infants are indeed capable (Baldwin, Baird, Saylor, & Clark, 2001; Levine et al., 2019). Action segmentation is key to infants’ development. It is linked to memory construction and social and linguistic progress, as well as more generally building an infant’s understanding of everyday interaction (Levine et al., 2019).

The findings and implications of Brand et al. (2002) sparked several investigations of how infants respond to the phenomenon of motionese. Perhaps the first study to examine this was conducted by Brand and Shallcross (2008), who explored whether infants prefer, and thus

pay more attention, to motionese. Other infant-directed modalities, such as motherese, are known to be preferred by infants relative to speech that is directed to adults (Fernald, 1985).

Discovering whether this applies to motionese is valuable as increased attention helps infants process the world around them (Brand & Shallcross, 2008). Brand and Shallcross (2008) found that 6- to 8-month-old and 11- to 13-month-old infants looked at infant-directed video clips more than adult-directed clips when the two were shown side by side. When shown still frames from these two clips, infants did not differ in looking time, therefore showing that the infants' preference was truly a result of the type of action and not the characteristics of the actor in the video. Additionally, Brand and Shallcross (2008) also found that these two groups of infants preferred motionese videos even when the actor's face was blurred in the video. This is significant as previous research identifies eye contact and facial expressions to be key factors in capturing infants' attention. The results of Brand and Shallcross (2008), however, suggest that infant attention towards motionese persists regardless of these components. Thus, motionese versions of bodily movement alone engross infants, showing that motionese carries a "specialized role" in the modifications adults employ when interacting with infants.

Expanding on the Brand and Shallcross (2008) findings, Koterba and Iverson (2009) examined how amplitude (range of movement) and repetition, two parameters of motionese, affect infants' attention to and subsequent exploration of, objects. These two outcomes were tested by caregivers demonstrating novel objects to their infants (movement trials). Movement trials were interchanged with still trials, where the caregiver held the novel object in a fixed position. Results showed that when at least one action parameter was elevated, infants spent more time looking at movement trials than still trials. Specifically, this result occurred in high amplitude/high repetition, low amplitude/high repetition, and high amplitude/low repetition

conditions. When both parameters were low (low amplitude/low repetition), infants spent less time looking at still trials. These findings corroborate those of Brand and Shallcross (2008). Additionally, they shed light on whether the parameters of motionese are additive as two enhanced parameters did not engage infants' attention any more than one enhanced parameter (Koterba & Iverson, 2009). Regarding object exploration, infants were allowed to play with the novel object after the caregivers' demonstration. Results showed that manipulating the amplitude parameter had no effect on how infants explored the object. Repetition, however, did. Higher levels of repetition during the caregiver's demonstration led to more banging and shaking of the object by the infant. Lower levels of repetition led to infants spending more time rotating and turning the object. These discoveries carry important implications for the different parameters of motionese. On the one hand, higher repetition trials might draw infants' attention to the caregiver's movement, causing them to attempt replication. On the other hand, lower repetition trials might spark excitement and curiosity within the infant, so when they have the chance, they are eager to examine the object in various ways.

The discussion on object exploration in the Koterba and Iverson (2009) study prompts questions of whether motionese promotes imitation in infants. In 2014, Williamson and Brand investigated this query. The results of this study showed that children paid equal attention to both infant-directed and adult-directed demonstrations of novel objects. However, when given the opportunity to play with the object, children who viewed an infant-directed demonstration were much more likely to perform the targeted action. Therefore, motionese inspired imitation more than adult-directed action. Williamson and Brand (2014) attributed these findings to the idea that motionese highlights intention. In other words, through exaggerated movements, the caregivers'

goals seem to be emphasized, which is crucial information for infants and likely aids their observational learning and bolsters their desire to imitate.

Motherese and Motionese

One perspective that provides background on the interaction between motherese and motionese is the study of how adults use language and gesture together in general. Essentially, gesture accompanies speech (Goldin-Meadow, 1999). Any observer, even outsiders who are not trained researchers, can interpret the spontaneous gestures of others. For example, gestures can help listeners understand the speaker's message. Gesture can also uncover information that is not explicitly stated by the speaker. Conclusively, gesture, when combined with speech, enriches communication.

In a more specific sense, relatively little is known about how motionese and motherese precisely interact. However, there are studies that investigate related questions (Meyer et al., 2011; Gogate & Bahrick, 1998; Gogate et al., 2000). Particularly, a number of studies have investigated various forms of synchrony between object motion and words. Gogate et al. (2000), for example, proposed the existence of a "multimodal motherese", meaning that caregivers use more than just speech when they communicate with infants. Specifically, this study found that when teaching infants target words versus nontarget words, caregivers used more temporal synchrony between their action, their speech, and sometimes their touch. In other words, when caregivers are trying to teach their infant a novel word, they utilize multiple modalities to do so. Additionally, the use of synchrony shifts depending on the lexical ability of infants. Caregivers communicate with more synchrony towards prelexical infants (that is, infants who don't yet comprehend and/or produce words) than they do early lexical and fully lexical infants. These results suggest, overall, that adult communication with infants involves more than just

motherese; it is multifaceted. Furthermore, it is adaptive for caregivers to utilize this synchrony between speech and action as it may capture infants' attention with communication that is "most salient" to infants. This idea is further supported by Gogate & Bahrick (1998). This study found that in 7-month-old infants, learning of vowel-object pairings was best facilitated by a moving-synchronous condition, involving synchrony between the object's movement and a novel vowel sound, as opposed to a still and moving-asynchronous condition. When vocalizations are synchronous with moving objects, infants can relate arbitrary speech to an object. Thus, temporal synchrony supports learning. As it turns out, when demonstrating something to an infant, caregivers naturally sync their actions to their "action-describing utterances" (Meyer et al., 2011). Not only does this synchrony help infants learn, but it also happens spontaneously within the context of everyday interaction. Clearly, there is something key about the combining of speech and action within communication with infants.

Present Study

Prior research on both motherese and motionese has uncovered a wealth of relevant information about both phenomena, but some very basic questions remain. For one, as yet it is not clear the extent to which adults tend to deploy them together. Although the research described earlier demonstrates that modifications to speech and action clearly co-occur, the degree to which they tend to "travel together" has not been established. I hypothesize that the degree to which caregiver interactions utilize motherese and motionese will be positively correlated. Put differently, caregivers that introduce infant-directed modifications in one modality will tend to do so to the same degree in the other modality as well, and therefore interactions high on one dimension will also tend to be high on the other dimension.

Although my hypothesis that motherese and motionese travel together is highly plausible, it is not at all self-evident. On the one hand, it seems plausible that caregivers reliably introduce modifications to both speech and action as they interact with infants. If so, caregivers who are prone to high levels of motherese modifications will also be prone to introducing high levels of motionese modifications. As a result, infant-directedness ratings for speech and action will tend to be positively correlated, perhaps especially when caregivers were interacting with infant partners. On the other hand, it also seems plausible that caregivers might have a tendency to rely on just one modality (either motherese or motionese) to enhance communication with infants, and thus motherese and motionese would “trade off” with one another, rather than co-occurring. If so, no positive correlation, or even a negative correlation, will emerge between motherese and motionese in observers’ infant-directedness judgments.

A secondary question of interest that I addressed in this thesis concerned possible differences in observers’ ability to detect infant-directed modifications in speech versus action. It seemed plausible that the two modalities might differ in the magnitude of modifications and/or observers’ sensitivity to those modifications. If so, observers’ judgments might reflect a larger differential in ratings of infant-directedness for speech versus action. Because this was a previously unexamined question, I did not have an *a priori* prediction about the directionality of any difference that might emerge.

In order to determine the degree to which motherese and motionese travel together, I used videos of interactions between caregivers and their child or an adult. In these interactions, the caregiver demonstrates how to use a novel toy and is addressing either their child or an adult who is in the background. I presented adult research participants with a) audio clips from these videos conveying motherese speech, and also b) silent video clips conveying motionese

information. I asked the participants to rate the degree to which these clips depicted motherese or motionese, respectively. This allowed me to discover the extent to which these two components within one-and-the-same interaction travel together, and whether there are possible differences in observers' ability to detect infant-directed modifications in speech versus action.

Methods

Participants

Participants for this study were students at the University of Oregon. Through the university's Psychology Human Subjects Pool, participants completed the study online and received course credit. Overall, 279 people participated in the study, but some were excluded either because they did not finish the survey or did not pass an attention-check question. This left an ultimate sample of 250 participants with the following demographics. On average, participants were 20 years old. One hundred and forty-nine participants were female, 91 were male, and 2 were non-binary, with 8 participants choosing not to disclose their gender. Regarding race and ethnicity, 7 participants were American Indian or Alaskan Native, 20 were Asian, 18 were Black or African American, 5 were Native Hawaiian or Other Pacific Islander, 159 were White, and 23 were Hispanic or Latino. Thirteen participants selected dual racial/ethnic identities, 4 selected "other", and 1 chose not to disclose race and ethnicity. 91% of participants reported normal or corrected-to-normal vision, and 79% reported normal or corrected-to-normal hearing.

Materials

As mentioned previously, this thesis utilized videos of interactions between caregivers and their child or an adult. These videos were a subset of videos previously collected by Dr. Jessica Kosie when she completed her dissertation research at the University of Oregon (Kosie, 2019). The Kosie & Baldwin corpus featured caregivers presenting a series of novel objects selected to be of interest to infants in the 9- to 18-month age range (Baldwin, 2019). Caregivers demonstrated all novel objects to both their infant and an adult partner. As caregivers completed

these demonstrations, background noise occurred relatively frequently due to infants playing and vocalizing in the environment. This background noise was potentially problematic to the present thesis research as it could possibly bias observers' ratings about the extent to which the clip exemplified infant-directedness. To overcome this problem, we engaged in preliminary data collection in which we sought judgments from naive unbiased observers to identify which of the audio clips were uncontaminated by background noise, to the extent possible.

The first step in this process was to trim the videos in the Kosie & Baldwin corpus into 10-second clips. This controlled for variability in length across videos and enabled us to present multiple videos to adult observers for their judgments. These 10-second clips were separated into audio clips and silent video clips. We asked observers to make a number of judgments regarding: background noise, quality/comprehensibility of the audio, and how much the primary speaker talked throughout the clip. Observers only made these judgments regarding audio clips, as the silent video clips did not have any problematic features such as background noise. The set of selected audio clips was chosen from observer judgments to maximize clips in which caregivers produced a high rate of speech at a high level of comprehensibility but a low level of background noise.

Ultimately, audio clips were selected from 31 caregivers demonstrating five different novel objects. Each caregiver contributed an infant-directed audio clip and an adult-directed audio clip to the study. These were then matched with their corresponding silent video clips. Thus, 31 caregivers contributed 4 clips to the study: a) an infant-directed speech clip, b) an adult-directed speech clip, c) an infant-directed video clip, and d) an adult-directed video clip. (To view an example of these clips, please visit https://drive.google.com/drive/folders/1w5PbU0AMTxUIgVyyKQbx_8HzVNsBbHun). In a

given pair of infant-directed and adult-directed clips, the caregiver demonstrated the same novel object to the interaction partner. Out of the five novel objects, one object occurred in seven adult/infant/speech/action sets and four objects occurred in six sets.

Procedure

Participants signed up to take part in the study through the University of Oregon's Psychology Human Subjects Pool. Participants completed the study entirely online through a Qualtrics survey. Prior to answering any questions, participants filled out a consent form. The consent form included a brief overview of the study, allowing participants to make an informed decision about their participation. If the participant did not consent, the session was terminated. If the participant did consent, they were prompted to fill out a demographic questionnaire, which inquired about the participant's age, gender, and race. Participants were also asked whether they had normal or corrected to normal vision and hearing. Participants were required to answer all demographic questions, but were given the option "I prefer not to respond".

Participants then moved on to the section of the survey asking them to make judgments about the audio and video clips. Before viewing any clips, participants were instructed on how to rate the clips and were given examples of clips that demonstrated both high and low levels of motherese/motionese (view Appendix A). After receiving instructions and examples, participants then began to rate clips. After listening to/watching each clip, the participant was asked about the extent to which the person in the clip was using infant-directed speech (or action) behaviors and about the extent to which it seemed like the interaction was directed toward an infant (view Appendix B).

All participants rated all 124 clips. Whether participants judged audio clips or video clips first was randomized, with the constraint that each order occurred roughly equally often across

participants. The order of clips within the audio and video sets was also randomized. After rating all clips, participants were asked a series of follow-up questions, including a second block of demographics. Participants were asked how frequently, on average, they interact with children. They were also asked if they have children. If a participant reported that they did have children, they were asked the age(s) of their child(ren). These questions about children were not analyzed in the thesis. Lastly, participants were asked if any of the questions were difficult, unclear, or confusing. They were required to answer these questions but were given the option “I prefer not to respond”. Participants were then asked a final attention check question, which asked them to disclose how closely they adhered to the survey’s instructions. The survey concluded with a debriefing form, and participants were granted psychology course credit upon completion.

Results

Motherese and Motionese Travel Together

The primary question under investigation in my thesis concerned the extent to which motherese and motionese travel together in caregivers' interactions. We investigated this via two highly similar questions that we asked observers regarding both audio and video clips (view Appendix B); the extent to which a) the caregiver used infant-directed behaviors and b) the interaction seemed directed to an infant. Perhaps not surprisingly, the pattern of findings emerging for these two questions was virtually the same: thus, below we report results only for the second question regarding the interaction being infant-directed. As predicted, bivariate Pearson correlations revealed that observers' judgments of infant-directedness were significantly positively related for speech and action when infants were the interaction partners, $r(249) = 0.62, p = .000$ (See Figure 1).

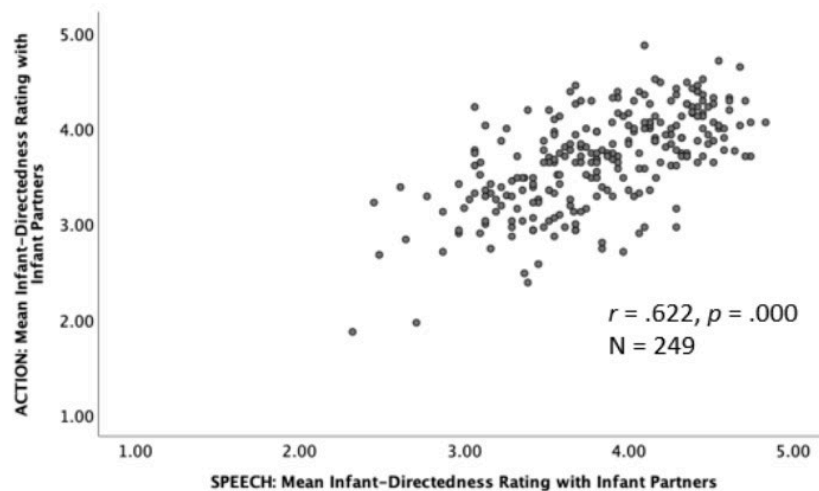


Figure 1. Infant interaction partners: Observers' judgments of caregivers' infant-directedness for speech and action.

Interestingly, a significant positive correlation between ratings of infant-directedness for speech and action also emerged when the caregivers' interaction partners were adults, $r(249) = 0.57, p = .000$ (See Figure 2). That is, a “travel together” relationship between motherese and motionese was not unique to caregivers' interactions with infant partners.

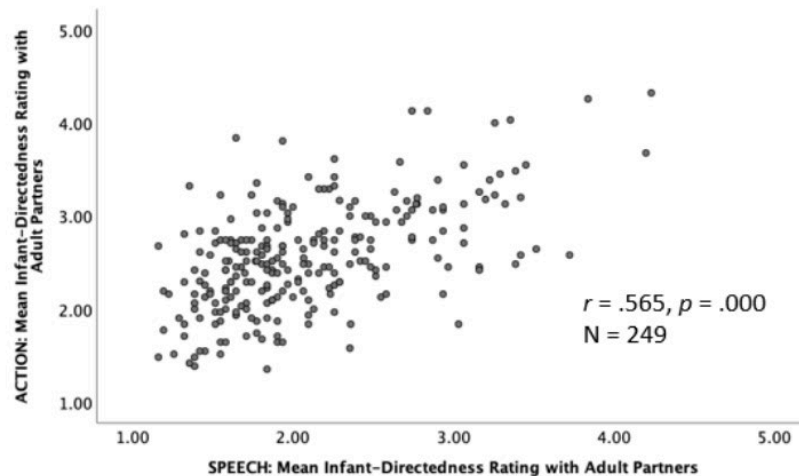


Figure 2. Adult interaction partners: Observers' judgments of caregivers' infant-directedness for speech and action.

A Pattern of Infant-Directedness in Action but not Speech

The study design enabled us also to examine another set of possible relationships: those between infant-directedness ratings when a) speech was directed to infant versus adult partners, and b) action was directed to infant versus adult partners. Of interest in these analyses was the extent to which caregivers' level of infant-directedness within a given modality (i.e., speech versus action) showed an overall pattern of infant-directedness observable across both infant and adult partners. Additional bivariate Person correlations revealed a marginally significant negative correlation for infant-directedness ratings in speech with an adult partner and an infant partner, $r(250) = -0.12, p = .056$ (See Figure 3).

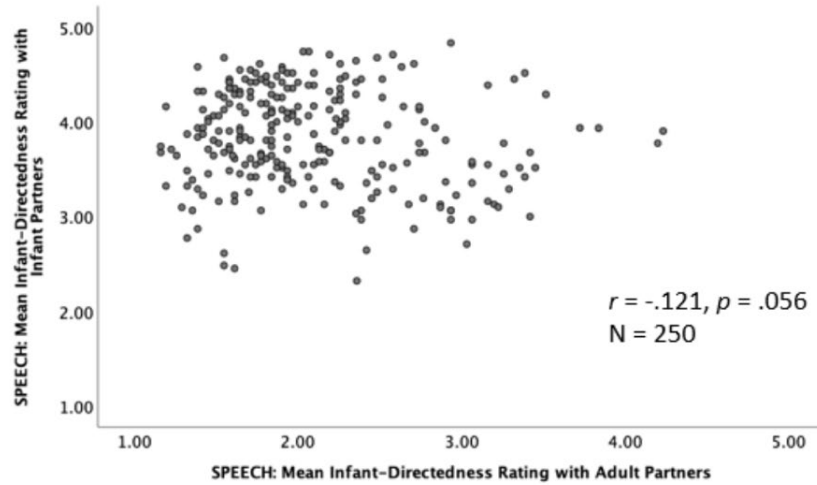


Figure 3. Speech: Observers' ratings of caregivers' infant-directedness with infant and adult interaction partners.

In contrast, for action, a significant positive correlation emerged in infant-directedness ratings for adult and infant interaction partners $r(249) = .38, p = .000$ (See Figure 4). These findings suggest that caregivers tend to show a pattern of infant-directedness (across both infant and adult partners) in their action, but not in their speech.

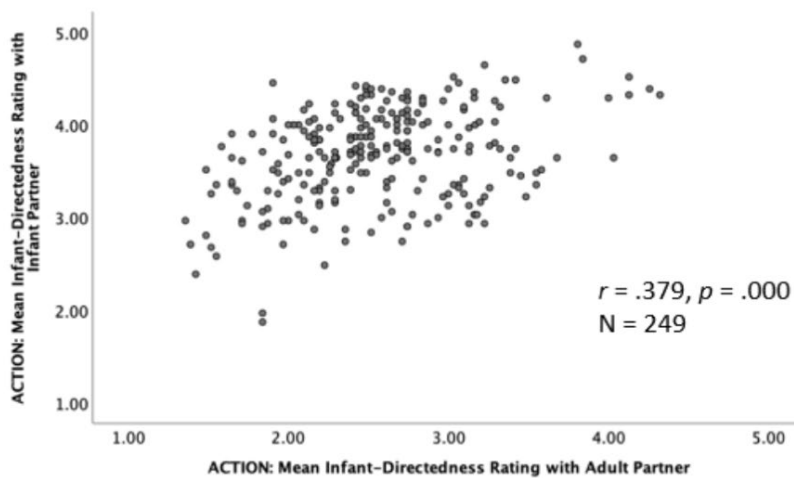


Figure 4. Action: Observers' ratings of caregivers' infant-directedness with infant and adult interaction partners.

Individual Caregiver Correlations Corroborated Overall Findings

Motherese and motionese traveled together for the majority of caregivers. With infant partners, infant-directedness in speech and action were significantly positively correlated for 23 of the 31 caregivers (74.19%). They were never significantly negatively correlated for any caregiver. That roughly three-quarters of caregivers displayed a significant positive correlation in the infant-directedness of their speech and action on an individual level showcases how strong the “travel together” relationship is for motherese and motionese. With adult partners, infant-directedness in speech and action were also significantly positively correlated to nearly the same high degree at the individual caregiver level, with 22 of 31 caregivers (70.96%) displaying a significant positive correlation in infant-directedness ratings for their speech and action. Again, significant negative correlations never occurred for any caregiver. This also showcases the strength of the “travel together” relationship, as it occurred at high rates even in interactions with adults. As well, the complete absence of negative correlations in infant-directedness ratings for speech and action (with either infant or adult partners) clearly disconfirmed the “trade-off” alternative hypothesis for how infant-directedness might pattern in speech versus action.

An infant-directedness pattern emerged for action in the majority of caregivers, but not for speech. For speech ratings, infant-directedness with infant and adult partners was significantly correlated for only about half of caregivers (14 of 31, 45.16%). Of those correlated, roughly equivalent percentages were in a positive direction (6 of 14, 42.86%) versus a negative direction (8 of 14, 57.14%). That is, in their speech, caregivers did not display any consistent infant-directedness pattern in their interactions with infant and adult partners. In contrast, for action ratings, infant-directedness with infant and adult partners was significantly correlated for

the majority of caregivers (19 of 31, 61.29%). Of those correlated, the majority were in the positive direction (15 of 19, 78.95%) rather than the negative direction (4 of 19, 21.05%). Thus, in contrast to speech, with action many caregivers indeed tended to display an infant-directedness pattern across interactions with both infant and adult partners.

Repeated Measures Analysis of Variance

Another topic of interest in the thesis centered on comparisons between action and speech in the degree of infant-directedness caregivers exhibited. To examine this, we undertook a repeated measures analysis of variance with two independent variables, modality (speech versus action) and partner (infant versus adult). The ANOVA revealed a significant main effect of modality, $F(1,248) = 37.15, p = .000$, partial Eta-squared = .13, with higher levels of infant-directedness judged for action ($M = 3.12, SE = .03, [3.06, 3.17]$) relative to speech ($M = 2.96, SE = .02, [2.92, 3.01]$). A significant main effect of the partner variable also emerged in the analysis, $F(1,248) = 1,128.93, p = .000$, partial Eta-squared = .82, with judgments of infant-directedness higher when infants were partners ($M = 3.75, SE = .03, [3.70, 3.81]$) relative to when adults were partners ($M = 2.33, SE = .03, [2.26, 2.39]$). However, interpretation of these main effects was qualified by a significant modality by partner interaction, $F(1,248) = 279.44, p = .000$, partial Eta-squared = .53 (See Figure 5).

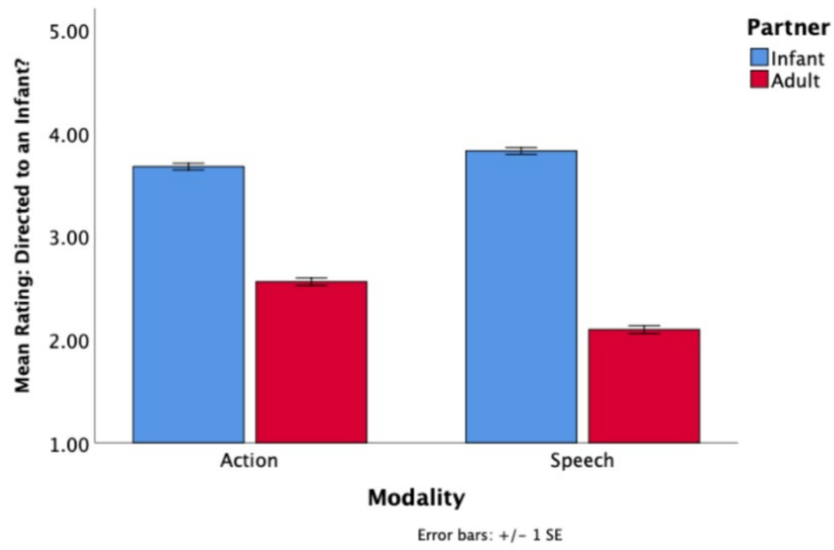


Figure 5. Observers' mean level of endorsement for infant-directedness when clips of action versus speech were derived from interactions with an infant versus an adult partner.

Planned comparisons were undertaken to explore the locus of this interaction. Paired *t*-tests revealed that all four comparisons were statistically significant, all *t*'s > 5.41, all *p*'s = .000. It is notable that, with infant partners, speech was rated significantly higher on infant-directedness than action, but the reverse was true for interactions with adult partners, in which speech which was rated significantly lower in infant-directedness than adult-directed action. Also noteworthy in the modality by partner interaction pattern is the fact that the infant-directedness differential between infant and adult partners was substantially stronger for speech than for action. This finding can be explained in multiple ways, which I will take up in the general discussion to follow.

Discussion

This thesis produced several major findings. Firstly, the findings provided clearcut evidence that motherese and motionese do indeed travel together. In other words, when observers rated an audio clip as high in infant-directed speech, they also rated the corresponding silent video clip from the same interaction as high in infant-directed action. This travel-together trend persisted regardless of whether caregivers were interacting with infants or adults, despite the fact that overall ratings of infant-directedness tended to be lower for interactions with adult than infant partners.

Our findings also provided strong evidence against the alternative possibility, that motherese and motionese might trade-off one another rather than traveling together. Analysis of correlations calculated at the individual caregiver level revealed not even a single caregiver showing a negative correlation in infant-directedness ratings for speech and action. The complete absence of a trade-off pattern across all 31 caregivers featured in the research clearly disconfirms the trade-off hypothesis.

The second major finding of this thesis is that observers more readily detected the distinction between infant and adult-directed modifications in the context of speech than in the context of action. One explanation for this could be that motherese is a relatively well-known phenomenon, to the public at large as well as researchers. For example, most people are aware that it is common to speak to young children using “baby talk” without even consciously intending to do so. Thus, it seems sensible that observers are sensitized to recognizing infant-directed speech, and therefore skilled at determining whether a caregiver is addressing an adult or an infant. In contrast, there seems to be considerably less general awareness of “baby action” (motionese) than “baby talk” (motherese), so people may be less attuned to infant-directedness

characteristics in action, and thus poorer at recognizing whether a caregiver's action is infant-directed or not. Put another way, the observers who were rating speech versus action might have been driving the pattern we found of greater discriminability for infant versus adult partners in speech versus action.

A different, but equally plausible, explanation for our finding is that the driver could have been differences in the way caregivers themselves expressed speech versus action in their interactions with infant versus adult partners. That is, perhaps caregivers themselves injected more exaggerated speech into their interactions with infants versus adults relative to what they expressed in their action. If so, observers would have had an easier time detecting partner-related infant-directedness differences for speech than action.

Unfortunately, the present data do not allow us to disentangle these two alternative explanations for the finding that ratings of speech displayed greater discriminability between infant versus adult partners than ratings of action. This will be a fascinating focus for future research.

Limitations

As with any piece of research, important limitations should be noted. For one, as mentioned previously, the Kosie & Baldwin video corpus consisted of caregivers presenting a series of novel objects to both their infants and to an adult interaction partner (Baldwin, 2019). The stimuli for this study were a subset drawn from this corpus, after going through a preliminary process to select the most appropriate clips. When video of interactions was originally collected, caregivers first demonstrated a set of novel objects to their infant and then to an adult partner (Kosie, 2019). Thus, it is possible that infant-directed speech and action qualities utilized in the interaction with the adult partner declined as the caregiver became more familiar

with the object, and not as a result of the change in partner, per se. This seems unlikely, however, given the wealth of previous findings documenting enhancements to both speech and action for interactions with infant versus adult partners, especially given that some of these studies controlled for such order effects (e.g., Fernald & Simon, 1984; Brand, Baldwin, & Ashburn, 2002).

It is also noteworthy that collection of the video corpus involved infants first participating in the ManyBabies study, a large collaborative project for developmental research, prior to video-recording caregiver-infant and caregiver-adult object demonstrations (Kosie, 2019). While infants were completing the ManyBabies study, caregivers listened to masking stimuli via headphones, which included bits of infant-directed speech. Thus, caregivers could have been primed with infant-directed speech, causing them to use more motherese than they typically would with their infants. If so, this could have contributed to observers having rated speech with infant partners higher in infant-directedness than action with infant partners.

Other limitations of this study bring into question the generalizability of the findings. For one, the majority of clips used in this study were taken from mothers. As only two (out of 31) of the caregivers were fathers, it cannot be determined whether the results generally apply to all parents. Secondly, all infant-directedness judgments collected in this study came from college students at the University of Oregon. It is likely that many students have had little experience with infants. Thus, they may be less sensitive to differences in infant-directed speech and action than other groups of the population, specifically parents. Furthermore, the data collected is from a WEIRD (Western, educated, industrialized, rich, democratic) population. This is important to consider in any interpretation of the results of this study as there is not a clear consensus on the

consistency of infant-directed speech across cultures (e.g., Hilton et al., 2022; Weinstein & Baldwin, 2022).

Broader Implications and Future Directions

Understanding that caregivers integrate motherese and motionese together when interacting with infants carries important broader implications. Motherese and motionese are components of natural pedagogy, which means they are phenomena that humans engage in, often unconsciously, to communicate effectively and to help novices, such as children, to learn. Specifically, motherese and motionese amplify language and action, respectively, in order to provide children with a window into fluent communication. With the finding that motherese and motionese do indeed travel together, it is possible that humans might communicate by using infant-directed speech and action in tandem. In other words, infant-directed speech might not be designed separately from infant-directed action; the two phenomena might be inseparable. This knowledge may be helpful downstream in designing interventions for children experiencing learning difficulties, specifically children with Autism Spectrum Disorder (ASD). Children with ASD have been shown to disprefer motherese, and even to demonstrate a preference for non-speech sounds (Kuhl et al., 2005). Perhaps the reason for this is that children with ASD fail to attend to social stimuli, such as speech, gesture, and facial expressions (Dawson et al., 1998). As gesture is considered to be under the umbrella of social stimuli, and as the two travel together in interactions, it is possible that children with ASD also disprefer motionese in addition to motherese, as both are highly social phenomena used in communication. A failure to attend to motherese and motionese means that children with ASD have less access to forms of speech and action that facilitate learning, therefore slowing learning down overall for these children. Future research should investigate whether children with ASD indeed have a tendency to disprefer

motionese, and if so, how to design interventions to make communication compelling and effective for children of varying learning abilities.

A second thing to consider with the “travel together” finding is that it does not reveal what degree of motherese and motionese is most advantageous for infants’ learning. Motherese and motionese are designed to capture infants’ attention, but this involves tradeoffs. When a caregiver is focusing an infant’s attention on one thing, they are automatically removing attention from something else. In other words, it should be expected that infants take away some information from interactions involving high levels of motherese and motionese, while simultaneously missing other information. This tradeoff should be considered when interpreting the result that motherese and motionese do travel together. Utilizing motherese and motionese together might be how caregivers tend to communicate, but that does not mean that is what is optimal for infants’ learning. Determining what levels of motherese and motionese best facilitate an infant’s learning is an exciting path for future research.

Regarding the second finding of this thesis, the extent that infant-directed modifications are more readily detectable in speech than in action is important when considering how infants learn. If infant-directedness is more pronounced in speech, then an infant’s ability to tune into speech is of paramount relevance for their development. It could be that infants might come to preferentially attend to speech because of its high degree of information and value to them. In other words, perhaps there is a developmental change in attention to modality on the infant’s part. Additionally, this result is notable as it suggests that parents might be emphasizing infant-directedness in their speech relative to their action. This tendency may be culturally driven, as perhaps infant-directed speech is something with which American parents are concerned. In other words, a differential between infant-directed modifications in speech and action might not

show up to the same degree in cultures that are less concerned with assisting in language development. The tendency to emphasize infant-directedness in speech relative to action could also be developmentally driven. Perhaps as infants get closer to producing speech, caregivers might further emphasize motherese. In fact, some evidence already exists for changes in caregivers' motherese modifications in the period between six and twelve months of age, just when infants are beginning to comprehend and then produce words (Kitamura & Burnham, 2003). Exploring further the degree to which caregivers' motherese might change with the age and linguistic ability of a child is an intriguing avenue for future research.

Conclusion

The present findings convincingly demonstrate that motherese and motionese tend to travel together. This effect is so strong that motherese and motionese emerge in tandem even when the interaction partner is an adult. Furthermore, we found no evidence to suggest that caregivers “trade-off” in their use of infant-directed speech and action. On the one hand, these findings make it seem plausible that motherese and motionese emerge from one-and-the-same underlying driver, which perhaps is an urge to exaggerate for purposes of communication. At the same time, other findings that emerged in the thesis suggest differences in how infant-directedness operates for speech and action. Altogether, our findings point to tight linkage between motherese and motionese as caregivers produce speech and action in their interactions with yet some noteworthy nuances in the details of how infant-directed communicative efforts are expressed in these two modalities.

Appendix A

Participant instructions for audio clips:



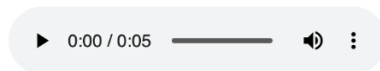
When speaking with infants, adults often use behaviors such as using simple words, speaking in a higher pitched voice, stretching out words, exaggerating pitch changes, and inserting extra enthusiasm.

For the following audio clips, you will be asked to rate – on a scale of 1 to 5 – how much the person is using these speech behaviors. You will also be asked to rate the extent to which it seems like this interaction is directed to an infant.

First, you will listen to example clips that are rated high and low in use of the above-described behaviors.

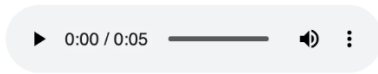


Please listen to the clip below. This clip would be rated **high** in the person's use of infant-directed speech behaviors. It represents a 5 on the scale. It would also be rated as **highly likely** that this interaction is directed toward an infant.





Please listen to the clip below. This clip would be rated **low** in the person's use of infant-directed speech behaviors. It represents a 1 on the scale. It would also be rated as **not likely** that this interaction is directed toward an infant.



Participant instructions for video clips:



When interacting with infants, adults often use behaviors such as using simple actions, demonstrating actions close to an interaction partner's body, making large-scale movements, exaggerating movement patterns, and inserting extra enthusiasm.

For the following video clips, you will be asked to rate – on a scale of 1 to 5 – how much the person is using these action behaviors. You will also be asked to rate the extent to which it seems like this interaction is directed to an infant.

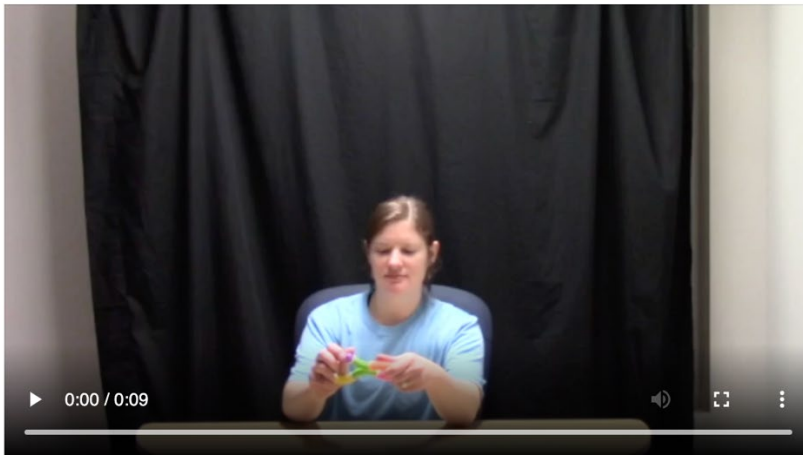
First, you will watch example clips that are rated high and low in use of the above-described behaviors.



Please view the clip below. This clip would be rated **high** in the person's use of infant-directed action behaviors. It represents a 5 on the scale. It would also be rated as **highly likely** that this interaction is directed toward an infant.



Please view the clip below. This clip would be rated **low** in the person's use of infant-directed action behaviors. It represents a 1 on the scale. It would also be rated as **not likely** that this interaction is directed toward an infant.



Appendix B

After listening to each audio clip, participants answered two questions:

1. To what extent is this person using infant-directed speech behaviors (e.g., using simple words, speaking in a higher pitched voice, stretching out words, exaggerating pitch changes, and inserting extra enthusiasm)?
 - 1 (Not at all)
 - 2
 - 3
 - 4
 - 5 (Very much)
2. To what extent does it seem like this interaction is directed to an infant?
 - 1 (Not at all)
 - 2
 - 3
 - 4
 - 5 (Very much)

After watching each video clip, participants answered two questions:

1. To what extent is this person using infant-directed action behaviors (e.g., using simple actions, demonstrating actions close to an interaction partner's body, making large-scale movements, exaggerating movement patterns, and inserting extra enthusiasm)?
 - 1 (Not at all)
 - 2
 - 3

- 4
 - 5 (Very much)
2. To what extent does it seem like this interaction is directed to an infant?
- 1 (Not at all)
 - 2
 - 3
 - 4
 - 5

References

- Baldwin, D. A., Baird, J. A., Saylor, M. M., & Clark, M. A. (2001). Infants parse dynamic action. *Child development*, 72(3), 708–717. <https://doi-org.libproxy.uoregon.edu/10.1111/1467-8624.00310>
- Baldwin, D. (2019). Kosie & Baldwin Video Corpus. *Databrary*.
- Brand, R. J., Baldwin, D. A., & Ashburn, L. A. (2002). Evidence for 'motionese': Modifications in mothers' infant-directed action. *Developmental Science*, 5(1), 72–83. <https://doi-org.libproxy.uoregon.edu/10.1111/1467-7687.00211>
- Brand, R. J., & Shallcross, W. L. (2008). Infants prefer motionese to adult-directed action. *Developmental Science*, 11(6), 853–861. <https://doi-org.libproxy.uoregon.edu/10.1111/j.1467-7687.2008.00734.x>
- Dawson, G., Meltzoff, A. N., Osterling, J., Rinaldi, J., & Brown, E. (1998). Children with Autism Fail To Orient to Naturally Occurring Social Stimuli. *Journal of Autism and Developmental Disorders*, 28(6), 479–485. <https://doi.org/10.1023/A:1026043926488>
- Ferguson, C. A. (1964). Baby talk in six languages. *American Anthropologist*, 66(6), 103–114. https://doi.org/10.1525/aa.1964.66.suppl_3.02a00060
- Fernald, A. (1985). Four-month-old infants prefer to listen to motherese. *Infant Behavior & Development*, 8(2), 181–195. [https://doi-org.libproxy.uoregon.edu/10.1016/S0163-6383\(85\)80005-9](https://doi-org.libproxy.uoregon.edu/10.1016/S0163-6383(85)80005-9)
- Fernald, A. (1989). Intonation and Communicative Intent in Mothers' Speech to Infants: Is the Melody the Message? *Child Development*, 60(6), 1497–1510. <https://doi.org/10.2307/1130938>
- Fernald, A. (1984). The perceptual, affective, and linguistic salience of mothers' speech to infants. *Infant Behavior and Development*, 7, 113. [https://doi.org/10.1016/s0163-6383\(84\)80175-7](https://doi.org/10.1016/s0163-6383(84)80175-7)
- Fernald, A., & Simon, T. (1984). Expanded intonation contours in mothers' speech to newborns. *Developmental Psychology*, 20(1), 104–113. <https://doi.org/10.1037/0012-1649.20.1.104>
- Fernald A., Taeschner, T., Dunn, J., Papousek, M., de Boysson-Bardies, B., & Fukui, I. (1989). A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants. *Journal of Child Language*, 16(3), 477–501. <https://doi.org/10.1017/S0305000900010679>
- Gogate, L. J., & Bahrick, L. (1998). Intersensory redundancy facilitates learning of arbitrary relations between vowel sounds and objects in seven-month-old infants. *Journal of Experimental Child Psychology*, 69(2), 133–149. <https://doi-org.libproxy.uoregon.edu/10.1006/jecp.1998.2438>

- Gogate, L. J., Bahrick, L. E., & Watson, J. D. (2000). A study of multimodal motherese: the role of temporal synchrony between verbal labels and gestures. *Child development*, 71(4), 878–894. <https://doi-org.libproxy.uoregon.edu/10.1111/1467-8624.00197>
- Goldin-Meadow, S. (1999). The role of gesture in communication and thinking. *Trends in Cognitive Sciences*, 3(11), 419–429. [https://doi.org/10.1016/s1364-6613\(99\)01397-2](https://doi.org/10.1016/s1364-6613(99)01397-2)
- Hilton, C. B., Moser, C. J., Bertolo, M., Lee-Rubin, H., Amir, D., Bainbridge, C. M., Simson, J., Knox, D., Glowacki, L., Alemu, E., Galbarczyk, A., Jasienska, G., Ross, C. T., Neff, M. B., Martin, A., Cirelli, L. K., Trehub, S. E., Song, J., Kim, M., ... Mehr, S. A. (2022). Acoustic regularities in infant-directed speech and song across cultures. *Nature Human Behaviour*, 6(11), 1545–1556. <https://doi.org/10.1038/s41562-022-01410-x>
- Iverson, J. M., Capirci, O., Longobardi, E., & Caselli, M. C. (1999). Gesturing in mother–child interactions. *Cognitive Development*, 14(1), 57–75. [https://doi-org.libproxy.uoregon.edu/10.1016/S0885-2014\(99\)80018-5](https://doi-org.libproxy.uoregon.edu/10.1016/S0885-2014(99)80018-5)
- Kemler Nelson, D. G., Hirsh-Pasek, K., Jusczyk, P. W., & Cassidy, K. W. (1989). How the prosodic cues in motherese might assist language learning. *Journal of Child Language*, 16(1), 55–68. <https://doi.org/10.1017/S030500090001343X>
- Kitamura, C., & Burnham, D. (2003). Pitch and Communicative Intent in Mother’s Speech: Adjustments for Age and Sex in the First Year. *Infancy*, 4(1), 85–110. https://doi.org/10.1207/S15327078IN0401_5
- Kosie, J. (2019). Pupillometry as a Window on the Role of Motionese in Infants’ Processing of Dynamic Activity [Doctoral dissertation, University of Oregon]. Scholars’ Bank.
- Koterba, E. A., & Iverson, J. M. (2009). Investigating motionese: The effect of infant-directed action on infants’ attention and object exploration. *Infant Behavior & Development*, 32(4), 437–444. <https://doi-org.libproxy.uoregon.edu/10.1016/j.infbeh.2009.07.003>
- Kuhl, P. K. (2004). Early language acquisition: cracking the speech code. *Nature Reviews. Neuroscience*, 5(11), 831–843. <https://doi.org/10.1038/nrn1533>
- Kuhl, P.K., Coffey-Corina, S., Padden, D., & Dawson, G. (2005). Links between social and linguistic processing of speech in preschool children with autism: behavioral and electrophysiological measures. *Developmental Science*, 8(1), F1–F12. <https://doi.org/10.1111/j.1467-7687.2004.00384.x>
- Levine, D., Buchsbaum, D., Hirsh-Pasek, K., & Golinkoff, R. M. (2019). Finding events in a continuous world: A developmental account. *Developmental Psychobiology*, 61(3), 376–389. <https://doi.org/10.1002/dev.21804>
- Meyer, M., Hard, B., Brand, R.J., McGarvey, M., & Baldwin, D.A. (2011) Acoustic Packaging: Maternal Speech and Action Synchrony. *IEEE Transactions on Autonomous Mental Development*, 3(2), 154–162. doi:10.1109/TAMD.2010.2103941.

- Newport, E. L. (1975). *Motherese: The speech of mothers to young children*. Doctoral Dissertation.
- Sapir, E. (1921). *Language: An Introduction to the Study of Speech*. New York: Harcourt, Brace
- Shatz, M., & Gelman, R. (1973). The development of communication skills: Modifications in the speech of young children as a function of listener. *Monographs of the Society for Research in Child Development*, 38(5, Serial No 152), 1–37. <https://doi-org.libproxy.uoregon.edu/10.2307/1165783>
- Thiessen, E.D., Hill, E. A., & Saffran, J. R. (2005). Infant-Directed Speech Facilitates Word Segmentation. *Infancy*, 7(1), 53–71. https://doi.org/10.1207/s15327078in0701_5
- Weinstein, N., & Baldwin, D. (2022). Reification of infant-directed speech? Exploring assumptions shaping infant-directed speech research. *Culture & Psychology*, 0(0). <https://doi-org.libproxy.uoregon.edu/10.1177/1354067X221147683>
- Williamson, R. A., & Brand, R. J. (2014). Child-directed action promotes 2-year-olds' imitation. *Journal of Experimental Child Psychology*, 114, 119-126. <https://doi.org/10.1016/j.jecp.2013.08.005>