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”Putting the Baby Down”: The Role of
Physical Proximity in Mother-Infant
Vocal Communication

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“Putting the Baby Down”:
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Abstract

A new theory by anthropologist Dean Falk suggests that infant-directed speech (IDS) evolved in humans' hominin ancestors as a communication technique whereby foraging mothers could vocally keep in touch with infants out of their physical control. Crying is proposed also to have evolved at this time for infants to signal to their distant mothers the need to reestablish physical contact. To investigate the current potential effects of physical proximity and separation on mothers' IDS and infants' crying, a study comprised of a questionnaire on caregiving practices and an observation session with physical distance and physical proximity conditions was conducted with 10 mother-infant pairs. It was hypothesized that mothers' IDS would be more exaggerated (wider F0 range) while physically separated from their infants during the observation session in the lab. Also, mothers who spend more time in daily life physically separated from their infants were expected to exhibit more exaggerated IDS and to have infants who cry more than mothers who spend more time in physical contact with their infants. Though results did not reach significance, they showed trends in the expected directions, suggesting that further research of this sort might lend support to Falk's theory of why IDS originated as a linguistic phenomenon in the human species.

“Putting the Baby Down”:
The Role of Physical Proximity in
Mother-Infant Vocal Communication

Language is a unique capacity of humans that helps to set us apart from other animals. Not only do such higher cognitive functions and reasoning abilities define the human species, but so do some underrecognized basic characteristics like the mother-child relationship. Researchers in many academic fields are dedicated to discovering and understanding the nature of being human. Biologists, psychologists, sociologists, anthropologists, and linguists, for example, are concerned with both past and present aspects of humans’ physical composition, cognitive behavior, societal organization, and cultural constructs. Physical remains and artifacts that have become part of the fossil record of human development are used to comprehend how various aspects of humanness have undergone change or have remained the same from the past to the present. This fossil record provides clues about important advancements along the evolutionary timeline such as upright walking on two feet (bipedalism), tool technology, diet, religion, culture, and kinship.

However, the fossil record does not provide direct evidence concerning humans’ most significant innovation—language. Analogies to other species can be used to supplement indirect evidence from the fossil record, and though analogies are often useful, they are not straightforward because human language is far more complex than the communicative processes used by animals. Thus, little is known, but much is hypothesized, about the advent of humans’ linguistic ability.

A new hypothesis by anthropologist Dean Falk published in a target article for *Behavioral and Brain Sciences* entitled “Prelinguistic evolution in early hominins: Whence

motherese?” proposes a story of the development of human language focused on understanding the way mothers talk to infants. Falk (2004) sees the phenomenon of *motherese* or infant-directed speech (IDS), as the fundamental communicative function originated by humans’ hominin ancestors.

Though thousands of different languages have developed with sounds, words, and grammars specific to individual cultures, these languages seem to share certain universal features—linguistic commonalities found in all the world’s languages. IDS, which is recognized today as the sing-song, prosodic speech people instinctively use when talking to a baby, is one of these universal features of language. Universality suggests that some kind of genetic mechanisms are operative to make the behavior innate in the human species; innate behaviors, in turn, suggest an underlying evolutionary significance. If this significance can be elucidated by pieces of knowledge from various academic fields, then understanding the phenomenon of IDS can contribute to the formation of a fuller story about humans’ unique capacity for language.

That distinct cultures and linguistic societies actually share the same basic acoustic features that define IDS is evidence for its universality (see Fernald et al., 1989). Moreover, not only does IDS appear to be common to languages worldwide, but it also is employed by speakers of both sexes (Fernald et al.; Jacobson, Boersma, Fields, & Olson, 1983; Papousek, Papousek, & Haekel, 1987), and by speakers who have little experience with infants (Jacobson et al.). Thus IDS is not a feature of language that is taught and learned, either through cultural convention or parenting experience, but rather one that is inherent in the human species. People often think that IDS sounds silly or absurd—in fact, some parents make the conscious decision not to use it with their baby—but IDS must serve a purpose or it would not be found in such a wide variety of linguistic societies.

Although research has provided evidence for the universality of IDS and, therefore, implies evolutionary underpinnings with adaptive functions, the question remains as to when and why a special style of infant-directed vocalization entered humans' linguistic repertoire. Falk's (2004) "putting the baby down" hypothesis attributes the advent of IDS to the need for hominin mothers to vocally keep in touch with and to regulate the emotions and behaviors of infants out of their physical control.

This paper presents additional evidence supporting Falk's (2004) theory and considers how IDS as it is used today both poses more questions about, and is explained by, the implications of hominins' putting their babies down. Infant-directed vocalizations in other species also will be discussed, as well as evolutionary theory and human ancestral history, and current cross-cultural trends in IDS and childrearing. The context of these varied discussions will be the role that physical separation plays in vocal communication between mother and baby. Additionally, a study was conducted to observe how the time spent by mothers and infants in physical contact is related to mothers' IDS and infants' crying in individuals from a single, linguistically homogenous population.

Infant-Directed Speech: Qualities, Contexts, and Functions

In modern linguistic societies, when compared to adult-directed speech (ADS), IDS exhibits the following acoustic characteristics: higher mean fundamental frequency (F0), or pitch; higher F0 maximum and F0 minimum; wider F0 range, which is the difference between the F0 maximum and F0 minimum; shorter utterances; longer pauses; and more repetition of words or phrases as well as of prototypical forms of intonation contours (Garnica, 1977; Grieser & Kuhl, 1988; Fernald, 1992, 1994; Fernald et al., 1989; Fernald & Simon, 1984).

Today, these characteristic features of IDS are present in many languages, utterances by speakers of both sexes, and even the speech of people inexperienced with infants. IDS has been observed in languages including American English (Fernald et al., 1989; Garnica, 1977; Jacobson et al., 1983; Papousek et al., 1991); British English (Fernald et al.; Shute & Wheldall, 1989); German (Fernald et al.; Fernald & Simon, 1984; Papousek et al., 1987; Papousek & Papousek, 1991a; Papousek, Papousek, & Bornstein, 1985); French (Fernald et al.); Italian (Fernald et al.); Mandarin Chinese (Grieser & Kuhl, 1988; Papousek & Papousek, 1991a; Papousek & Papousek, 1991b); and Japanese (Fernald et al.; Masataka, 1991; Niwano & Sugai, 2002; Niwano & Sugai, 2003). Additionally, research has shown that males as well as females exhibit the characteristics of IDS while vocalizing to infants (Fernald et al., 1989; Jacobson et al., 1983; Papousek et al., 1985; Papousek et al., 1987). Hence, although females are traditionally infants' primary caregivers, IDS is not a linguistic tactic learned only by women, but a function of language instinctive in the species regardless of gender. Even non-parents who have little experience with infants adjust their speech in the same ways as mothers and fathers when talking to babies (Jacobson et al.).

Not only is IDS used by adults both across linguistic cultures and across sexes, but infants, in fact, prefer listening to IDS over ADS both when spoken in different languages and by males as well as females. In terms of infants' attentional (looking time) and affective responsiveness, IDS promotes greater response in infants than ADS, even when the IDS presented is in a nonnative language (Fernald, 1993; Werker, Pegg, & McLeod, 1994). Thus, the characteristics of IDS are salient to infants even when the phonological sounds of the language are unfamiliar, furthering the suggestion that IDS is a universal phenomenon.

Also, whether IDS is produced by a male or female speaker does not detract from its

appeal to infants. Males and females provide different acoustic signals in terms of F0—males generally have lower F0s relative to female speakers because of males' larger vocal tracts. Yet, infants prefer (i.e., they attend more (look longer) and show more positive affect) IDS utterances over ADS utterances made by both males and females (Werker & McLeod, 1989). Even though male speakers do not produce F0s as high as female speakers, infants recognize when a man's F0 has been raised in his IDS with respect to his typical ADS. These results indicate that infants appreciate the qualities of IDS not in terms of absolutes, but in relative terms comparing speakers' ADS characteristics to their IDS characteristics.

Why do male and female speakers across cultures use IDS today? Debates continue concerning whether, and in what ways, IDS might be beneficial for children's acquisition of language. Though the effects on acquisition are uncertain, one specific feature of IDS has apparent immediate advantages: the universal forms of intonation contours enable caregivers to regulate infants' affective state and to influence their behavior (Fernald, 1989, 1992, 1993, 1994; Papousek, Bornstein, Nuzzo, Papousek, & Symmes, 1990; Papousek et al., 1985; Papousek & Papousek, 1991a; Papousek & Papousek, 1991b). Because prelinguistic babies do not understand the meanings of the words and phrases in speech, the exaggerated prosody in IDS carries speakers' intended meaning.

Characteristic prosodic patterns in mothers' speech are elicited by the following four basic interaction contexts between mother and infant: attention, approval, prohibition, and comfort (Fernald, 1992, 1994). In general, vocalizations used by mothers to gain and hold infants' attention are characterized by a high mean F0 and a wide F0 range with variable contour shapes, though the shape is most often rising at the end of the utterance. Mothers' approval vocalizations also exhibit a high mean F0 and a wide F0 range, but they can be recognized by

their prominent bell-shaped rise/fall contour. Prohibition vocalizations have a low mean F0 and narrow F0 range, and have an overall short, sharp *staccato* quality. Comfort vocalizations are also produced with a low mean F0 and narrow F0 range, but they have a longer, less intense *legato* quality with falling contours.

These prosodic features of IDS most likely have roots in more primitive and deep-seated acoustic signals used similarly by various types of animals. Morton's (1977) idea, cited by Fernald (1994), is that

because they give the impression of larger body size, harsh, lower-frequency vocalizations have been selected for across species as signals in hostile interactions Conversely, the higher-frequency, tonal vocalizations used by many animals in fearful or friendly motivational states are effective in eliciting approach and support because they resemble the vocalizations of smaller, nonthreatening animals. (p. 413)

Therefore the context-specific qualities of IDS, for example, those characterizing prohibition and approval utterances, correspond to other species' vocalizations that are crucial for communicating emotion. The sounds of IDS, then, could very well have been evolved out of humans' ancestors' vocal repertoire consistent with that found in rest of the animal world.

For modern human infants, their preference for IDS appears to be based on the F0 patterns typical of mothers' speech. In a study by Fernald and Kuhl (1987), the lexical content (words) of the speech stimuli was eliminated, allowing the researchers to test the hypothesis that the intonation qualities of IDS alone are enough to elicit earlier findings of infants' preference for IDS over ADS. That is, when caregivers use IDS, prelinguistic infants, as one would expect, are attending to the prosody rather than to the words (to which they do not connect meanings). Results revealed that infants only showed significant preference to the F0 patterns, not the

duration or amplitude patterns found in IDS, suggesting that the prosodic melody is the most essential communicative feature of IDS.

Another later and more specific study (Papousek et al., 1990) demonstrated that infants respond differentially to prototypical approving and disapproving (prohibition) intonation patterns. Approving contours, independent of lexical content, increased infant preferential looking, whereas disapproving contours inhibited it. Furthermore, a study by Fernald (1993) found that even when infants are presented IDS vocalizations without the accompanying facial cues of the speaker, infants tend to respond with more positive affect (smiling) to approval vocalizations and with more negative affect (distress or frowning) to prohibition vocalizations.

That infants have such differential responses to IDS, but not ADS, reinforces the hypothesis that IDS, specifically, contains intonational information salient to infants. The universality of such information is confirmed by a study in which American infant subjects responded differentially to approvals and prohibitions regardless of whether the utterances were in unfamiliar languages (German and Italian) or in nonsense English and natural American English (Fernald, 1993).

Finally, Fernald (1989) found that adults, both experienced parents and those inexperienced with babies, could use prosodic cues to identify speakers' communicative intent with accuracy significantly higher for IDS than for ADS. Approval, attention, prohibition, and comfort vocalizations without lexical content were presented to the adult subjects in both IDS and ADS. Subjects could correctly categorize each type of vocalization with greater accuracy in IDS than in ADS, suggesting that "the melody carries the message in speech addressed to infants to a much greater extent than in speech addressed to adults" (Fernald, 1989, p. 1505). This study of adult responses verifies that communicative meaning expressed by context-specific intonation

patterns is more salient in IDS than it is in ADS.

The usefulness of IDS for communicating with prelinguistic infants through melodic messages is clear: babies who cannot understand the meanings of words and phrases can be alerted, praised, prohibited, or soothed simply based on unconditioned vocal stimuli. Caregivers thereby have a method for influencing infants' behavior and emotional affect before they acquire verbal skills and semantic understanding. Additionally, by the second-half of infants' first year of life, another function of IDS is emerging (Fernald, 1994): infants begin to recognize that speakers' utterances reflect their emotions, intentions, and motivations. Mothers' melodies no longer merely affect infants as unconditioned stimuli; rather, infants realize that other people have communicative goals reflecting their moods, needs, and wants.

Such early social training establishes the basis for communication and interaction with others later in life (Fernald, 1994). Infants who develop this social competence early on by learning to read their mothers' emotions are better prepared to court, reproduce, and parent successfully in the future, which is evolutionarily advantageous. This adaptive function of IDS—together with infants' predisposition to prefer IDS over ADS and the cross-language and cross-gender universality of IDS production—indicates that IDS has biological underpinnings and significance.

However, when and why IDS entered the human species' evolutionary timeline as a linguistic phenomenon is not known. Falk's (2004) "putting the baby down" hypothesis ventures to explain the development of IDS by *Homo sapiens'* hominin ancestors.

The "Putting the Baby Down" Hypothesis

Around the time of the transition from late australopithecine to early *Homo* beginning about 2.5 million years ago (Howells, 1997; Lewin, 1993; Parker, 2000), the upright posture and

bipedal locomotion characterizing hominins were traits continuing to evolve. Alongside these advancements came an emerging trend for increasingly larger brain size. The shift to uprightiness caused a change in the shape of pelvises, making them broader and shorter—effectively reshaping the birth canal in females. Because bigger brains made infants' heads too large to fit through the newly sized birth canal, infants had to be born earlier in the gestation period at a fairly undeveloped stage (see also Ragir, 1985; Small, 1998).

At this early developmental stage, infants were helpless and dependent, meaning they were not strong or coordinated enough to cling to their mothers as monkey and ape babies are able to do. Additionally, hairlessness was another trait evolving at this time, so clinging to a nearly vertical, hairless surface would have been difficult in its own right. Because of this loss of infants' clinging ability (see also Martin, 1995; Parker, 2000; Savage-Rumbaugh, 1994; Zihlman, 1981), hominin females thus had to carry their babies in their arms. Such dependent carriage, however, is a large energy drain on the mother. In order to conserve energy, while foraging for and processing food, hominin mothers had to put their babies down on the ground nearby. Hominin mothers essentially sacrificed constant physical proximity with their infants to gain foraging utility and efficiency.

“Putting the baby down” caused a separation between mother and infant that reduced the amount of physical contact and tactile control normally experienced by hominins' anthropoid (ape and monkey) predecessors whose infants could cling. Falk (2004) believes this separation led to the advent of two important characteristics of mother-infant communication: infant-directed vocalizations and crying (see also Parker, 2000; Savage-Rumbaugh, 1994; Small, 1998). Babies' cries served as signs of discomfort and the desire to reestablish physical contact with distant mothers; in turn, mothers used special prosodic utterances to keep in touch with, reassure,

and regulate the emotions of infants not in their direct physical care. In sum, Falk's (2004) "putting the baby down" hypothesis proposes that vocal signals produced by infants and mothers were developed as mechanisms to compensate for the reduction of physical contact caused by the evolution of bipedalism.

Supporting Evidence: Communication in Squirrel Monkeys

The plausibility of the "putting the baby down" hypothesis will be further supported if observation of other species also demonstrates that separation between a mother and her infant is an impetus for the use of special vocal communication. Although IDS is characterized as a uniquely human event, studies of the vocal behavior of squirrel monkeys suggest the existence of a form of mother-infant communication. This is not to say that monkeys exhibit IDS as it is defined in human language—monkeys do not, and neither do apes like common chimps or bonobos—but the circumstances in which squirrel monkeys use infant-directed calls resemble the circumstances Falk (2004) claims were the motivation for the development of IDS.

Adult squirrel monkeys (*Saimiri boliviensis peruviansis*) exhibit a unique infant-directed call with four different context-dependent variations related to situations involving dorsal contact, nursing, inspection, and retrieval (Biben, Symmes, & Bernhards, 1989; see also Symmes & Biben, 1992). Female squirrel monkeys use these variants of the caregiver call to differentially affect the infants with acoustic cues, much as human mothers do with IDS today.

More critically, another study of squirrel monkey communication (Biben, 1992; see also Symmes & Biben, 1992) shows that mothers vocalize very little to their infants during the early period when infants are always clinging to their mothers' backs. But it was seen that "maternal vocal behavior increased sharply with their offsprings' first forays off the back, when mothers began using long, elaborated caregiver calls to retrieve straying infants" (Biben, p. 86). Results

revealed a nearly five-fold increase in maternal vocalization from the 2 weeks before infants ventured off on their own to the 2 weeks right after the infants first broke dorsal contact.

From a study of wild squirrel monkeys in Peru (*Saimiri sciureus*) (Boinski & Mitchell, 1995) comes further evidence that caregiver calls are important for mothers to be able to communicate with their infants when physically separated. These squirrel monkeys were seen to use infant-directed vocalizations for coordinating nursing bouts with their infants. Again, mother-infant proximity appears to be the central issue concerning this form of vocal communication. Boinski and Mitchell observed that caregiver calls were produced in consistent ecological and spatial contexts: over 90 % of nursing bouts were vocally initiated while the mother was hidden under dense foliage and her infant was 5 to 10, and occasionally more than 15, meters away.

Also, this study, consistent with the one conducted by Biben (1992), found that by the time squirrel monkey infants are 3 or 4 months old and no longer regularly carried on their mothers' backs, caregiver calls are produced more frequently.

More directly connected to the "putting the baby down" hypothesis is the observation that "high foraging costs would probably accrue to both mother and infant if they maintained sufficiently close spatial proximity so that visual signals would be adequate to coordinate nursing bouts" (Boinski & Mitchell, 1995, p. 136). Hominin mothers had to put their babies down in order to accomplish productive foraging and thus needed to use vocal signals in lieu of physical or visual communication. Similarly, squirrel monkey mothers developed a caregiver call as a vocal way of keeping contact with their distant infants so that they could forage unimpeded.

Foraging needs have been demonstrated to cause changes in maternal care in squirrel monkeys (Lyons, Kim, Schatzbert, & Levine, 1998), just as Falk (2004) suggests such needs

affected hominins' mothering practices. Compared to other primates, squirrel monkeys, like humans, produce large infants relative to mothers' body size: 10-week old squirrel monkey infants are about one third of their mothers' size, and so, according to Lyons et al., as an infant grows larger, caretaking demands on the mother conflict with her other needs and interests like finding enough food for herself and her offspring.

In a study by Lyons et al. (1998), some squirrel monkeys were put in a High Demand (HD) foraging condition (food was scarcer and thus more difficult to find), while others were put in a Low Demand (LD) condition (food was more plentiful and accessible). In both conditions infants stopped being carried on their mothers' backs altogether by 17-weeks postpartum. But because of the high energy cost of toting such large infants, squirrel monkey mothers in the HD condition began this transition earlier as they stopped carrying their infants at significantly younger ages than mothers in the LD condition.

Thus, maternal foraging needs can have an impact on infant care: when it is burdensome for a mother to carry her baby while foraging, the mother is likely to put the baby down. Additionally, according to the studies presented earlier, when squirrel monkey infants are physically out of reach, mothers increase their utilization of special infant-directed vocal signals. Such behaviors lend precedence to Falk's (2004) analysis of the origination of IDS in humans' ancestral lineage. Like squirrel monkeys, hominin mothers also could have opted for vocal communication to keep in touch with their infants whom they put down while foraging.

Furthermore, Biben (1992) suggests that vocal interaction between mothers and infants could have intrinsic value:

Squirrel monkeys are one of the most vocal primate species and much of their vocal behavior consists of dialogues between affiliated animals, particularly females

(Symmes & Biben, 1988). Caregiver calls to newborns represent the earliest means of eliciting a social response, be it vocal or behavioral, and may initiate infants in the process of social interaction. (p. 91)

The function of infant-directed calls as social training for infant squirrel monkeys is similar to the suggestion by Fernald (1994), discussed earlier, that an adaptive function of IDS for human infants is the early development of social understanding.

Because squirrel monkeys are not humans' closest primate ancestors, mother infant communication in apes is also important to consider. Common chimpanzees and bonobos are actually observed to be very quiet animals with respect to infant-directed vocalizations. Instead, they tend to make use of an extensive repertoire of facial gestures to express emotional states (Falk, 2004). Like humans, though, chimp infants have a prolonged period of dependency, but chimps retain the ability to cling to their mothers for protection and travel, whereas human babies do not. Support for the "putting the baby down" hypothesis comes from the fact that chimp and bonobo mothers use *hoos* as infant-directed calls only when infants are off on their own, rather than when they are riding on their mothers' backs or clinging to their chests. As Falk (2004) asserts, "it is significant that one of the few circumstances under which chimpanzee mothers routinely produce ID vocalizations is in conjunction with foraging and travel" (p. 493). That is, chimp mothers separate from their infants when they need to search for food, and when the mothers must communicate with their distant infants, they use infant-directed calls, the *hoos*, to retrieve their infants in order to move on to a new location.

Evidence from primates including squirrel monkeys, chimps, and bonobos showing that mothers tend to adopt special vocalizations to use with distant infants conforms to Falk's (2004) proposal that IDS was developed to bridge the physical distance between foraging hominin

mothers and their babies. However, Falk does not explain why mothers today mainly use IDS in physically proximal, face-to-face situations with their infants. How did IDS evolve from a technique for communicating while separated to an innate, universal phenomenon occurring both in circumstances of physical closeness and physical distance?

Technology and Time: Baby Slings and the Baldwin Effect

One of the first non-lithic, or non-stone, tools to be invented by evolving hominins is proposed to be a kind of sling used to carry dependent infants (Ehrenberg, 1989; Parker, 2000; Zihlman, 1981). A tool such as a baby sling would essentially simulate infants' lost ability to cling to their mothers, allowing for the reestablishment of mother-infant proximity. But IDS would not have persisted in the species if slings took away the need for mothers to put their babies down while foraging, thereby eliminating the situation of physical removal suggested to be the catalyst for special infant-directed vocalizations.

Somehow by the time slings were used regularly by hominin mothers to reinstate physical contact, IDS must already have been proven to be advantageous and subsequently ingrained in mothers' caregiving practices. Instinctive use of IDS would mean that mothers did not cease their prosodic vocalizations in the absence of separation from their infants.

The Baldwin effect is an evolutionary theory that helps to explain how IDS could have become an inherent trait in the human species (Baldwin, 1896; Turney, 1996; Turney, Whitley, & Anderson, 1996). The basic claim of the Baldwin effect is that a behavior that was once learned can eventually become instinctive given sufficient time if the behavior increases fitness. The Baldwin effect is not the same as Lamarckian evolution: it does not maintain that behaviors acquired in a lifetime of learning by an individual are directly, genetically inherited by the next generation. The Baldwin effect is Darwinian in that it is committed to gradual change; there is

selective pressure in a stable environment for the evolution of instinctive behaviors because learning is expensive for the organism. In a changing environment, the ability to learn new and different behaviors is beneficial, but in a stable environment, an adaptive behavior that fills a niche is more valuable if it is innate because learning takes more time and energy.

As discussed previously, infant-directed vocalizations employed by mothers increase fitness because babies' affective states can be regulated. For instance, hominin mothers could soothe and quiet out-of-reach crying infants whose noise might otherwise attract the attention of predators in the area. Another suggested adaptive function of IDS is that babies use the prosodic cues to recognize their caregivers' emotions and intentions and thereby receive the social training that will lead to successful reproduction and parenting later in life. As the Baldwin effect allows, the valuable behavior of IDS learned by hominin mothers could have eventually worked its way into the set of adaptive traits passed on genetically from one generation to the next, causing the use of infant-directed vocalizations to be an instinctive action in the species.

By this reasoning, when baby slings finally experienced widespread usage, IDS already would have been encoded and so caregivers would have continued instinctually to use such speech in a proximal context just as they originally did under the circumstances of physical separation while foraging. IDS also currently must retain adaptive significance—likely including the emotional regulation, social training, and potential language-acquisition functions—allowing for its continuing presence in human language.

Caregiving Practices and Mother-Infant Communication Today

Though IDS is innate and universal, today, caregiving practices and mother-infant proximity vary across cultures. To generalize, mothers in Western societies spend more time physically separated from their infants than mothers in non-Western societies (Barr, 1999;

Hewlett & Lamb, 2002; Konner, 1976, 1977; LeVine et al., 1994; Lummaa, Vuorisalo, Barr, & Lehtonen, 1998; Small, 1998). The following discussion specifies the potential effects of mother-infant proximity on infants' crying and hypothesizes effects on mothers' vocalizations.

Hewlett and Lamb (2002) examined the differences between how often Aka infants are held, as part of an African foraging society, as opposed to how often Euro-American (EA) infants are held, as part of an upper middle-class industrial society. They found that Aka infants, who sleep with their parents (co-sleeping or sleep-sharing), are held or touched 99 % of the time in a 24-hour period, whereas EA infants, who sleep in a separate room in their own beds, are only held or touched 18 % of the time. LeVine et al. (1994) also compared an African group—the Gusii—to Americans—middle-class Bostonians. The Gusii practice co-sleeping and hold infants most of their waking hours, whereas the American mothers hold their babies significantly less over the infants' first 10 months. In fact, American mothers held their infants in less than one third of their observed interactions with babies 6 months and older. Like the Aka and the Gusii of Africa, the !Kung San hunter-gather tribe of the Kalahari desert also are known to carry their infants constantly, whether in their arms or in a sling (Barr, 1999; Lummaa et al., 1998). The sling in which !Kung San infants sit is nonrestrictive and located the mother's hip, providing passive and unbroken mother-infant contact that is noted by Konner (1976, 1977) to be twice the amount experienced by infants in industrialized cultures.

Although Japanese urban society is more Westernized and industrialized than the African cultures just discussed, Japanese caregiving parallels these foraging and hunter-gatherer societies in that parents are shown to be more proximal to their infants than Western, American parents. Mothers in Japan hold and carry their infants more, practice co-sleeping more regularly, and also are more likely to use snugglies (which are similar in function to slings) than strollers (Barratt,

Negayama, & Minami, 1993; Hewlett & Lamb, 2002; Rothbaum, Pott, Azuma, Miyake, & Weisz, 2000). Like Japanese infants, Korean infants, too, experience more contact with their caregivers than Western infants. Lee (1994) found that Korean infants spend only 8.3 % of their time alone and are carried about twice the amount of time per day as American babies, who were observed to spend 67.5 % of their time alone.

Proximity between caregivers and infants is an apparent factor related to infant crying. Experimental evidence (Hunziker & Barr, 1986) has shown that increasing the amount of infant carrying by 1.7 hours per day (from 2.7 to 4.4 hours per day) between the ages of 4 and 12 weeks results in a 43 % reduction in babies' total duration of crying per day.

Cross-cultural, anthropological evidence also demonstrates the connection between physical contact and crying. In societies where babies spend more time in physical contact with their mothers, they tend to cry less than babies in societies with greatly reduced mother-infant contact. Aka babies who are almost always held fuss and cry for less time than Euro-American babies who are held much less frequently (Hewlett & Lamb, 2002). Gusii infants' crying during a four-hour period was observed to be about half as frequent as the American infants' bouts (LeVine et al., 1994). Likewise, !Kung San babies have a reduced propensity to prolonged crying sessions, and cry half as long in duration as Dutch babies (Barr, Konner, Bakeman, & Adamson, 1991). Taken together, these findings reaffirm the idea that crying probably evolved as an adaptive mechanism for attracting the attention of a distant caregiver, signaling the need to reestablish physical contact.

Tellingly, *colicky* babies, who engage in inconsolable and prolonged crying bouts, are found only in Western societies. *Colic* is not a syndrome in non-Western societies where infants are physically proximal to their mothers, who tend to respond immediately to the first signs of

infants' discomfort or unhappiness (Barr, 1999; Lummaa et al., 1998; Small, 1998). Western caregiving, which regularly separates mother from infant, appears to put babies into a culturally-altered environment to which they have not biologically adapted, as infants still expect the perpetual physical care they became accustomed to millions of years ago (Small, 1998).

Across different societies today, culturally-determined caregiving practices cause mother-infant proximity and infant crying to vary, though in relation to each other. Because Falk's (2004) theory proposes that crying and mothers' vocalizations developed together for mother-infant communicative purposes, as there are variations in crying, there also might be cross-cultural differences in IDS. As demonstrated earlier, IDS as a universal phenomenon is remarkably consistent cross-linguistically in its contextual uses and its acoustic and prosodic characteristics. However, across diverse linguistic communities, certain differences do appear to be present when comparing mothers' vocalizations to their infants.

Generally, American mothers, who spend less proximal time with their babies, are more prone to attend vocally to infants compared to non-Western mothers, who spend more proximal time with their babies and attend more with touch or holding. According to LeVine et al. (1994), with Gusii mothers, "virtually all of their interaction with the babies includes holding or carrying, and they often respond to infant vocal or visual signals with physical contact rather than reciprocal talking or looking" (p. 198). American mothers, on the other hand, "seek to engage their infants in visual and verbal communication at a distance" (LeVine et al., p. 198). Similarly, in a study of Japanese and American face-to-face interaction between mothers and 3-month-old infants (Fogel, Toda, & Kawai, 1988), whereas Japanese mothers' engagements included more touching, American mothers used more vocalizations.

Concerning acoustic differences in IDS, studies have shown that speakers of Japanese (Fernald et al., 1989) and Mandarin Chinese (Papousek et al., 1991) do not expand their F0 range as much as American mothers do. In fact, a study by Masataka (1992) demonstrated that Japanese mothers only significantly exaggerated their utterances in terms of raising their F0 and widening their F0 range after two or three initial vocal attempts to attract infants' attention were unsuccessful. This difference between Japanese and American IDS is perhaps corroborated by findings in Fernald's (1993) study in which infants responded differentially to approval and prohibition vocalizations in English and nonsense English, and in two unfamiliar languages (German and Italian), but did respond in this manner to vocalizations in a third unfamiliar language—Japanese.

Fernald (1994) attributes the difference found in Japanese and American mothers' IDS to “culture-specific ‘display rules’ governing the public expression of emotion” (p. 399). That is, in Japanese culture, displaying emotion through exaggerated vocal or facial expression is less acceptable than in American culture, where such expressiveness is “not only tolerated but expected” (Fernald, p. 399). Though cultural norms and expectations probably do influence how mothers speak to infants, a connection between physical proximity and IDS (related to the apparent effects of mother-infant separation on infant crying) should also be considered. Perhaps because Japanese parents are more often in close physical proximity to their infants (Barratt et al., 1993; Hewlett & Lamb, 2002; Rothbaum et al., 2000), they do not exaggerate the intonation in their IDS as much as American parents, who are shown to be less proximal.

Perhaps the cultural acceptance of emotional expression is not the sole factor leading American mothers to use such extreme IDS. Maybe there is still some kind of instinctual compensation going on for the lack of physical contact with their infants. “Compensation” is

qualified because American mothers do not use IDS only during the time that they are physically separated from their infants, as it is proposed that hominin mothers did as compensation; there might, however, exist a residual notion that IDS bridges a gap between mothers and infants who spend time apart. Hence, mothers who spend more proximal time with their infants feel less of a need to attend to their babies using exaggerated speech because more physical attendance occurs, whereas mothers who spend less proximal time with their infants habitually make up for the reduced physical attendance with a heavy emphasis on prosodic vocal attendance.

Because cross-cultural differences in IDS exist, then differences in IDS among individuals within a single linguistic culture can also likely be found. Just looking at English-speaking mother-infant dyads in America, for example, mothers who spend more time in physical contact with their babies might be predicted to use more restricted prosody than mothers who spend less proximal time with their infants. Additionally, infants of mothers who spend more time in contact might cry less than infants of mothers who are less physically proximal.

Investigation of Mother-Infant Communication and Physical Context

To gain further knowledge of the links between mother-infant proximity, crying, and IDS, a study was designed to compare the acoustic quality of mothers' IDS in terms of F0 range to their self-reported number of hours spent in physical contact with their babies during a 24-hour day, as well as to the number of minutes or hours they perceive their babies cry during a 24-hour day. Mothers who spend more proximal time with their infants are hypothesized to use narrower F0 ranges in their IDS and to have infants who cry less than mothers who do not spend as much proximal time with their infants.

An observational component of the study was conducted to investigate whether acoustic changes in mothers' IDS would occur depending on whether mothers are in physical contact with

or physically separated from their infants. Acoustic measurements of mothers' IDS utterances including mean F0, F0 maximum, F0 minimum, and F0 range are hypothesized to be significantly exaggerated while mothers are physically separated from their infants as compared to while they are in physical contact. For example, mothers are proposed to widen their F0 ranges when they are not holding, touching, or carrying their infants with respect to their ranges exhibited when they are in physical contact with their infants.

In order to gain and hold their infants' attention or to praise their infants while they are physically out-of-reach, mothers might use more exaggerated IDS. Thus, mean F0, and F0 maximum, in addition to F0 range, are expected to be higher in the physical distance condition than in the physical proximity condition. F0 minimum, on the other hand, is more difficult to predict; it also might be higher in the physical distance condition if mothers' raise their pitch in general (higher F0 minimum is characteristic of IDS as compared to ADS, see Fernald et al., 1989), but it could be lower because a lower F0 minimum and a higher F0 maximum would contribute to an expectedly wider F0 range.

Method

Participants

Subjects were 10 mothers and their infants ranging in age from 2.5 months to 14 months (mean age = 7.4 months). All mothers were fluent English speakers and residents of Northfield, MN and surrounding areas. Participants were recruited from Northfield Public Library's Early Literacy Program, Mothers of Preschoolers (MOPS) mothers' group, and Carleton College. Mothers were a mix of stay-at-home moms, part-time workers, and full-time workers. All reported that they are their baby's primary caregiver, although some of the infants attended daycare. For participating, mothers were compensated by a \$15 gift certificate to Target.

Materials and Apparatus

A questionnaire on caregiving practices concerning mother-infant proximity and infant crying was given to participants (mothers) (see Appendix for complete questionnaire). Some questions irrelevant to the study were included so participants would not be able to guess the exact variables being examined. Examples of relevant questions on the questionnaire include:

1. Can you estimate how much total time your baby cries in 24-hours? (please circle)

15 min. 30 min. 45 min. 1 hr. 2 hr. 3 hr. 4 hr. 5 hr. 6 hr. more

2. Can you estimate how much total time you are in physical contact with your baby in 24 hours—holding, touching, or carrying? (please circle)

(Note: if appropriate, include time carrying your baby in a sling close to your body and/or time spent sleeping with your baby)

30 min. 1 hr. 2 hr. 3 hr. 4 hr. 5 hr. 6 hr. 7 hr. 8 hr. 9 hr. 10 hr.

11 hr. 12 hr. 13 hr. 14 hr. 15 hr. 16 hr. 17 hr. 18 hr. more

In the Developmental Psychology Lab at Carleton College, observation of mother-infant interaction and vocal communication required a Sony video camera, tripod, and wireless microphone. Baby toys and books were provided for use by the mother-infant dyads. Mothers also were allowed to bring their own baby carriers and toys.

Video-recordings of the observation sessions were edited on a Macintosh computer using iMovie and acoustic analyses of mothers' IDS utterances were done using a speech analysis program called Praat. Individual mothers' mean F0, F0 maximum, F0 minimum, and F0 range (mean F0 minimum subtracted from mean F0 maximum) were calculated for each of 20 infant-directed utterances.

Design and Procedure

During the lab sessions conducted separately with each mother-infant dyad, a warm-up period was initiated to discuss the goals of the study and to get acquainted with the mother and her infant. The mother was told that the study concerned child attachment and mother-infant proximity so that they would not be self-conscious of their vocalizations to their infants. Then the mother was given the questionnaire and asked to complete it before beginning the observation/recording period. Upon finishing the questionnaire, the mother was equipped with the wireless microphone, and the video camera located behind a two-way mirror was set to record the 20-minute session.

For 10 minutes, the mother was asked to interact with her infant while in physical proximity—holding, touching, or carrying. The mother was encouraged to use the toys and books provided to make the interaction as natural as possible as she would in her own home. For an additional 10 minutes, the mother was asked to interact with her infant while maintaining physical distance—not holding, touching, or carrying. The mother was told that if during this 10 minutes her infant became uncomfortable or cried, she was encouraged to try to comfort her baby without reestablishing physical contact. If the infant remained unhappy and the mother felt she needed to hold her child, the mother was not prohibited from doing so. The two 10-minute conditions (physical proximity and physical distance) were counterbalanced between participants so that half began the session in the physical proximity condition and the other half began the session in the physical distance condition.

Video recordings with included audio were made of each mother-infant dyad session. Video was employed to confirm the condition in which mothers' infant-directed utterances taken for analysis were used (physical proximity or physical distance). From the audio, 20 clear

instances (not mumbled, whispered, or obscured by the noise of the baby or a toy) of IDS for each mother were chosen to analyze using Praat. To get a representative sample of utterances, the first clear instance of IDS from each minute of the session was used for the analysis, resulting in 10 utterances from the physical proximity condition and 10 utterances from the physical distance condition.

Because F0 range is the most telling dependent variable in this study, prohibition and comfort utterances in mothers' IDS generally were not used for analysis because they are typically narrow in F0 range (Fernald, 1994). Thus, the utterances selected for analysis were restricted to the approval and attention utterances that exhibit wide, exaggerated F0 ranges and contours. This is why mothers were encouraged to use the toys and books provided during interaction with their infants. Mothers' utterances to themselves (asides), singing, reading the text of a book (though talking about the book was accepted), nonsense vocalizations, or imitations of babies' noises were excluded from the sample utterances.

Although 10 mother-infant dyads were observed, data from only 9 could be used for the analyses because the videotape from one session was defective. For each of these 9 mothers, mean F0, F0 maximum, F0 minimum, F0 range were found for each of the 20 utterances.

Results

Correlational Analyses

Three correlational analyses were designed to be run using mothers' self-reported data from the questionnaires and the calculated acoustic data collapsed over the two conditions in the lab. If the hypothesis is upheld that the amount of time mothers spend in physical contact with their infants is related to both the amount of time infants spend crying and the F0 range exhibited in mothers' IDS, results of the three correlations are expected as follows: (1) a negative

correlation between the number of hours mothers spend in physical contact with their infants in a 24-hour period and mothers' F0 ranges (mean F0 range for each mother from F0 ranges of 20 utterances collapsed over the physical proximity and physical distance conditions); (2) a negative correlation between the number of hours spent in physical contact and the number of minutes or hours that infants spend crying in a 24-hour period; (3) a positive correlation between mothers' F0 ranges and the number of minutes or hours infants spend crying.

Numerical information from the questionnaires revealed almost no individual variability in terms of amount of time in 24-hours estimated by mothers that their infants cry and amount of time in 24-hours estimated by mothers that they spend in physical contact with their infants. A greater range was expected to appear in the mothers' self-reported amount of time their babies spend crying, but nearly every mother reported that her infant cries either 15 or 30 minutes a day (see Table 1). Similarly, though it is unsurprising that in this sample of American mothers the amount of proximal time spent with infants is low, the majority of participants were not expected all to report the same number of hours. Almost every mother reported that she spends either exactly or near 3 hours a day in physical contact with her baby (see Table 2). This lack of variability, then, in terms of crying time and time in physical contact, precluded the three correlational tests planned at the outset of the study from being run.

To investigate the hypothesized relationship between the number of hours spent in physical contact and F0 range using another method, a between-subjects factor was added to the four repeated measures ANOVAs run on data from the recordings of mothers' IDS. While most of the mothers reported exactly or near 3 hours for the amount of time they spend in physical contact with their babies, two mothers reported 7 hours. The mothers were thus grouped as either 3-hour contact mothers or 7-hour contact mothers, and this factor was incorporated into

the analysis to see if there were any measurable differences between these two groups. The 3-hour contact mothers were hypothesized to use more exaggerated IDS (wider F0 ranges) than the 7-hour contact mothers. Although this between-subjects factor did not yield any significant results, it is worth noting that the 3-hour contact mothers did produce greater F0 range ($M = 234.72$ Hz, $SE = 14.46$) than the 7-hour contact mothers ($M = 212.08$ Hz, $SE = 27.04$), $F(1, 7) = .54, p = .48$.

Experimental Analyses

A repeated measures ANOVA for each measurement—mean F0, F0 maximum, F0 minimum, and F0 range—was designed to compare the means across mothers' utterances from the physical proximity condition to the means from the physical distance condition. If contact or separation from an infant does immediately influence the quality of mothers' IDS, utterances from the physical distance condition should yield exaggerated measures when compared to those from the physical proximity condition. No statistical significance was found for the ANOVAs run on the four acoustic measurements under consideration (mean F0, F0 maximum, F0 minimum, F0 range). However, results did show trends in the expected directions.

Mothers were hypothesized to raise their overall pitch—mean F0—when talking to their babies who were physically separated. As expected, the average mean F0 in the physical distance condition ($M = 258.59$ Hz, $SE = 18.17$) was increased as compared to the average mean F0 in the physical proximity condition ($M = 244.04$ Hz, $SE = 15.31$), though not significantly so, $F(1, 7) = 3.14, p = .12, d = .32$ (see Figure 1).

Like mothers' mean F0, their F0 maximum was hypothesized to be higher when physically separated from their infants than when in contact. The F0 maximum was, in fact, higher in the physical distance condition ($M = 381.65$ Hz, $SE = 25.43$) than in the physical

proximity condition ($M = 356.72$ Hz, $SE = 14.17$), but not at a significant level, $F(1, 7) = 2.34$, $p = .17$, $d = .27$ (see Figure 2).

The F0 minimum did not receive a definitive prediction. It either could have been higher in the physical distance condition, following the general predicted trend of an overall pitch increase, or it could have been lower, suggested by the idea of exaggerating acoustic characteristics. Results revealed the F0 minimum to be higher in the physical distance condition ($M = 151.77$ Hz, $SE = 12.56$) than in the physical proximity condition ($M = 140.41$ Hz, $SE = 7.65$), though the finding was not significant $F(1, 7) = 1.89$, $p = .21$, $d = .25$ (see Figure 3).

Finally, and perhaps most critically, mothers' F0 ranges (the most telling measure of the exaggeration of IDS) were hypothesized to be significantly wider in the context of physical separation than in that of physical contact. Conforming to the hypothesis, the F0 range in the physical distance condition ($M = 230.50$ Hz, $SE = 18.95$) was wider than the F0 range in the physical proximity condition ($M = 216.31$ Hz, $SE = 13.60$); but, again, this statistic did not reach a level of significance, $F(1, 7) = 1.36$, $p = .28$, $d = .21$ (see Figure 4).

Discussion

The results of the analyses conducted on four measurements of the acoustic quality of mothers' IDS utterances from the physical proximity condition and the physical distance condition were not significant, but did reveal trends in the expected directions. The mean F0, F0 maximum, F0 minimum, and F0 range all were greater in the physical distance condition than in the physical proximity condition. These findings suggest that mothers do exaggerate their speech when talking to their babies who are physically separated—their overall pitch is

increased, both their maximum and minimum pitches are higher, and the range from their minimum pitch to their maximum is wider.

In particular, the implications of the F0 minimum are slightly difficult to understand. The F0 minimum was found to be higher in the physical distance condition, which is to be expected if pitch is raised overall in this condition (shown by the mean F0 and F0 maximum measurements). However, the idea of a mother exaggerating her IDS might suggest that just as maximum pitches get higher, minimum pitches would get lower. Also, the F0 range is wider in the physical distance condition, which could be the result of the F0 maximum being higher and the F0 minimum being lower in the physical distance condition than in the physical proximity condition. That the F0 minimum was actually lower in the physical proximity condition might have had contributed to the F0 range measurement not reaching significance. If the F0 minimum had been lower in the physical distance condition, the resulting difference between the F0 maximum and F0 minimum would have been greater, leading to a wider F0 range.

Another possible explanation for the lack of significant results is that the effect sizes were small, meaning that a greater N would be necessary to detect the differences between groups. The sample size of this study was only 10 mothers, which was lowered to 9 for the analyses because of a defective videotape. More participants in a future study would be necessary to investigate whether the trends shown in this study might actually be significant differences.

Additionally, the circumstances of the interaction between mother and infant could have been a confounding factor. While in the physical proximity condition, mothers were touching, holding, or carrying their babies, but even while in the physical distance condition, they often were not much farther apart. Playing with their infants brought mothers close to their babies while offering or showing them toys—mothers' hands, feet, or bodies were frequently near to or

almost touching their babies. Thus the two conditions that were intended to be quite different circumstances, producing noticeably different interactions and vocalizations, were actually very similar when implemented in the lab.

Also, the ease with which mothers could control whether or not they were touching their babies was dependent on the age of the infant. Mothers could manipulate the distance between themselves and their infants who were not independently mobile (crawling, cruising, or walking) without difficulty, but this was much harder with older, more developed babies. Using babies of a more consistent, younger age, and somehow creating more distinct conditions of proximity and distance would be important changes to improve this study.

The best method of investigating mothers' vocalizations to their infants might be a natural observation of the pairs in their own homes. This way, mothers would not simply be playing with their infants in the forced conditions of proximity and distance, but would be interacting in a number of different ways as determined by whether or not they were in physical contact with their babies. A mother trying to appease a distant fussy infant while she is trying to cook dinner, for example, is a very different situation from a mother being asked to maintain a certain distance while playing with her infant in an observation lab.

That the majority of mothers in this study estimated a similarly low amount of time (concentrated around 15 to 30 minutes) their infants spend crying during a 24-hour period might be attributed to a self-selection bias: only mothers with relatively easy-going, happy babies chose to participate in the study, whereas mothers with fussier or *colicky* babies may have refrained. Such mothers either could have been too exhausted themselves to want to participate, or could have been too embarrassed or uncomfortable to bring their infants to a psychology experiment. If this study were to be repeated in the future, an effort would need to be made to

attract mothers with infants of all temperaments, including fussy babies or those with *colic*, in order to have participants who constituted a more representative sample of the population. Perhaps effective solutions would include recruiting from pediatricians' offices in addition to mothers' groups (where mothers of even-tempered babies might be self-selected for in the first place), and being explicit that fussy babies are welcome, or even desired, participants.

Why the mothers were so consistent in their estimations of how much time (concentrated around 3 hours) they spend in physical contact with their infants is uncertain. The mothers were a mix of stay-at-home moms and working moms, and for even that one reason it is surprising that there was not greater variability in the self-reported number of hours. And although the self-reported low amount of time their infants cry might suggest that the mothers were trying to please or impress the researcher, the same cannot be said for self-reporting a low amount of time spent in physical contact.

That the mothers reported spending about only 12.5 % of the day physically proximal to their babies is not entirely remarkable, however, as research has shown that American babies are not touched or held much, especially compared to non-industrialized African societies (Hewlett & Lamb, 2002; LeVine et al., 1994) and other non-Western areas like Korea (Lee, 1994).

This study had the potential to demonstrate that physical closeness and physical separation are, in fact, related to mother-infant vocal communication. Past literature has shown that an increased amount of physical contact between mother and infant is linked to a decreased amount of infant crying (see Barr, Konner, Bakeman, & Adamson, 1991; Hewlett & Lamb, 2002; Hunziker & Barr, 1986, LeVine et al., 1994). Also, though not directly or explicitly, cross-cultural literature on IDS paired with cross-cultural literature on caregiving practices suggests that mothers who spend more time in physical contact with their infants do not

exaggerate their prosodic vocalizations to their infants as much as mothers who are less proximal (see Fernald et al., 1989; Masataka, 1992; Papousek et al., 1991). This study was designed to investigate whether these connections also can be observed in individuals from the same linguistically and culturally homogeneous society.

Because there was insufficient variance in participants' self-reported data concerning infant crying and mother-infant physical contact, tests could not be conducted to compare these two variables to each other, as well as each to mothers' observed F0 ranges. Hopefully, improved methodology in a future study would enable such analyses. The analyses of mothers' mean F0, F0 maximum, F0 minimum, and F0 range did not yield significant results, but did suggest that IDS utterances are more acoustically extreme in circumstances of physical separation between mother and baby. Given a larger sample size, better distinctions between proximity and distance, and perhaps a more natural observation setting, the trends found in this study might be shown to be significant differences.

Conclusions

Falk's (2004) "putting the baby down" hypothesis will be further supported if future studies are able to demonstrate either the general tendency for mothers who spend less time in physical contact with their babies to use more exaggerated IDS, or the immediate adjustment in mothers' prosody based on whether they are physically proximal or physically distant from their babies. Additionally, future research should investigate correlations linking babies who cry for more time per day to mothers who are less physically proximal and to mothers who use more exaggerated F0 ranges in their IDS. Such evidence would help to strengthen the argument that vocal communication between mother and infant (IDS and crying) was, and perhaps still is, instigated by physical separation, whether in immediate or habitual circumstances.

The “putting the baby down” hypothesis is convincing within a greater context provided by studies of other species like squirrel monkeys and by anthropological and sociological analyses of caregiving styles in non-Western and Western societies. Researchers will never definitively know why or when IDS developed as a universal linguistic phenomenon in the human species, but Falk’s (2004) theory is intriguing and promising, and deserving of further exploration. Humans desire to understand both what makes individuals unique and what makes all members of the species the same. Language, in its varying forms and universal qualities, incites these very curiosities about what it means to be human.

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Appendix
Participant Questionnaire

Your name (first and last): _____

Your baby's name: _____

Your baby's age (in months): _____

1. When you carry your baby, you prefer to use a: (please circle all that apply)

stroller baby/car seat sling snuggly backpack other

If you said 'other' please describe: _____

If you use more than one kind of carrier, when/in what circumstances do you use each?

2. Does your baby have siblings?

If so, how many? (please circle) 1 2 3 4 5 6 more

What ages?

3. Are you your baby's primary caregiver?

If not, who is? (husband, partner, nanny, extended family, etc.)

4. Which describes you best? (please circle)

stay-at-home mom

work part-time

work full-time

12. Can you estimate how much total time you are in physical contact with your baby in 24 hours—holding, touching, or carrying? (please circle)

(Note: if appropriate, include time carrying your baby in a sling close to your body and/or time spent sleeping with your baby)

30 min. 1 hr. 2 hr. 3 hr. 4 hr. 5 hr. 6 hr. 7 hr. 8 hr. 9 hr. 10 hr.
11 hr. 12 hr. 13 hr. 14 hr. 15 hr. 16 hr. 17 hr. 18 hr. more

13. Is reading an activity you and your baby enjoy together?

If so, how often? (please circle)

<i>frequently</i>	<i>sometimes</i>	<i>rarely</i>
<i>never</i>		
(at least once/day)	(a few times/week)	(a few times/month)

14. Do you and your baby attend a baby-group or mothers'-group regularly?

Table 1

Mothers' Reports of the Amount of Time their Infants Cry in 24 Hours

Infant Crying Time (in minutes)	15	30	45
Number of Mothers	5	4	1

Table 2

Mothers' Reports of the Amount of Time Spent in Physical Contact with their Infants in 24 Hours

Physical Contact Time (in hours)	2	3	4	7
Number of Mothers	1	6	1	2

Figure Captions

Figure 1. The average of mothers' mean F0s from the physical proximity condition compared to the average from the physical distance condition.

Figure 2. The average of mothers' F0 maximums from the physical proximity condition compared to the average from the physical distance condition.

Figure 3. The average of mothers' F0 minimums from the physical proximity condition compared to the average from the physical distance condition.

Figure 4. The average of mothers' F0 ranges from the physical proximity condition compared to the average from the physical distance condition.

Figure 1

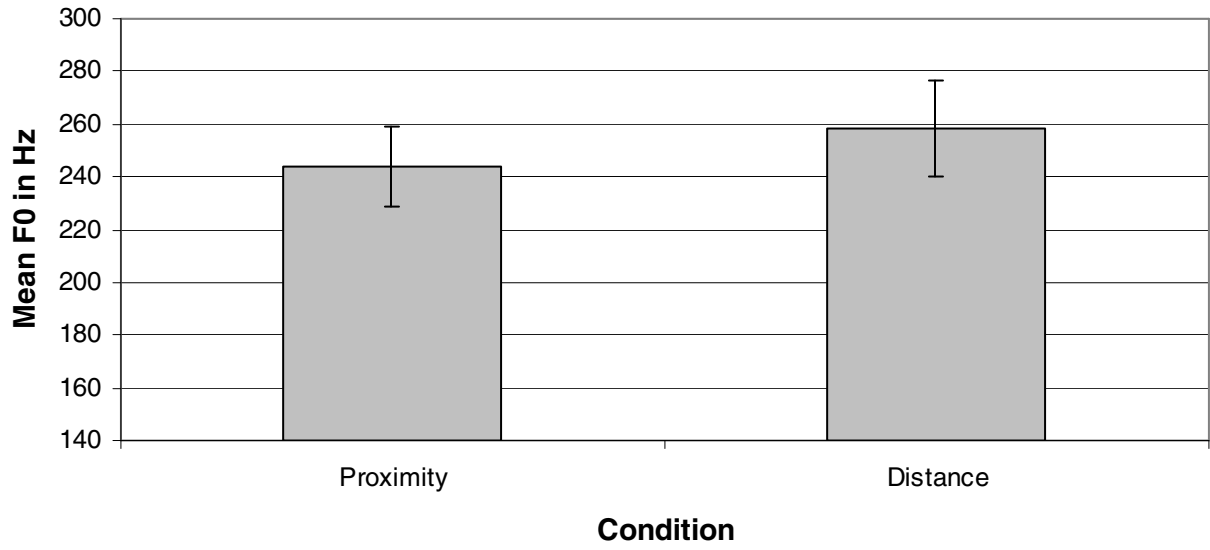


Figure 2

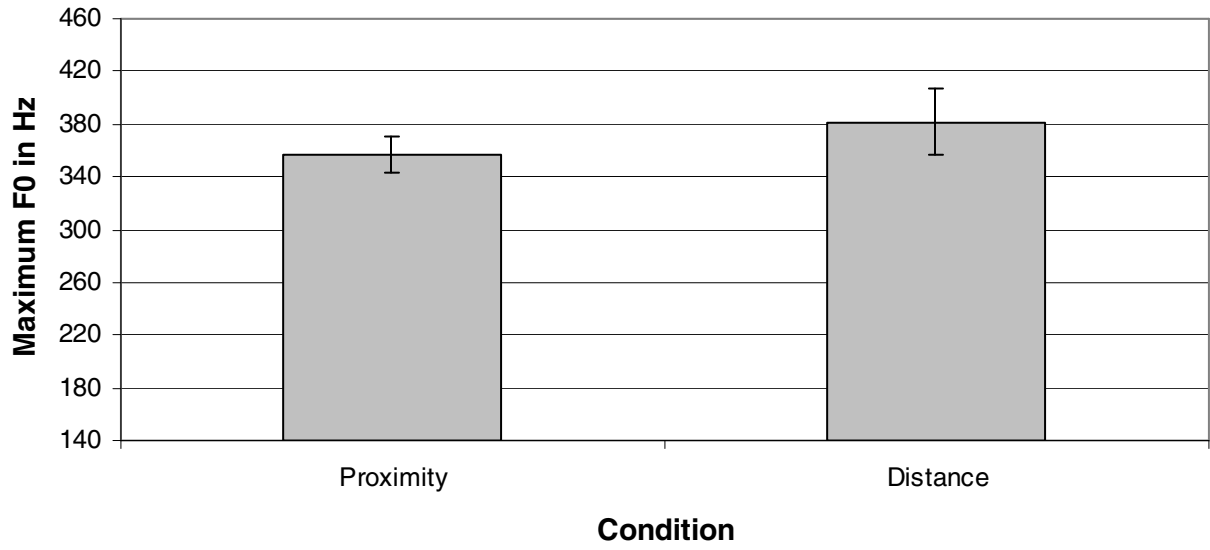


Figure 3

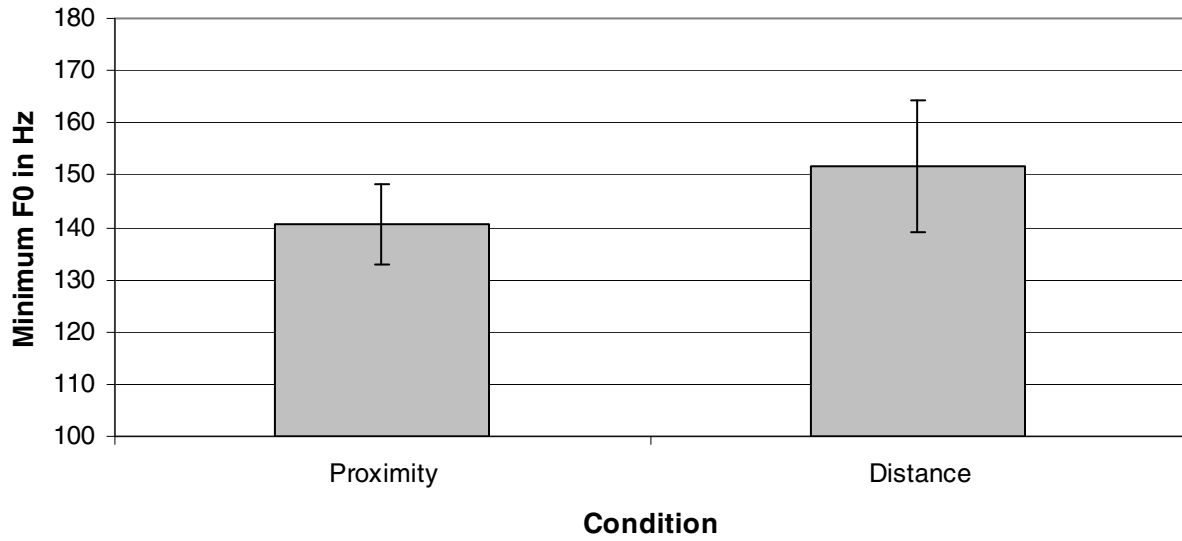


Figure 4

