Exploring infant engagement, language socialization and vocabulary development

Mastin, J.D.

Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

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Exploring Infant Engagement, Language Socialization & Vocabulary Development:
A Study of Rural and Urban Communities in Mozambique

Netherlands Organisation for Scientific Research

This research was supported with a VIDI grant from the Netherlands Organization for Scientific Research (NWO, grant number 276-70-018), for the project: "Cultural and social aspects of multimodal interactions in language acquisition."

TiCC Ph.D. series no. 31

ISBN: 978-94-6203-449-5

Printed by CPi Wöhrmann print service
Art direction and design by Didier García
Front cover photo by Didier García
Back cover photo by J. Douglas Mastin

Exploring Infant Engagement, Language Socialization & Vocabulary Development: A Study of Rural and Urban Communities in Mozambique

PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan Tilburg University
op gezag van de rector magnificus,
prof. dr. Ph. Eijlander,
in het openbaar te verdedigen ten overstaan van een
door het college voor promoties aangewezen commissie
in de aula van de Universiteit
op vrijdag 11 oktober 2013 om 10:15 uur

door

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geboren op 15 oktober 1981 te Dallas, Texas, Verenigde Staten

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Preface

This dissertation is the product of an abundant amount of support, determination, supervision, novel thinking, and hard work. The research presented herein was undertaken within a much larger research project – Cultural and social aspects of multimodal interactions in language acquisition (CASA MILA) – of which Dr. Paul Vogt is the primary investigator. He proposed that in order to create better computer models of language acquisition and language evolution required the application of real-world constraints. To address this issue required the collection and analysis of extensive naturalistic observation data of infants in three prototypical learning environments: the Netherlands, rural and urban Mozambique. The project aimed to address the categorization and analysis of infant engagement, the relation of gestures and non-verbal communication to language acquisition, the role that multi-party households play during infant socialization, the measurement of infant vocabulary size, and variations in child-directed speech styles.

In 2009, I was offered the first Ph.D. position on the CASA MILA project, and felt more than privileged to accept. I knew that this the perfect opportunity since my first Master's degree involved in-depth field research in Namibia, and my second focused on cognitive development within evolutionary linguistics. I saw the opportunity to continue my work within a specific scope of research, while still making fundamental contributions to multiple fields of study. In many respects this project was and is a huge undertaking, and those people associated with the group are not only part of it, but are *invested* in the research. From the early days of sharing a desk with Paul while looking at videos, we have grown to two offices with online desk assignment calendars. To date, 10 local research assistants in Mozambique, and 9 student assistants and researchers at Tilburg University have supported the CASA MILA project.

While there were many types of concrete data to focus on and analyze – such as gestures, speech or partner type – this dissertation looks more specifically at the underlying theory of infant engagement, cultural forms of infant socialization, and their relations with early vocabulary development in rural and urban Mozambique. This

shift occurred early in my research because it became apparent to both Paul and myself that an assessment of how engagement is analyzed and categorized was missing from the literature. This formed the foundation of Chapter 2. While trying to assess how to universally approach infant engagement and various engagement levels, I realized that a feature-based analysis of the components of engagement and attention allowed for a preliminary approach to standardizing engagement analysis. My novel application of *mutual interaction goals* as an overt component of engagement showed that a more extensive categorization of infant engagement existed, and the experiment presented in Appendix 6 shows that engagement level coding could one day be reduced to goal-oriented judgments only. In applying this extended categorization to naturalistic observation data from Mozambique allowed me in Chapter 4 to extensively analyze the proportional distribution of various engagement levels across development. In Chapter 5, I analyze the relations between these engagement levels' distributions and infants' reported vocabulary scores. Finally, I provide a concrete data analysis of the distribution of infants' engagements with various individual communication partners as well as with groups. This analysis allows me to look more deeply into the construction and style of infant socialization during early development, as well as how caregiving systems and beliefs about infant development may affect word learning and language acquisition.

Without the assistance and help of different organizations and individuals, this dissertation would not have been possible. I must express my gratitude and recognize the following organizations: Netherlands Organization for Scientific Research (NWO); Tilburg Center for Communication and Cognition (TiCC); Department of Communication and Information Sciences (DCI); Tilburg School of Humanities (TSH); Tilburg University (TiU); Wona Sanana; and Associação Communitário Ambiente da Mafalala. There are also a multitude of individuals who have played crucial roles in the completion of this dissertation and my research at Tilburg University, and they deserve personal acknowledgements (see page 295).

J. Douglas Mastin October 2013, Tilburg, the Netherlands

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Abbreviations

CASA MILA:	Cultural and Social Aspects of Multimodal Interactions in Language Acquisition
SES:	Social-economic status
HDI:	Human Development Index
MBCDI:	MacArthur-Bates Communicative Development Inventory
Passive-JA:	Passive Joint Attention
Shared-JA:	Shared Joint Attention
Coordinated-JA:	Coordinated Joint Attention
Age:	Age is represented in Years;Months(.Days) Example: 18 months and 4 days = 1;6.04

THE ROLE OF ENGAGEMENT

1.1. Introduction

A fundamental question of linguistics and developmental psychology is how infants first begin to engage in the social practices that make up their culture and also their language, which suggests that shared experience helps build cognition (Callaghan, Moll, Rakoczy, Warneken, Liszkowski, Behne, & Tomasello, 2011; Tomasello, Kruger & Ratner, 1993). These shared experiences are realized in different forms of engagement, where communication partners are able to facilitate the learning of symbols during goal-oriented social interactions (Hobson, 2000; Tomasello, 1995). Infants begin to improve their social interaction skills at around one year of age, and the emergence of vocabulary happens not long after, suggesting that the two are intertwined (Bates, Benigni, Bretherton, Camaioni, & Voltera, 1979; Bruner, 1981). In fact, language acquisition entails learning the socially appropriate ways to engage with others in culturally relevant activities (Garrett & Baquedano-Lopez, 2002). As Hoff (2006) points out, "all human environments meet the basic environmental prerequisites for language development, but different environments do so in different ways and to different degrees with consequences for the rate or course of language development" (p. 76).

Regardless of how language is approached, it cannot be denied that to learn a language requires an individual be exposed to the target language. It has been well established that the amounts of language an infant is exposed to significantly correlate with their vocabulary development (Hart & Risley, 1995; Pan, Rowe, Singer, & Snow, 2005). Yet other research has shown that this is also true for different types of infant social engagement, such as joint attention and social play (Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Childers, Vaughan, & Burquest, 2007; Dunham, Dunham, & Curwin, 1993; Markus, Mundy, Morales, Delgado, & Yale, 2000; Mundy & Gomes, 1998; Tomasello & Farrar, 1986), as well as the amount of child-directed gestures within social engagement (Iverson, Caprici, Longobardi, & Caselli, 1999; Rowe & Goldin-Meadow, 2009). Thus, not only is exposure to the target language important, but also exposure to other aspects of human interactions. In actuality, these

are all different multimodal aspects of strategies people use to engage others and interact in the environment. Since culture, social interactions, and goals each apply to different aspects of language acquisition, this suggests that how infants engage and are engaged by others, as well as how often this occurs, could relate to the universal potentials of language acquisition and vocabulary development.

One possible reason for why humans evolved specific word-learning strategies is because, in principle, the potential number of meanings of any individual word is almost infinite – something Quine (1960) labeled as *referential indeterminacy*. For instance, using a different example than Quine's *gavagai* example, imagine you are visiting a family in a foreign country where you do not know the language. When you arrive, a family member approaches you with a gift and says "Teka," but you do not know what they are saying. The expression of *teka* could have many different meanings – 'welcome' or 'a gift' or 'my name is Teka' – but you are yet unable to determine the specific referent of *teka*. However, the meaning may become clearer if the family member repeats *Teka* while extending the gift to you, looking at the gift, and then smiling. This allows the situation to be judged from different aspects using human-specific mechanisms for learning. Without using word-learning strategies that aim to reduce referential uncertainty, it would be a sheer impossibility to learn a human-sized vocabulary within a lifetime (Vogt, 2012). It is well established that humans, even with cognitive impairments, use a variety of word learning mechanisms simultaneously – cognitive, linguistic and social – to better understand what a word may signify (de Marchena, Eigsti, Worek, Ono, & Snedeker, 2011).

Cognitive mechanisms allow us to exclude potential referents or add preferences to others. The mutual exclusivity bias is one such cognitive mechanism, which assumes that only one word-label pertains to any object (Markman & Hutchinson, 1984; Markman & Wachtel, 1988). This means that if you encounter an unknown word when only two objects are present, and you already know one object's label, then by mutual exclusivity the novel word applies to the unknown object. Sentential cues, such as marking verbs by infinitives, "He wants <u>*to*</u> X," or marking nouns by articles, "He wants

the/an X," are types of linguistic mechanisms, which make use of information contained in the syntactic structure to guide attention towards a certain referent, be it an event or an entity (Gleitman, 1990). And social cues obtained through aspects of interactions with others, such as aligning joint attention or providing feedback, are also essential to establish common ground (Chouinard & Clark, 2003; Clark & Marshall, 1981; Tomasello, Carpenter, Call, Behne, & Moll, 2005). The combination and use of various word learning mechanisms and strategies are not only exclusive to each individual, but also each culture. Thus, by understanding how people engage with and are engaged by others, we are better able to understand not only how we interact with the environment, but also the specific aspects of human interactions that are most beneficial to acquiring language.

Applying these methods to the *Teka* example, allows us to overcome referential indeterminacy – cognitively you might realize that the word *teka* has an intended meaning in the environment that refers to either the family member, the gift, yourself, or some interaction of these; linguistically you might realize that *Teka* is more likely an object name or a request, rather than a question or a description; and socially, you might realize that *Teka* is an instruction based upon the family member's gesture of offering the gift, looking at it, and then smiling as a form of positive reinforcement. With enough exposure and interactions, you may eventually realize that *Teka* is the 2nd person singular, present tense verbal directive meaning '(you) take (this)'. Ultimately, any and all of these realizations only occur through some manifestation of engagement with the environment, which includes the family member and yourself. Therefore, any interaction that involves other communication partners can potentially result in a word-learning experience, and the more often these interactions can occur, based upon who is interacted with and how, then the greater likelihood of acquiring a language.

Much of what is known about word-learning strategies comes from studies focused on Western infants and interaction studies of industrial cultures. However, studies have already noted differences in culture's linguistic or infant socialization practices (Brown, 1998; Keller, Voelker, &Yovsi, 2005; Schieffelin & Ochs, 1986; Zukow-

Goldring, 2002), which in turn suggest that there are cultural differences in word-learning strategies. A number of studies have shown cultural differences in how infants engage others in play (Bornstein, Haynes, Pascual, Painter, & Galperín, 1999; Rogoff, 2003), and in the amount of triadic joint engagement (Chick, 2010; Gaskins, 2006). Yet, despite such differences, children in different traditional cultures acquire and develop language skills (Brown, 2011; Lieven & Stoll, 2010; Schieffelin & Ochs, 1986). This dissertation develops from the idea that it is interesting to see to what extent word-learning strategies are applied differently and how this affects word learning. Since cultural differences appear mainly in social constructs, it makes sense to start looking at the social word learning strategies, such as the types of engagement that occur, for how long, with whom, and the ways these interactions are coordinated.

One way to analyze this is to look at the different ways and amount of time that infants and others interact in different cultural settings. One would probably expect that how individuals interact with the environment might have a rather direct relation to the potential types and amount of words that can be learned. For example, in the previous *Teka* situation, the presence of a gift and the social cues delivered by the family member created joint attention between yourself and both other entities. This would allow for multiple possible meanings of *Teka*, but for only very concrete possibilities – most likely something to do with the object itself. However, if there was no gift, and the family member said *Teka* while looking at you without any accompanying gestures or social cues, the amount of concrete possible interpretations decreases in such a form of social (dyadic) engagement. Therefore, different types of engagement and how often they occur, either alone or in social interactions, could have a potential relationship to an infant's vocabulary development, and how individuals interact in different cultures would certainly affect this.

The general objective of this dissertation is to explore the potential of infant engagements in relation to vocabulary development, and investigate how infants' interact in an environment with communication partners of an extended family network in a non-industrial country. I approach this through a six-step process: First, I

assess how engagement is defined and categorized within the field of child development and language acquisition, and provide an extended categorization of infant engagement that resolves methodological biases. Second, natural observation data is collected of infants' activities in their home environments, as well as parental checklists pertaining to vocabulary size and general household information from different sites within rural and urban non-industrial communities in order to further the understanding of cross-cultural and intra-cultural differences in language acquisition. Third, I apply the extended categorization of engagement to this observation data to measure the proportions of time spent in all possible engagement levels. Fourth, I provide a correlation analysis of the proportion of time spent in different types of engagement with vocabulary development to assess the potential of different engagements in regard to language acquisition. Fifth, I assess the benefit of using natural observation data and an extended engagement level categorization by drawing descriptive comparisons to similar, though not identical, research studies using less broad engagement level classifications. Sixth, I provide a novel analysis of non-industrial infants' social networks, and the relation between engagement and specific communication partners and infants' vocabulary development.

1.2 Infant Engagement

This section focuses on how we understand engagement within the fields of child development and language acquisition, and specifically what aspects of infant engagement still require exploration and additional study. In Section 1.2.1, I offer a definition of what engagement refers to within this dissertation, as well as fully defining the different dependent aspects of engagement that are necessary for interactions. From here, Section 1.2.2 takes a preliminary look at how engagement has been analyzed within the research, and whether or not the current classifications of engagement categorization are complete in their current forms. Section 1.2.3 next turns to investigate how engagement occurs differently in various cultures, and shows that research of non-industrial cultures is highly under-represented in the literature,

which may account for some of the issues in regard to the extensiveness of engagement categorization. The way that infants are engaged and socialized in different cultures may relate to the way that they learn and develop their language skills, which is the focus of Section 1.2.4. In order to assess the relationship between engagement and vocabulary requires the collection of longitudinal data to assess developmental trends. Finally, in Section 1.2.5, I also begin to explore the differences between infants social network sizes across cultures, and the relationships that these networks could have on vocabulary development and language acquisition.

1.2.1 Defining Engagement

When the topic of engagement is discussed in this dissertation, it relates to an infant's engagement within their environment. As mentioned in the previous section, multiple studies have focused on different aspects and dynamics of infant engagement (Bakeman & Adamson, 1984; Carpenter & Liebal, 2011; Carpenter et al., 1998; Childers et al., 2007; Dunham et al., 1993; Gaffan, Martins, Healy, & Murray, 2009; Iverson et al., 1999; Markus et al., 2000; Mundy & Gomes, 1998; Rowe & Goldin-Meadow, 2009; Tomasello & Farrar, 1986) and each have provided slightly different definitions or provided a more detailed definition of a specific aspect of engagement. For this dissertation, I offer the following definitions, which are inspired by these multiple studies:

- *Engagement* involves the different and increasingly complex ways that an individual may choose to interact with and within their environment, which is made up of him/herself, other individuals, events, and objects (both animate and inanimate). Engagement can manifest through either solitary or joint engagement:

- *Solitary engagement* occurs when an individual does not interact with any other individual or group of individuals in the environment. The individual may observe others, interact with him/herself alone, or interact with only objects.

- *Joint engagement* occurs when an individual interacts with another individual or group of individuals in the environment, and their interaction may either include only themselves (*social dyadic engagement*) or also include a target (*triadic engagement*). All individuals in the interaction are aware that their focus of attention coincides with that of the other individual(s), via communication: verbal language, body language, coordination of eye gaze, or corresponding behaviors. This joint awareness allows for individuals to assess each other's goals and interact in goal-oriented engagement.

- A *target* is a specific object or event within a person's environment, and is attended to through direct manipulation, gaze association, physical gesturing, or verbal referencing. When an individual attends to a target then goal-oriented behavior is involved. If an object is a target in triadic engagement, then goal-oriented behavior must involve both the target and the other individual. Otherwise, if the attention to the object is not related to simultaneous attention to another individual in connection with goal-oriented behavior, then the object is not a target, and is considered secondary to the social goal-oriented behavior, even if it occurs in parallel.

- *Communication* refers to any and all actions that provide an indication that attention is shared between individuals, making it "mutually manifest or public" (Carpenter & Liebal, 2011, p.167), which can then alleviate much, though not all, of the doubt as to what each person is attending to and what their goals involve. Furthermore, what then underlies all human

communication is the strong motivation to share in one's attention and experiences (Carpenter, 2009; Carpenter & Liebal, 2011; Clark & Marshall, 1981; Tomasello et al., 2005).

- *Coordination of eye-gaze* occurs when an individual looks at another person's eyes to ascertain the focus of their attention, which is often to assure the individual that they are sharing visual attention to the same target. In addition, eye gaze can be used to adjust someone's attention to an external target by shifting gaze once coordinated focus on each other has been attained. This is considered an *explicit* action because it involves a direct shift in one person's attention to achieve a goal – redirecting someone's attention to share attention to an additional external target.

- *Corresponding behaviors* are considered to be appropriate reactions within an interaction. These are categorized separately from eye-gaze because the latter is an individual physical action, and corresponding behavior may occur with, in response to, or without coordination of eye-gaze. Corresponding behaviors are more explicit when accompanied by eye-gaze than when lacking eye-gaze. Some examples of corresponding behaviors in association with eye-gaze are: following directional eye-gaze pointing; emotional response (e.g., smiling); gestures that acknowledge joint focus (e.g., waving). Some examples where explicit eye-gaze is not necessary include – verbally responding to a request, taking something placed in front of you, finishing a song that someone else started singing, running ahead when pushed in a certain direction, shifting one's head in the general direction of someone's speech, or even pointing. Declarative gestures, like pointing, can occur with and without coordination of eye-gaze if there is already a shared context, since producing a gesture implies having an already existing goal of sharing attention with another individual (Carpenter & Liebal, 2011). Usually corresponding behaviors lacking

coordination of eye-gaze occur because an individual has enough implicit or contextual information that explicit eye-gaze is not necessary. One example could be if an infant is not facing the caregiver and a caregiver verbally asks an infant to play with a specific toy; the infant locates the toy in the environment, and begins to play with the toy without checking the caregiver's eye gaze. This reaction, the infant's choice to play with that toy, is considered an *implicit* corresponding behavior because responding to the verbal request implies that the infant understands another person is involved, and that person's goal is for the infant to play with that specific toy, without requiring checking the other person's attention for affirmation.

1.2.2 Analyzing Engagement

Engagement is a dynamic spectrum of attention, which naturally increases in complexity with the addition of objects, other communication partners, and goals. In principle, how individuals engage their environment relates to how and what they could create word-meaning mappings to. For example, if an individual does not interact with any part of their environment, neither people nor objects, then they would most likely not develop a symbolic communication system. If, however, an individual interacted with only people, but never objects, then one might expect that any emergent communication system would possibly concern aspects of social relations, the human body, and abstract concepts of thought and life. Furthermore, if an individual interacted with not only people, but also objects and the environment itself (more realistic), one would expect their communication system to involve many more referents, resulting in more complex engagement and wider linguistic variety. This process could carry on indefinitely – the more complex the environment, the more ways that an individual is able to interact with and learn from their environment, which extends into the social and cultural aspects of human society. It is therefore relevant to study and analyze engagement by its natural varying levels of complexity,

yet, to my knowledge, an assessment of engagement categorization has yet to be addressed in the literature.

One of the first studies to address engagement as a hierarchical spectrum of mutually exclusive categories was Bakeman and Adamson's (1984) study of infant's states of attention. They outlined the potential different engagement states of infants, the distribution of these engagements, and also patterns of engagement within simulated play interactions. The engagements they defined are: *Unengaged*; *Onlooking*; *Object* manipulation and play; *Person* engagement that are dyadic, social engagements excluding targets; and *Passive Joint Attention* and *Coordinated Joint Attention*, which are triadic engagements including targets. Various other studies took their work further and analyzed how aspects of engagement levels might affect or relate to infant vocabulary development. However, to my knowledge, Bakeman and Adamson's (1984) original categorization of engagement has not been assessed critically, and studies since then have used different aspects of this categorization of engagement, rather than its totality. Some research has focused on the construction and use of social engagement with infants and language learning, specifically in joint attention (Mundy & Gomes, 1998; Mundy and Newell, 2007; Tomasello & Todd, 1983). Other studies have also analyzed how these engagements, or their gestural components relate to infants' vocabulary development (Adamson, Bakeman & Deckner, 2004; Carpenter et al., 1998; Iverson et al., 1999; Rowe & Goldin-Meadow, 2009).

Typical of all these studies (Bakeman & Adamson, 1984; Carpenter et al., 1998; Morales et al., 2000; Mundy, Block, Delgado, Pomares, van Hecke & Parlade, 2007) is that they rely upon observation methods of data retrieval involving elicitation techniques (e.g., object-naming), simulated play instructions (e.g., mothers instructed to recreate normal play scenarios), or direct play instructions (e.g., mothers are instructed to play with their infants and the toys provided in coordinated tasks), which are all characteristics of *structured observation* methodology (Zechmeister, Shaughnessy, & Zechmeister, 2009). As previous research has collected data from the home environments of infants, and generally involves no intervention by the

researchers, this type of data has been considered *naturalistic* (e.g., Bakeman & Adamson, 1984; Childers et al., 2007). However, given the constrictions placed on the environment by the methods implemented by researchers, it is doubtful that that these data are naturalistic. In these studies, researchers may not intervene themselves, but, by applying instructions, novel toys, or suggesting play scenarios researchers place the parent in interactions which are pre-structured according to their goals and instructions. Therefore, we refer to this method as *semi-structured observation* (Eisenbeiss, 2009). In semi-structured observation, techniques used to elicit certain types of data can be as simple as the introduction of toys (Quay, 1995), to something more complex like the use of a controlled reference, such as a book (Mayer, 1969) or a film (Junker, 2008), to elicit certain types of engagement or speech (c.f., Eisenbeiss, 2010). In this way, semi-structured observation is different from naturalistic observation. The use of elicitation techniques runs the risk of collecting data in which particular levels of solitary engagement are underrepresented as well as to create a scenario where the caregivers' actions are to appease the researcher's goals.

Thus, an important starting point for my study is the conviction that these methods offer biased results as they underestimate the role of less active interaction behaviors (see Section 1.1). Both instructions and novel objects automatically result in the constraint of the environment and any potential engagement that can occur in the environment. This is not the same as *naturalistic observation*, where no interaction instructions are given to parents and observations rely upon what and who are regularly present in the infant's environment. Within a dynamic environment, an infant has a multitude of options from which to engage their attention, and some of those involve the infant in solitary engagement, such as being an observer or in object-oriented activities, both of which are not social engagement. In addition, dynamic environments offer the greater chance of interactions breaking down, goals being misunderstood, and interactions having detrimental effects, which semi-structured observation methods do not take into account. This could especially be true over early development, as infants are not very socially independent: either physically confined

while carried by the mother, geographically restricted in regard to designated play areas, or lacking knowledge of culturally specific social dynamics.

In summary, in natural settings an infant may certainly spend more time as an observer of distal social engagement than would the infant in a semi-structured research setting, where the infant is automatically the center of attention and actively enticed to interact with objects or people. Such differences between semi-structured and natural, dynamic environments imply that how engagement has been previously categorized may not be able to take into account all infant interactions in daily activities. Yet, within either setting, there are some identical components of infant engagement – the point of view or focus of attention of the infant, the attention of other external communication partners, whether or not objects are included in the interaction, and having a purpose or desire to interact with others. When the cultural and learning environments are stripped away from how we view infant engagement, these basic components of group dynamics become more prevalent. In order to capture the many layers of group dynamics within engagement requires an even more fine-grained, universal approach than this, which raises my first exploratory research question:

> **What engagement levels would emerge by analyzing engagement via the basic universal components of infant interactions?**

1.2.3 Engagement and Culture

Most studies on infant engagement and language acquisition have been carried out in Western, industrial societies, but it has become well documented that many non-industrial countries' cultures have different beliefs about and approaches to child rearing (Abels et al., 2005; Blount, 1972; Bornstein, 2010; Bornstein & Putnick, 2012; Brown, 2001; Brown, 2011; Childers et al., 2007; Gaskins, 2006; Harkness, 1977; Keller et al., 2005**;** LeVine et al., 1994; Lieven, 1994; Schieffelin & Ochs, 1986). It has also been observed that caregiving is affected by multiple sources of cognitive and socio-

emotional factors - personality, education, family members, culture, and media (Bornstein & Putnick, 2012). How people care for children, or the different potential for social interaction, will relate to how often children are spoken to and verbally engaged. Hart and Risley (1995) have shown this to be true – the higher the parents' socio-economic status (SES), the more words they tend to address to children, and the larger these children's vocabularies become. Hoff (2006) adds to this by pointing out that the characteristic SES-related differences in language use are amplified by differences in how parents choose to engage their children.

If most research focuses on high-SES industrial cultures, then what does this lead us to believe about developing countries with overall lower SES status? In addition, as the studies just mentioned have begun to look at differences between high-SES and low-SES communities in the same industrial cultures, what differentiations between communities should be made when analyzing developing countries? In regard to vocabulary development, the data available comes in forms of independent reports of various cultures. However, what is needed is a systematic analysis of the effect of culture itself (Hoff, 2006). Therefore, if socialization practices across cultures are not similar, I am left with the assumption that infants around the world may not be exposed to the same learning environments, which implies that infants may (be forced to) use different learning strategies. In turn, the use of different strategies in different environments would also predict differences in word learning and vocabulary development.

This raises the issues of both intra-cultural and cross-cultural differences in child rearing. If higher SES makes a significant difference (Hart & Risley, 1995), then studies of child language acquisition should rely upon more than one SES sample of the overall population. Without comparable communities, the results will only be able to provide information about one specific group, rather than understanding what makes individual communities unique or what universalities exist across cultures. As research has focused mostly on industrial cultures, it is necessary to complement this research with that of non-industrial cultures, and to also focus on different communities within

that non-industrial culture. Based upon Greenfield's (2009) and Keller's (2012) analyses of cultural universals and categorization, there are three prototypical cultural learning environments in modern human society: industrial urban communities, non-industrial urban communities, and non-industrial rural communities.

Generally, in industrial urban communities there are smaller household family sizes, social interactions are geared toward learning (e.g., object-naming and book reading tasks), parents' engagement styles are more focused on the child's attention and desires, and caregiving is child-centered. In the non-industrial rural community, infants grow up in larger household made up of extended family members of multiple generations, caregiving is more regularly provided by young siblings, and parents' caregiving is more situation-centered, revolving around social relations and household responsibilities. The difference between child-centered and situation-centered caregiving has typically been defined in terms of how parents and other caregivers speak to an infant when interacting with them (Schieffelin & Ochs, 1986). In child-centered communities, parents regularly address children as potential linguistic partners by engaging them in conversation and also simplifying speech from birth; whereas, in situation-centered communities, parents believe that children are responsible for their own language acquisition by observing speech and engagement of other partners, and thus children are only verbally interacted with once they have started to speak their first words. While this difference is directly related to the amount of child-directed speech, there are fundamental implications that parents in situation-centered communities have a different belief concerning infant's pre-linguistic cognitive abilities than those parents of child-centered communities. Due to this relationship between child-directed speech and infant cognition, the terms child-centered and situation-centered will have a broader reference in this dissertation to include communities' beliefs about caregiving and infant socialization.

The third prototypical learning environment – non-industrial urban communities – have similarities with both other prototypical learning environments, but possibly more with their rural counterpart. Since much of this population is recently migrated

from rural areas over the preceding two/three generations, this means that their cultural values still have strong ties to rural, traditional heritage (Keller, 2012). It is for these reasons that an understudied non-industrial country was selected from which to collect observational video data of both a rural and an urban community for an impartial exploratory analysis. By relying on video recordings of observations, more accurate details can be provided than from field observation notes, which traditionally note the number of occurrences of each interaction. However, while information regarding the occurrences of different types of engagement is useful, Tomasello and Todd (1983) showed that the longer engagement lasted, the more important the interaction was for cognitive development. Therefore, it is actually the *proportion* of time spent in engagement levels, rather than the number of occurrences, that are more informative for analysis of infant engagement. Based upon the above information, I raise my second research question:

> **What is the proportional distribution and development of infants' engagement levels in spontaneous, natural interactions in rural and urban non-industrial communities?**

1.2.4 Engagement and Longitudinal Vocabulary Development

Based upon the preceding sections, it should be clear that how often, with whom, and in what style individuals interact with their environment and other communication partners has great effects on cognitive development and word-learning. Researchers in language acquisition have regarded different types of joint attention as possibly essential prerequisites for language because the construction of these engagements requires the attention of an infant and a communication partner to be shared in some manner to a target, which greatly decreases the referential uncertainty of a word (Bruner, 1981; Dunham & Dunham, 1992; Tomasello & Todd, 1983; Tomasello & Farrar, 1986). It has since been established that one acceptable approach to understanding the relation between types of engagement and vocabulary development

is through a correlation analysis (Carpenter et al., 1998; Childers et al., 2007; Dunham et al., 1993; Markus et al., 2000; Morales et al., 2000; Mundy & Gomes, 1998).

However, taking the viewpoint of joint attention unaccompanied by any other type of engagement involves a Western bias toward object-naming activities, which may not be an applicable aspect of word-learning interactions in all cultures. Rather than analyzing correlations between the number of occurrences of specific engagement levels and vocabulary size, it is more informative and interesting to analyze correlations based upon the proportions of each possible type of engagement (Tomasello & Todd, 1983). In this approach, one is better able to judge the positive and negative potential relationship that the amount of time spent interacting in a certain manner has with vocabulary development. Furthermore, as engagement represents a spectrum of possibilities, there are possible effects across engagement level types, which an individual analysis would not be able to capture. In addition, since so much research has focused on different industrial communities, there is a need for analyses of non-industrial cultures and the effects of traditional views on infant caregiving.

In order to analyze the relation between the proportions of time spent in different types of engagement and vocabulary development, longitudinal data of at least infants' vocabulary sizes is required in order to understand the developmental relationship between engagement and word learning. One way to measure infants' vocabulary sizes, is via parental checklists: where parents provide information regarding what words their child speaks (expressive language), understands but does not speak (receptive language), or does not know. An accepted standard for parental checklists of vocabulary is the MacArthur-Bates Communicative Development Inventory (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994), which was originally created in English, and can (and has been) adapted into other languages as well. While video observations may provide direct information about child-directed speech, this is very situation specific, and cannot account for all possible verbal interactions that could occur on any given day. For these, and other reasons discussed in Chapter 2, a parental checklist was considered the best possible option given general research constraints. It also provides

for a standard comparison to be made across and within participants. This allows me to raise my third exploratory research question:

> **Do engagement levels' proportions from naturalistic observation data at infants' ages of 1;1, 1;5 and 2;1 have any significant relations to these infants' vocabulary scores at concurrent and subsequent collection periods?**

1.2.5 Social Networks of Infants: Nuclear versus Extended Families

Studies of infants in industrial societies rely predominantly on data analysis drawn from paired mother-infant interactions, and even in studies of non-industrial cultures only some have touched on other communication partner relationships – such as those of siblings, fathers, or other adults (Bakeman, Adamson, Konner, & Barr, 1990; Brown, 2011; Harkness, 1977; LeVine et al., 1994; Lieven, 1994; Zukow, 1989; Zukow-Goldring, 2002). Yet, is the normal developmental situation of a human infant to spend the first years of their life interacting with only the same one or two people? The nuclear family is a rather recent development when we look at the span of human cultural evolution. While primary caregivers are probably the main source of most input for infants, they are not the only communication partner that infants can overhear or are regularly interacting with, regardless of family size or culture. One should also assume that time spent interacting with peers, siblings, other adults, or groups, has some effect as well on language acquisition and socialization. For example, the use of daycare, preschool or nannies is quite normal for many families in urban industrial cultures. As Hoff (2006) points out, research on the effect of daycare or preschool consists primarily of descriptions of the interactions that occur and identification of the pragmatic skills such interactions require (e.g., Küntay & Senay, 2003; Pesco & Crago, 1996; Sheldon, 1996), but such studies have not analyzed the relation of these experiences to measures of language development.

Social practices surrounding children in many non-industrial countries' societies often differ substantially from industrial ones (Schieffelin & Ochs, 1986). Children of non-industrialized communities tend to grow up in relatively large families where multi-party interactions are more frequent than in industrial communities, and caregiving responsibilities are usually distributed among members of the extended family, such as siblings, aunts and grandmothers (Bakeman et al., 1990; Brown, 2011; Rabain-Jamin, Maynard & Greenfield, 2003; Zukow-Goldring, 2002). This alone causes me to question the role that peers and siblings play in the caregiving and cognitive/linguistic development of an infant. It could be that siblings are very effective at language socialization and that understanding child interactions can lead to a great deal of understanding culture (Zukow, 1989); or it may be instead that siblings are less able/willing to take an infant's perspective or give in to their wants, thus causing an infant to re-adapt their socialization system and possibly resulting in negative effects on the developmental process (Mannle & Tomasello, 1987). The fact that engagement with siblings could have drastically different effects on language development supports the notion that communication partners that are not the infant's mother can affect infant development in significant ways. One could expect that the type of communication partner (e.g., peers, siblings, adults) that an infant interacts with most frequently, second to their mother, would be the additional main source of external, community-based engagement and socialization. Specifically, therefore, the number and type of communication partners that an infant will interact with over development must be taken into consideration. Interacting with continually different people could cause various relations between specific interaction styles and vocabulary if an infant constantly has to adapt their social interaction style. Thus, my fourth exploratory research question concerns:

How do the different levels of joint engagement with different communication partners relate to vocabulary development?

1.3 The CASA MILA Project

The research presented in this dissertation is part of a larger project concerning the Cultural and Social Aspects of Multimodal Interactions in Language Acquisition (CASA MILA). The aim of the CASA MILA project is to investigate how aspects of children's non-verbal and verbal engagement during their second year of life affect their early learning of word-meaning mappings and vocabulary development. My research and analyses were completed under the supervision of, and close collaboration with, the primary investigator –Paul Vogt. Both he and I carried out all data collection and coding presented in this dissertation; data analysis that was primarily completed by Vogt is referenced and cited as his own where appropriate.

To provide a wide array of cultural and social backgrounds, three distinct prototypical cultural environments are necessary: industrialized urban, non-industrialized urban, non-industrialized rural (Keller, 2012). To fulfill this, two non-industrial sites were chosen in Mozambique, and the Netherlands was selected for the industrial urban site. This dissertation specifically concerns the analysis of the two non-industrial environments, in regard to engagement level proportions, infant social networks, and vocabulary development. In doing so, I am able to provide a novel and naturalistic analysis of infant engagement in a non-industrialized society. Due to the fact that field data analysis is a time consuming process, a comparative analysis with the Netherlands data is not possible as of yet, and thus falls outside the main scope of this dissertation.

Furthermore, by relying on naturalistic observation data, I am able to look at a much broader range of infant social dynamics – including not only how they interact at home, but also with whom, for how long and how often. In addition, the CASA MILA project analyzes the video data for multimodal aspects of engagement (e.g., gestures, speech, eye-gaze) and their relation to vocabulary development (Vogt & Mastin, 2013a; Vogt, Masson-Carro, & Mastin, 2013). Ultimately, analyses of these interactions' structures and relations with vocabulary development will be used in the construction

of various computer model studies which will simulate the observed behavior to investigate the socio-cognitive mechanisms underlying language acquisition (Vogt & Lieven, 2010; Vogt & Mastin, 2013b). With such exploratory research goals, the CASA MILA project provides an exemplary platform for me to assess the categorization of infant engagement and the various relations between infant engagement, infant social networks, and word learning.

1.4 Structure of Dissertation

Chapter 2 opens with the topic of engagement and how it has been categorized and analyzed in previous research on child development and language acquisition. My starting point was the suspicion that the range of engagement levels currently established in the literature was not complete because semi-structured observation methods have been applied to studying different aspects of infant engagement, thus constricting the range of engagement available for study. To address this, the first goal of this chapter is to provide a cross-cultural, theoretical framework covering infant engagement, language socialization, and vocabulary development. Finding additional limitations in how preceding studies have categorized infant engagement, the second goal is to implement a novel approach to engagement level analysis by presenting the individual, universal components of engagement and all the possible combinations of such components. By using a component-based analysis, the aim is to identify possible engagement categories that, to my knowledge, have not been extensively researched individually, or as part of a spectrum, in relation to vocabulary development.

Chapter 3 presents the methods applied for the breadth of data collection, data analysis, and both statistical and experimental verifications of coding methodologies. I first present information concerning the process of selecting and justifying the different cultural sites under analysis, as well as the demographic information of the participating families from both of the non-industrial communities. Next, an outline of the materials used during data collection is presented, including the adaptation of the parental checklist for vocabulary measurement. From here, I describe the procedures

used during the collection and compilation of longitudinal video data. Afterwards, how data analysis was carried out is presented – coding procedures of engagement categories and types of communication partners, tests of inter-rater agreement, and the statistics used to compare sites and distinguish correlations with vocabulary size.

Chapter 4 presents a range of results and discussions concerning the proportion of time infants spend in solitary and joint engagement. I present results concerning the proportions of time spent in engagement levels from the observational data as per my novel categorization, and the differences between rural and urban non-industrial communities. Since these communities are of the same overall culture, it could be expected that there would be similarities in the distribution of engagement levels. However, since the two non-industrial communities are considered different prototypical environments, I also expect significant differences to exist between the proportions of specific engagement levels, which are found. In general, infants in the rural area spend significantly more time in forms of solitary engagement at 1;1 and 1;5, whereas infants in the urban area spend significantly more time in forms of joint attention interactions at all ages. Next, the difference between using naturalistic observation data versus that retrieved by semi-structured observation methods are addressed (e.g., elicitation or simulation). Unfortunately, to my knowledge, there are no direct comparisons available for the results of engagement level proportions observed naturally in non-industrial communities. However, the semi-structured observation data presented by Bakeman and Adamson (1984), and that by Childers et al. (2007), provide close comparisons to industrial and non-industrial societies respectively. To facilitate a comparison, their engagement categories will be replicated. Until the CASA MILA project has finished analyzing the Dutch data, this offers the best possible comparison of methods across prototypical cultures. I aim to show, to some degree, that pure observational data provides drastically different results than either industrial or non-industrial studies using semi-structured observation methods.

Chapter 5 focuses on the correlations between proportions of time spent in engagement levels and vocabulary development. First, I present and discuss the

expressive vocabulary scores of the rural and urban infants from an adapted MacArthur-Bates Communicative Development Inventory parental checklist (Fenson et al., 1994). Infants in the urban area have significantly higher vocabularies at each data collection period, which may be a result of bilingualism, SES or community caregiving styles. I next present the results of correlations between engagement type and vocabulary development applying my own engagement categorization to the data of the two communities. Results from the rural community are rather different from the urban site, which shows some correlations similar to studies of industrial cultures, but not exactly the same. Specifically results show that dyadic social engagement has significant positive relations to vocabulary size in both non-industrial sites. However, triadic engagement has a positive relation to vocabulary in the urban site, while they reveal a negative relation to vocabulary in the rural site. A discussion of these results suggests that differences between communities may relate to daily lifestyle, infant social network, language socialization techniques, or a combination of all three factors. After this analysis, I assess the benefit of using an extended engagement level categorization. To do this, I apply the engagement categorizations from two previous studies (Carpenter et al., 1998; Childers et al., 2007) to my naturalistic observation data. The comparison shows how the removal or combination of unique engagements can limit and create inconsistent results, especially if the engagement levels combined have different relations to vocabulary development.

Chapter 6 addresses the dynamics of infants' social networks – which communication partners they interact with most frequently, what types of engagement with specific communication partners relate to word learning, and what impact multi-party engagement have on vocabulary development. As it was already discussed in Chapter 2 that different cultures have different styles of caregiving, the results between non-industrial sites presented in Chapters 4 and 5 led me to question the socialization processes and caregiving structures used in each community. This analysis of communication partners is novel and has no known comparisons in the literature. I provide both a distribution and a correlation analysis concerning different

communication partners, their actions, and the relation of these measurements to infants' vocabulary development. Results show that the caregiving structure of rural infants is less stable than that of the urban infants, which could be a possible explanation for the different correlation results in Chapter 5, and suggests that engagements at 1;1 are not necessarily suitable predictors for vocabulary development. Furthermore, the data suggests that rural Mozambican mothers seem to follow a different approach, where primary care is transferred from mothers to siblings – a caregiving structure that is more situation-centered than focused on the infant. However, Mozambican urban mothers implement a language socialization process where the community appears more child-centered and caregivers act as supervisors, supporting infant socialization.

In the final chapter, a summary of conclusions is presented and what benefits this dissertation lends to studies of infant engagement, intra-cultural differences, and language acquisition. Overall, as an exploratory study, my aim is to assess the potential of different types of infant engagement in regard to vocabulary development, and I provide four novel contributions to the field of child language acquisition in this process. First, I am able to show that by looking at the universal components of infant engagement, an extended version of infant engagement is possible, which can account for differences in active and passive goal-oriented behavior within categories of engagement. Second, I provide naturalistic observation data of a non-industrial country, Mozambique, where such a study has not been carried out previously. Third, rather than only looking at one community, I analyze field data from both a rural and an urban community within the non-industrial communities, which relate to two of the three types of prototypical learning environments (Keller, 2012). Fourth, I provide a novel analysis of the proportional distribution of infants' social networks in joint engagement within these non-industrial cultures, as well as their correlations to vocabulary development. Ultimately, I hope that the results and discussions in this dissertation provide the field of child language acquisition with the next building blocks to standardize studies of infant engagement and vocabulary development

across all cultural paradigms and child-rearing strategies. Only then can we begin to have a better, and more universal understanding of the cultural differences in different language teaching and language learning strategies.

ANALYZING INFANT ENGAGEMENT AND SOCIALIZATION

In this chapter, I explore the topic of infant engagement and language socialization, specifically the structure of categorizing engagement, and it's role within the field of language acquisition research. My main objective is to assess how engagement has been categorized in some of the major studies of infant engagement, in order to provide both a quantitative and qualitative analysis of all engagement levels and their individual relations to language acquisition. In Section 2.1, I will first argue in favor of naturalistic observation research methods, as opposed to semi-structured observation methods using either elicitation or simulation instructions. Next, an outline and review of some relevant studies on infant engagement is provided in Section 2.2, and shows that previous research results apply data collection methods that are biased toward industrial culture's expectations of interaction types and structured tasks that control the environment. This outline lays a broad foundation for the focus of Section 2.3: a microanalysis of the theoretical structure and categorization of engagement levels based upon the universal components of human interactions. By following this approach, novel engagement levels are identified that have not been fully addressed by child development research. Finally, in Section 2.4, I present different examples of cross-cultural and intra-cultural sociodemographics of infant caregiving taken from various observation studies, and relate these observations to different expectations of results for the analyses presented in this dissertation.

2.1 Naturalistic Observation Data versus Semi-structured Observation Data

Before discussing the relevant literature, it is necessary to make a few important remarks on the distinctions between *naturalistic* and *semi-structured* observation methods. Semi-structured data is not the same as naturalistic observation, it is actually a simulation, meaning that observations of how infants engage the environment only measure infants' *behavior* and *abilities* in restricted engagement – what infants can do and learn in simulated circumstances – not *how* they navigate and learn within their environment naturally (Eisenbeiss, 2009). Thus, if a research goal is geared toward

measuring abilities via semi-structured methods, then the data retrieved will involve the infant constantly under some form of social engagement or monitoring. This is especially true when methods exclude data for when an infant becomes upset or is disturbed by the research process. In the real world, we cannot assume that the infant is constantly involved in proactive, enjoyable social engagement. In naturalistic observation, engagement level categorization must also account for more passive and seemingly 'unproductive' engagement.

Engagement categorization has been largely based around semi-structured methods involving observation of simulated play or elicitation of joint engagement through regulated interactions and targets (Bakeman & Adamson , 1984; Carpenter et al., 1998; Childers et al., 2007; Gaffan et al., 2009; Morales et al., 2000; Mundy et al., 2007). Such methods result in 'active' engagement levels becoming more prominent in the data. This result mirrors the Hawthorne Effect (Landsberger, 1958), which is a form of reactivity, where participants adjust their behavior because they know that some aspect of their performance or abilities is under study. An example of this comes from Homans (1941), who looked into the effects of different working conditions in an electric company, and what changed in conditions would create the highest productivity. The workers from the company knew they were being studied and that the research focused on productivity. During the study, productivity always increased regardless of the different working conditions implemented. Thus, due to the social psychology of compliance, these workers' performance was based upon this knowledge of the desired outcome, which caused them to work harder and more productively, rather than the actual difference between conditions having an effect on productivity (Homans, 1941). Due to this type of effect, I will argue that using data from naturalistic observation in home environments is better suited for analyzing the potential of infant engagement, and more informative than semi-structured observation methods.

As most research has focused on industrial cultures, there could be cultural biases in how categorizing engagement has been approached. For example, joint attention is

generally mediated throughout the literature by the coordination of eye-gaze, which presumes that all cultures abide by the same social understanding of eye contact. This alone raises the point that how individuals interact within a certain environment is critical to understanding joint engagement. In Section 1.2.3, I discussed how an individual engages with an environment should relate to how they learn, what they learn, and from whom they learn (e.g., if an environment contained only people, and no objects, then vocabulary would be restricted to aspects of human bodies and culture). Yet semi-structured research methods restrict or dictate the type of environment by allocating who is present, what is involved and how interactions should be managed, thus fundamentally changing the language environment.

Furthermore, the relevant studies using semi-structured observation methods predominantly rely upon mother-infant pairs, and sometimes involve minor additions to this duo (e.g., peer, sibling, known researcher, or father). Research must account for engagement outside of this mother-infant pairing, as well as for subtle differences between communication partners. For example, siblings and other adults may not interact with infants in similar ways as their primary caregivers. Such circumstances could lead to engagement in which the infant is only an observer, or the interaction fails because of a communication partner's lesser desire for coordination. This is particularly true when applied to naturalistic observation research because children are constantly interacting with, and also observing, many interlocutors of varying degrees of competency and intimacy. For semi-structured observation, it is much harder to capture all of these differences. It is for these reasons I wonder whether or not engagement analyzed via semi-structured methods can be generalized to how infants interact socially and learn within their own everyday environments.

2.2 Previous Studies Extensively Analyzing Infant Engagement

Previous studies focusing on infant engagement have made groundbreaking steps for child language acquisition research. Some prominent examples include: Bruner's (1981) analysis of semantic, syntactic and pragmatic language acquisition; Tomasello and Todd's (1983) findings that following into an infant's pre-existing attention is most beneficial to word learning; and, Morales et al.'s (2000) study of how successful infants themselves are at initiating engagement with others. Various studies have also analyzed infants' usage of and responses to different aspects of infant engagement and interactions separately, and the relations of these with cognitive development in a diverse array of experiments and studies (Adamson et al., 2004; Bakeman & Adamson, 1984; Carpenter et al., 1998; Childers et al., 2007; Gaffan et al., 2009; Iverson et al. 1999; Mundy & Gomes, 1998; Mundy & Newell, 2007; Perra & Gattis, 2012; Tomasello & Todd, 1983).

At the hub of this infant engagement research is the study by Bakeman and Adamson (1984) concerning infants' coordination of attention to people and objects. While this study is not recent within the field, the categorization it implements has been widely accepted since its inception, and is still used in different variations in studies of infant engagement and social interactions (e.g., Adamson et al., 2004; Carpenter et al., 1998; Childers et al., 2007; Mundy et al., 2007; Perra & Gattis, 2012). It has since been assumed that the usage of triadic engagement levels, specifically with caregivers, is fundamental to language acquisition. In fact, studies have mainly focused on correlations between vocabulary size and the occurrence of triadic engagement levels through elicitation or simulated play, rather than all engagement levels (Adamson et al., 2004; Carpenter, 2009; Carpenter et al., 1998; Childers et al., 2007; Dunham et al., 1993; Markus et al., 2000; Morales et al., 2000; Mundy & Gomes, 1998; Tomasello & Farrar, 1986).

However, only a few of these studies have looked in depth at a wide range of infants' engagement and social interactions. Table 2.1 compares Bakeman and

Adamson's categories with the categories represented in three other studies, thus showing how classifying engagement levels has been changed and clustered in different ways. In general, the classifications since Bakeman and Adamson (1984) are less complete, and those categories that are still used are not treated the same, as seen by different category labels and definitions.

Table 2.1. Comparing Bakeman and Adamson's (1984) engagement level categorization with those of subsequent studies. Un-accentuated fonts represent the same levels or levels with different labels but same definition. Italic type represents levels similar to Bakeman and Adamson, but with a slightly different definition. Empty slots represent missing levels.

		Bakeman and Adamson	Gaffan et al.	Carpenter et al.	Childers et al.[1]
Engagement Levels	*Solitary*	Unengaged			*Low-Level Attention*
		Onlooking	*Adult Active*		
		Objects	*Infant Active*	Objects	*Mid-Level Attention*
	Dyadic	Persons		Persons	
	Joint *Triadic*	Passive Joint Attention	Both Active	*Attention Following*	*High-Level Attention*
		Coordinated Joint Attention	*Shared Attention*	*Joint Engagement**	
	Other			Imitation	
Age span		0;6 – 1;6	0;2 – 0;9	0;9 – 1;3	1;0 – 2;7
Sample Type		Industrial (USA)	Industrial (UK)	Industrial (USA)	Non-industrial (Nigeria)
Relation to vocabulary		No	No	Yes	Yes

Bakeman and Adamson (1984) analyzed how infants coordinate attention to both people and objects, and how this changes over early development between 0;6 and 1;6 years old. They focused on different *attention states* (i.e., engagement levels), which are

[1] Childers et al.'s study (2007) provides a comparative analysis to Bakeman and Adamson's (1984) six-level classification, but they collapse this into the tri-level analysis provided here for the majority of all data analysis and discussion.

"characterized in terms of the infant's engagement with objects and/or people in the environment … [and] have some duration" (p. 1281). Bakeman and Adamson collected data in infants' home environments over three scenarios: in the first condition the mother was instructed to simulate spontaneous play with her infant using the toys provided; in the second condition a known peer and the infant were placed together with the toys, excluding the mother; in the third condition, which was not included in analysis, the infant was left alone with the toys.

Bakeman and Adamson (1984) analyzed their video recordings based on six engagement levels, as seen in Table 2.1. The first three levels are states in which infants are in solitary engagement, either being *Unengaged*, *Onlooking* to other persons' activities, or manipulating *Objects*. The next three levels are all part of what I refer to as *joint* engagement levels (Section 1.2.2), but only with one possible partner at any time. The first type (*Persons* engagement) involves dyadic social engagement where the infant is engaged with another person. This engagement concerns a shared activity, but not an external target. An example of such a *Persons* engagement would be two individuals playing patty-cake or dancing together. When the engagements involve an external target, the infant engages in one of two types of triadic joint engagement: *Passive Joint Attention* (*Passive-JA*) or *Coordinated Joint Attention* (*Coordinated-JA*). Both involve the infant interacting with another person and both infant and partner share their attention to a third object or event. *Passive-JA* differs from *Coordinated-JA* in that only one of the partners is overtly aware through eye-gaze checking that there is an alignment in attention. Yet, in *Coordinated-JA* both partners are aware that they share the same focus of attention. An example would be if an infant is playing alone and someone introduces a new toy to the infant, who then plays with the toy. If the infant does not react to the other person in any way directly, but only to the target, then this interaction is *Passive-JA*. However, if the infant acknowledges or interacts directly with the other person, then this interaction is *Coordinated-JA*.

Bakeman and Adamson's (1984) categorization of engagement levels is certainly comprehensive; however, there are interaction types that might be added to or

segmented from their categories. The study is self-categorized as naturalistic because it occurred in the infants' home environments, but since the design of the study focused on infants abilities in coordinating attention to people/objects and parents were instructed to play with their child in a way that would evoke typical performances and interactions, it should be classified instead as a semi-structured observation study. As their engagement level definitions are based upon fashioned, active scenarios including persons or targets, they leave out scenarios in which the infant is a passive observer by default. Doing so presupposes that these types of engagement do not affect development, which is an assumption that cannot be made without further research. In regard to their results, Bakeman and Adamson (1984) show that, regardless of communication partner, dyadic *Person* engagement lessened with age, while triadic engagement between infants, a communication partner and a target object (i.e., *Coordinated-JA*) increased with age, and all other engagement levels remained more or less constant. Also, it was found that triadic joint engagement occurred more frequently with mothers than with peers. However, since mothers had been instructed to simulate spontaneous play with their infants, and all other conditions were left uninstructed, it seems reasonable that this difference in frequency would occur. This could suggest that while the mother condition is constrained, the peer condition represents slightly more free engagement as neither infant was the recipient of instructions or simulated play interactions. In addition, data from when the infant was left alone was excluded from the analysis, which could have misrepresented data on the amount of time spent *Onlooking* or *Unengaged*. Spending large amounts of time in solitary engagement could also effect development.

The other studies represented in Table 2.1 implement different categorizations, engagement level labels and definitions than Bakeman and Adamson (1984). Gaffan et al. (2009) researched whether individual variation in British infants' joint attention at nine months of age could be accounted for by differences in mothers' interactive style at earlier age points (0;2, 0;4, or 0;6). Results show that variation in an infant's use of joint attention at 0;9 was directly predicted by variation in maternal behavior at 0;6,

but not from earlier measurements of maternal behavior at 0;2 or 0;4. Such findings suggest that social learning models should take into account specific adult actions, and their coordination with infant actions. However, some limitations within their study must be addressed. Foremost, the data Gaffan et al. (2009) rely on was originally collected in the 1980s to analyze effects of mothers' postpartum depression on infant development (Murray, 1992). The methods and procedure were not originally tailored to measure types of infant engagement and language acquisition, but instead measured if mothers with depression may interact less or differently with their infant.

As to the categories used, Gaffan et al.'s (2009) levels were derived from two studies of infant language acquisition – Carpenter et al. (1998) and Mundy et al. (2007) – both of which rely in some manner on Bakeman and Adamson's original categorization (1984). In some cases Gaffan et al. (2009) use the same labels as Bakeman and Adamson (1984), but with a definition that is slightly different (see the italicized labels in Table 2.1). For example, the category *Adult Active* is similar to Bakeman and Adamson's (1984) engagement level of *Onlooking*, but Gaffan et al. (2009) only assigned this category when a partner is only actively involved with an object/event, but not when a partner is passive and not interacting with anything. This differentiation is based upon *detecting* a communicative partner's presence versus *observing* goal-oriented behavior involving a target, thus sharing in the focus of attention. "While overt manifestations make more transparent what the speaker is focused on and what the child is attending to, the child may not need to be overtly engaged with the speaker in order to discern the speaker's focus. In short, joint focus [i.e., *Adult Active* – attention to the same target, but infant not interacting with target] may be critical for learning early words, but mutual engagement [triadic engagement with a partner and an object] may not" (Akhtar & Gernsbacher, 2007, p. 197). This leads me to believe that *Adult Active* is probably an individual category, as well as beneficial for word learning. Yet the distinction between active and passive engagement has still not been fully addressed, and is discussed further in Section 2.4.

The other two studies in Table 2.1 not only analyze engagement levels, but also their correlations to infant's language acquisition over development: Carpenter et al.'s (1998) research on joint attention and infants' communication competence, and Childers et al.'s (2007) similar work with Nigerian infants and noun versus verb learning. Carpenter et al. (1998) analyze the ways that infants, between 0;9 and 1;3 years old, and their primary caregivers, *share* (Trevarthen & Hubley, 1978), *follow* (Scaife & Bruner, 1975) and *direct* (Bates, Camaioni, & Volterra, 1975) each other's attention. Specifically, they have shown that the age of onset of different joint attention skills predicts later vocabulary development, and that the frequencies of these different skills also correlate to vocabulary size. This restricted their analysis to active engagement involving objects and people, while ignoring some categories of solitary engagement (Table 2.1). In addition, they also analyzed instances of imitation, which do not fit into Bakeman and Adamson's (1984) categories. A separate category of imitation suggests in itself that additional engagement levels are present, already supporting the notion of a more extensive spectrum of engagement.

Carpenter et al. (1998), inspired by the theoretical perspective of Tomasello (1995), expanded Bakeman and Adamson's (1984) definition of joint attention to include infants' understanding of others as intentional agents: they have goals, they make choices of what behaviors attain said goals, and they choose what they attend to in pursuing these goals (Carpenter et al., 1998). However, their correlation analysis focused only on *Joint Engagement** involving objects and people. While children certainly learn during active engagement with others, this does not necessarily mean that time spent unengaged, observing, or interacting without target objects do not also affect or relate to word learning. As Rabain-Jamin et al. (2003) point out, children can have a great impact on their own development, and most manifestations of this, such as symbolic play, exclude adults and other instructional communication partners entirely. Just as Bakeman and Adamson's (1984) omission of solitary play skews the distribution of engagement level usage, Carpenter et al.'s focus on *only* goal-oriented categories of *Attention Following* and *Joint Engagement** could cause distortions in

analysis. As engagement is an increasingly complex hierarchy of interaction and attention, it is crucial to include *all* levels of engagement, social or not, in analysis.

Childers et al. (2007) provide an example of another semi-structured study, but in a non-industrial culture, which concerned joint attention and word learning of Ngas-speaking infants, between 1;0 and 2;7 years old, in Nigeria. Table 2.2 provides this comparison between industrial and non-industrial cultures percentage of time that infants spend in different levels of engagement in semi-structured observation studies. Childers et al. (2007) relied on Bakeman and Adamson's (1984) six-level engagement categorization *only* for their analysis of engagement distributions. All other analyses made in their study relied upon the three category classification presented in Table 2.1.

Table 2.2. Comparing percentages of time spent in engagement levels from the original results of Bakeman and Adamson's (1984) data at 1;3 from the Mother-only condition of USA infants, and the results from Childers et al.'s (2007) data at 1;2 of non-industrial infants using the same engagement level categorization. Data is presented as percentages based upon the full length of video data analyzed. (Adapted from Childers et al., 2007, Table 2, p. 214)

	Bakeman and Adamson (1984)	**Childers et al. (2007)**
Mean age of infants	1;3	1;2
Length of Data	~10 minutes	~15 minutes
Culture	Industrial	Non-Industrial
Unengaged	6.1	8.8
Onlooking	14.0	16.5
Objects	40.7	24.3
Persons	4.6	4.5
Passive-JA	23.1	18.8
Coordinated-JA	11.2	25.9

The data unfortunately do not provide a direct statistical comparison. Many percentages of time spent in engagements do not differ between cultures, yet there are two engagement levels that have drastically different measurements in each culture. First, there is 15% more *Objects* engagement in the industrial data than in the non-industrial data. Second, there is over twice as much *Coordinated-JA* in the non-

industrial data than in the industrial data. Both of these engagements involve the toys provided by researchers to allow for simulated naturalistic interactions. If we look at all engagement involving objects (*Objects* + *Passive-JA* + *Coordinated-JA*), then industrial infants interact with objects 75% of the time and non-industrial infants do so for 70% of the time. These are almost identical distributions for object-oriented engagements. It could be possible to assume then that the difference in *Coordinated-JA* and *Objects* relates to a greater desire for joint exploration of objects in the non-industrial culture than solitary object play in the industrial culture. As the toys introduced in the industrial study were not foreign to participants, whereas those in the non-industrial study were novel toys, this could explain a greater need for social exploration of the toys in the non-industrial culture than in the industrial culture. If industrial infants are already familiar with the type of toys provided, it is possible that they would prefer to play with the toys themselves than with their mother as well, especially if they already have developed a specific play routine with such a toy. In addition to these two differences, there is one similarity worth discussing – there is no difference between the mean amounts of time that infants spent interacting with other individually in *Persons* engagement. Bakeman and Adamson (1984) controlled for the number of people present (paired interactions), while Childers et al. (2007) allowed for any family members present to interact with an infant individuals or in groups (multiparty interactions). I can assume that controlling for the number of people present and interacting with the infant during semi-structured observation has little effect on the results, since the amount of time infants spent in *Persons* engagement was not culturally different, though instructions were identical.

In addition, Childers et al. (2007) introduced toys from an industrial culture to the non-industrial field site, some of which even frightened children. The provision of foreign toys can affect how infants would normally engage with objects – either causing greater amounts of interaction with the object or avoiding interaction with the object because they are an unnatural addition to the infants' environment. While one could argue that all aspects of an infant's environment might be new and unnatural at

some point, it is harder to justify the introduction of objects that would be new and unnatural for the entire population as being representative of normal, typical engagement. When conducting an observational study focusing on infant engagement and interaction techniques it is fundamental to remain sensitive to the culture and community involved (Gaskins, 2006; Hughes, Seidman, & Williams, 1993).

When applied to further analyses, such as relations to vocabulary development, Childers et al. (2007) no longer rely upon Bakeman and Adamson's (1984) categorization, but instead apply a different, collapsed categorization of engagement levels (i.e., the categorization as presented in Table 2.1). Specifically, they combine Bakeman and Adamson's engagement levels into *Low-level Attention* (*Unengaged* and *Onlooking*), *Mid-level Attention* (*Object* and *Persons*), and *High-level Joint Attention* (*Passive-JA* and *Coordinated-JA*). They justify these combinations because the engagement levels in each of the three levels are related, which they consider *methodologically reasonable*. However, all engagement levels are related in some way, and the combination of categories they present seems somewhat unnatural. Specifically, *Mid-level Attention* combines *Object* and *Person* engagement, which seems inappropriate since engagement with people is dyadic *and* joint, whereas object manipulation is not a joint interaction. Their results showed that *High-level Attention* occurred more frequently than less complex engagement. Yet, mothers had again been instructed to simulate play with their children, which could create a bias towards more *High-level Attention* than any other category. They found that only *Mid-level Attention* engagement (*Object* and *Persons* engagement) correlated with both noun and verb learning at different times. Also, Nigerian infants were found to learn relatively many verbs, which was explained as either due to the cultural aspects of their lives or the linguistic properties of the language these children learn.

In summary, there may be multiple biases present in previous research on infant engagement that can greatly affect the understanding of results if compounded within individual studies or accumulated across multiple comparative studies. One main issue that was found across studies was that studies predominantly rely on semi-structured

observation, which would increase the amount of active or social infant engagement elicited. The time infants spend observing, overhearing or imitating other interactions in their environment may also have important relations to language acquisition and social development. Studies also characterize a selected portion of whom infants may be able to interact with, which is an inappropriate representation of family structure and community networks. A direct byproduct of semi-structured observation methods is then the use of a selective representation of engagement levels or a manipulation of engagement level classifications, which provides a disproportionate representation of infant engagement with their social networks. Infants are surely not always actively involved in social engagement with others, so the exclusion of solitary engagement or the combination of solitary and dyadic engagement is not justified. Another bias was related to cultural issues – either the over-assumption that industrial cultures represent normal paradigms of infant socialization and the importance of environmental characteristics is diminished, or the methods were not culturally sensitive enough to the population.

2.3 A New Approach to Categorizing Engagement

Based upon the considerations raised above in the literature review, this section describes how engagement level categorization is constructed and used throughout this dissertation. Section 2.3.1 discusses engagement in terms of goal-oriented behavior – the reasons why individuals interact with others and targets within their environment. Section 2.3.2 breaks down engagement into its most basic components. Section 2.3.3 provides an analysis of all possible component combinations, resulting in an extension of Bakeman and Adamson's (1984) categorization.

2.3.1 Engagement as Goal-Oriented Behavior

The definition of engagement used in this dissertation (see Section 1.2.1; repeated below) allows for joint engagement to include dyadic social engagement, which only involve interactions between communication partners, and triadic engagement, which are the same but include a target object in addition to any partners.

- *Engagement* involves the different and increasingly complex ways that an individual may choose to interact with and within their environment, which is made up of him/herself, other individuals, events, and objects (both animate and inanimate). Engagement can manifest through either solitary or joint engagement:
    - *Solitary engagement* occurs when an individual does not interact with any other individual or group of individuals in the environment. The individual may observe others, interact with him/herself alone, or interact with only objects.
    - *Joint engagement* occurs when an individual interacts with another individual or group of individuals in the environment, and their interaction may either include only themselves (*social dyadic engagement*) or also include a target (*triadic engagement*). All individuals in the interaction are aware that their focus of attention coincides with that of the other individual(s), via communication: verbal language, body language, coordination of eye gaze, or corresponding behaviors. This joint awareness allows for individuals to assess each other's goals and interact in goal-oriented engagement.

There are three benefits to this definition. First, previous classifications of engagement (Section 2.2) have involved a separation of categories by differentiating

what makes up various interactions numerically by components, and not looking at how interactions are qualitatively different. For example, Childers et al.'s (2007) three-level classification was based upon the number of elements added to solitary engagement – infant alone, infant + one (object *or* partner), infant + two (object *and* partner). This differentiation does not distinguish between types, which seems inappropriate. For example, 'infant + one' includes engagements that is 'infant + object' and 'infant + partner' which entail very different types of engagement that do not seem comparable. It could easily be the case that the proportion of time spent in 'infant + one' engagement is mostly 'infant + object', which is difficult to relate to word learning since this is a form of solitary engagement, and there would be no speech from which infants could learn.

Second, an infant's 'coordination of attention' is generally represented in the literature only by checking a partner's eye-gaze. Instead, I broaden this coordination of attention to encompass all communication, including language and behavior, rather than only eye-gaze (Section 1.2.1). This addition was inspired by Barton and Tomasello's (1991) understanding of joint action (joint engagement) to include 'appropriate' responses. Infants certainly begin as novices in their social environment, and may need to readily ascertain their communication partner's focus of attention. However, I assume that cognitive processes in social engagement that regularly occur are eventually learned, thus not requiring an automatic and continual checking of a partner's attention. For example, people can readily recognize others they know by their clothes, the sound of their voice, and many other personal characteristics, without seeing this other person's face to know it was they. In turn, people are fairly good at ascertaining someone's focus of attention, without directly seeing their eye-gaze, based upon posture, head position, and other aspects of body language.

Third, the engagement categorizations used in previous research do not overtly address the issues of having and understanding goals within an interaction, which research in parallel fields, such as social psychology, has already brought to light (Bratman, 1992; Carpenter & Liebal, 2011; Tomasello, 1995, Tomasello et al., 2005).

This is most likely because goals are a rather special aspect of human engagement, and harder to objectively identify at times. Carpenter et al. (1998) begin to address this issue by including goal-oriented actions within joint attention in their interpretation of intentional agency. This is taken even further by Carpenter and Liebal (2011), who argue that both partners *knowing together* that they are in simultaneous attention is crucial (e.g., Hobson, 2005; Tomasello, 1995), and that this 'sharing' in mutual knowledge is what changes parallel attention into joint attention. "It is not knowing *together*; it is each knowing what the other knows at the same time, and that is not quite the same thing" (Carpenter & Liebal, 2011, p.167). A similar account on the belief that others also believe to be acting jointly has been stressed by Clark (1996). In fact, Carpenter and Liebal (2011) argue that because infants are able to turn away from something interesting in order to share this experience with someone else has the strong indication that what underlies social engagement is the motivation, or ultimate goal, to share attention. They claim that this "strongly supports the idea that the sharing of attention and interest is an important end in itself," (Carpenter & Liebal, p.163) which raises goals to an equal level with attention in the discussion of joint engagement. Since goals can now be considered an additional component of social engagement, it is appropriate to next look at all components of engagement and their relation to each other and to types of infant engagement and social interaction.

2.3.2 Universal Components of Engagement

The components within an interaction are made up of individuals and their focus of attention. As the differences between solitary and joint engagement are based upon the accumulation of partners, objects, and goals, then the natural hierarchical structure of engagement allows for a straightforward analysis. I approached this hierarchy from a functional analysis of engagement components based upon the different constructions of infants' solitary and social engagement. At the most complex, an engagement includes an infant, communication partner(s), target object/event, attention between interlocutors, shared attention towards the target, and individual or mutual goals. At

the least complex, an engagement will involve only an infant's presence. For engagement to occur, the infant's attention needs to be directed somewhere, and/or in alignment with the attention of a partner(s): either toward him/herself, the environment, a target, or a partner. From this perspective, five components of infant engagement emerge:

1. Infant Attends to Partner
2. Partner Attends to Infant
3. Infant Attends to Target
4. Partner Attends to Target
5. Mutual Interaction Goal

The first and second components involve the monitoring of attention between individuals via communication, which includes anything that checks or responds to someone's attention (Joint Engagement definition above). While 'partner' is listed as singular, this applies to pairs of partners and also to a group of partners. The third and fourth components involve the different individuals' attention towards a target external to the infant-partner dyad. This can be an inanimate object, an animal or person, an interaction between either of these, or an event that involves multiple combinations of targets. Attention to targets would minimally involve the visual acknowledgement, and maximally involve the physical manipulation of said objects.

The fifth component, a mutual interaction goal, is more complex than the other components, and may be specific to human cultural activities (Carpenter, 2009; Carpenter & Liebal, 2011; Tomasello et al., 2005). The reason it is more complex is because a mutual interaction goal is dependent on the presence of some or all of the four other components of attention. This component was first inspired by Tomasello et al.'s (2005) presentation of shared intentionality, which discusses both Gilbert's (1989) 'we' intentionality and Bratman's (1992) 'joint cooperative activities'. Their discussion covers intentions, goals, and plans of action, but more specifically looks at the interface of these between communication partners. For Tomasello et al. (2005), shared intentionality

> contains not only the self's goal … but also the self's goal that this be accomplished with the partner. One might simply say, then, that [the self's] goal concerns their mutual interactions … but we may better say that the actor wants his [partner] to have, along with him, the [same] goal … And of course the partner, assuming she also desires collaboration, also wants her partner to share her goal … [thus] there is a special kind of shared motivation in truly collaborative activities in the form of a shared goal. (p.680)

Based off of Bakeman and Adamson's (1984) and Carpenter et al.'s (1998) results, Tomasello et al. (2005) restrict this shared intentionality to collaborative activities, which do not commence until between 1;0 and 1;3 years old. From the above excerpt, it seems that collaborative activities are focused first on the understanding of one's own goals, then those of another individual, and finally how to realize these goals through social interaction. Carpenter and Liebal (2011) took the idea of shared intentionality a step further and addressed *how* infants participate in goal-oriented social behavior, given the complexities of *knowing together* (Section 2.4.1 above). I therefore assume that shared intentionality (or mutual knowledge of attention and goals) is possible in all engagement involving a communication partner and an infant, after 1;0 year old. I use the term mutual, rather than shared, because mutuality denotes that the goals for each individual are the same, but independent for each individual, whereas sharing implies that the goal may be divided up between the participant and other communication partners, resulting in incomplete individual goals. Taking this information into consideration, the following definition is offered:

- A *mutual interaction goal* requires that both interlocutors understand the other interlocutor has a goal through communicative cues, and that the goals of both interlocutors are compatible based upon the dependent components present. This means that what/who each individual attends to is the same, and they both have an understanding of each other's knowledge and interactive goal. A *goal* is the desire to bring about a specific outcome in one's environment. An *interaction* goal involves the use of verbal/non-verbal cues upon a target object

and/or toward a communication partner, rather than simply acknowledging the presence of a target (see Joint Engagement definition above).

The *mutual interaction goal* can be recognized by the presence and compatibility of other components of engagement. It could not be applied if an infant and partner attend to each other, but only one of them attends also to a target object. This combination would invalidate the mutuality of the interaction. For example, if the infant and partner are attending to each other, and the partner is attending to a target, then the partner's goals involve the infant and the target, as a target is defined as the referential focus of engagement (Section 1.2.1). The infant in this case should also attend to the target by default as the infant is already attending to the partner, whose attention and communicative actions involve the infant and the target.

This is not the same as multitasking – where someone is completing another activity simultaneously while interacting socially – where an object is certainly acted on, but it is not a referent of the interaction, and therefore not a target. For example, a mother and infant are interacting in triadic engagement by talking about and gesturing toward a toy the infant is currently playing with. The object the infant is playing with is the target of this interaction, and both mother and infant share that as their mutual interaction goal in this triadic engagement. At the same time, the mother is preparing food for dinner, which takes up some of her attention. While the infant may notice that the mother is completing a separate task, neither individual comment on the task or the items involved, but continue talking about the infant's toy. Therefore the food preparation is not a target of the joint interaction, and only another object. If the infant or mother did attend to the food preparation as a target referent, by pointing to or verbally commenting about the food, then that would change the dynamics of the interaction and thus the components involved. Also, this would represent a separate triadic engagement interaction as the target object has changed.

It is possible for a *mutual interaction goal* to exist when both infant and partner attend to the same target object, and only one of them attends to the other individual

as well. In this way, as in the definition of *mutual interaction goal*, both interactants may understand each other's goals and focus of attention, but one individual may do this only through a corresponding behavioral response, which does not involve directly attending to the individual through eye-gaze. If there was no common understanding, this would only be a coincidence, where both infant and partner attend to the same target, such as touching a wall when each individual is on a different side of the same object and not visually aware of the other individual and what their target might be. Differences in the application of a mutual interaction goal are explained further in the following section.

2.3.3 Component-Based Analysis of Engagement

The five engagement components presented in the preceding section offer 32 potential combinations (2^5) maximally. By looking at all possible combinations of components, I attempt to sort out which combinations are viable from those that are not possible combinations, and which viable combinations are directly applicable to Bakeman and Adamson's (1984) categorization, and finally if any viable combinations are not strictly applicable to these existing engagement level categories. First, those combinations that are acceptable combinations and applicable to Bakeman and Adamson's (1984) categories will be discussed; then, those combinations that are impossible will be presented and discussed separately. Table 2.3 presents the 18 component combinations, with an infant's presence and perspective as the base necessities, which are viable combinations based upon the constraints of mutual interaction goals, multitasking and symbolic communication.

When applied to the six engagement levels proffered by Bakeman and Adamson (1984), 18 of these combinations can be accounted for based upon the definitions of engagement (Section 1.2.1), attention and mutual interaction goals (Section 2.3.2). Their category of *Unengaged* accounts for combinations 1, 2 and 3: as the infant is neither attending to any partners or targets, then the infant is not engaged with any external part of their environment.

Combinations 4 and 5 relate to Bakeman and Adamson's (1984) category of *Onlooking* – "the infant is observing another's activity, often quite intently, but is not taking part in that activity" (p.1281). This engagement description is rather vague on a few points. First, 'onlooking' by definition suggests one individual passively watching another, though the preceding definition's use of 'intent observation' is contradictory, especially if the infant does not take part. Also, what if the infant is not intently watching the partner? How do we measure the intensity of an individual's attention? Second, the observation of someone's 'activity' is not descriptive enough. I've already noted earlier, in Section 2.2 when discussing Gaffan et al.'s (2009) understanding of this engagement, that there is a difference in noticing someone and observing someone's actions. Thus, I assume that if the infant is 'not taking part' in the other partner's activity, then the partner is most likely not involved in any goal-oriented social interaction or object manipulation. In combination 4 the infant is only attending to the partner's presence, and the partner is neither attending to the infant nor any targets, so I apply this to the category of *Onlooking*. Combination 5 differs from the definition of *Onlooking* because here the infant is attending specifically to a partner's interaction with a target. I assume that attending to someone's tacit behavior and attending to someone's goal oriented interaction *with a target*, are different types of engagement. In a natural environment, the former can frequently occur and applies most broadly to the original definition, whereas the latter represents a different aspect of attention and understanding. For these reasons, combination 5 represents a different category of engagement, labeled in our extension as *Observing* engagement.

Table 2.3. Viable combinations of interaction components as applied to the six engagement level categories from Bakeman and Adamson (1984). Components present in each combination are marked (✓), and components not present in each combination are marked (--). Combinations are considered viable based upon the definition of engagement (Section 1.2.1), and the discussion of attention and mutual interaction goals (Section 2.3.2).

Bakeman and Adamson's Engagement Levels	Combination	Infant Attends to Partner	Partner Attends to Infant	Infant Attends to Target	Partner Attends to Target	Mutual Interaction Goals
UNENGAGED	1	--	--	--	--	--
	2	--	✓	--	--	--
	3	--	--	--	✓	--
ONLOOKING	4	✓	--	--	--	--
	5	✓	--	--	✓	--
OBJECTS	6	--	--	✓	--	--
	7	--	✓	✓	--	--
	8	--	--	✓	✓	--
PERSONS	9	✓	✓	--	--	--
	10	✓	✓	--	--	✓
	11	✓	✓	✓	--	--
	12	✓	✓	--	✓	--
PASSIVE-JA	13	--	✓	✓	✓	--
	14	✓	--	✓	✓	--
	15	--	✓	✓	✓	✓
	16	✓	--	✓	✓	✓
COORDINATED-JA	17	✓	✓	✓	✓	✓
	18	✓	✓	✓	✓	--

Combinations 6, 7 and 8 are all easily applied to Bakeman and Adamson's (1984) category of *Object* manipulation. In each of the three combinations the infant's only form of attention involves the target object. As was the case for the category of

Unengaged, I am primarily concerned with the infant's attention only, and then secondarily to the alignment of attention with their communication partners, but only if the infant interacts with or responds to those communication partners.

For the category of *Persons* engagement, which is dyadic joint engagement, there are four combinations that are applicable. Combinations 9 and 10 are straightforward because in each combination the infant and partner are both only attending to each other, making it purely dyadic interaction. In combination 10 there is the addition of a mutual interaction goal, implying that the interaction now involves dependent social goals. For example, if a mother was exercising an infant's limbs to aid in development this would relate to combination 9, where both infant and partner are aware of each other through physical touch. However, if the infant begins to grab for the mother's hand or tries to initiate a game by moving away or gesturing, and the mother responds to these actions, then this would relate to combination 10, because social play involves understanding that all parties involved understood each others' goals. Two other combinations, 11 and 12, relate to *Persons* engagement as well. In both of these combinations, both infant and partner attend to each other, but one individual in each combination is also attending to a separate target simultaneously, negating any mutuality in regard to the target. I include these two combinations with *Persons* engagement, rather than rejecting them, because the social dynamics of attention sharing between an infant and partner is more unpredictable than the focus of an individual's attention on a non-human target. Furthermore, interacting with a person is more cognitively taxing than interacting with an object because an active exchange is involved. Consider the following example: A mother is interacting with another person, an infant walks up to the mother with an object of interest and tugs on the mother's clothes to get her attention, while simultaneously trying to show the object to the mother; the mother responds, "Not now, Mommy is busy," without acknowledging the object in any way. Obviously an interaction has occurred here, a situation maybe you have seen yourself, but one that is hard to categorize. It was therefore decided that the individual who is also attending to an external object is multi-tasking (Section 2.4.2),

and the social interaction requires continual monitoring and updating, making it more prevalent in combinations 11 and 12. Note, however, that the inclusion of a mutual interaction goal in either combination would then result in a fully unacceptable combination, as the definition of a mutual interaction goal would be violated.

For Bakeman and Adamson's (1984) engagement level of *Passive-JA*, combinations 13 through 16 are applicable. In each combination both partner and infant are attending to the same target, but only one individual is attending to the other individual, which is what defines this engagement as passive. In combination 13 the partner would have initiated this interaction, and in combination 14 it is initiated by the infant; in both cases the initiator must be the one overtly attending to the other individual. Combinations 15 and 16 are respectively the same as combinations 13 and 14, yet they differ by the addition of a mutual interaction goal. In such occurrences, this implies that the individual who is only attending to the target, and not the other individual, attends to the target with the understanding that its introduction into their attention is with the goal of their interacting with that target. In those combinations excluding a mutual interaction goal (13 and 14), the target is introduced into one individual's attention, but they do not interact with the object in anyway further than acknowledging its presence.

Combination 17 directly relates to Bakeman and Adamson's (1984) definition of *Coordinated-JA* – where the infant is actively involved with a partner, a target object is present in the interaction, and both infant and partner coordinate their attention and actions to each other and the target. Such coordination implies an understanding by both infant and partner that each other have goals in regard to the target and each other, and that these goals can be aligned. Therefore, the full combination of all components, including a mutual interaction goal, is necessary for this complex level of triadic joint engagement.

In addition, combination 18 is similar, but not identical to, Bakeman and Adamson's (1984) definitions. It is best applied to their category of *Coordinated-JA.* However, without a mutual interaction goal, it appears that the infant's coordination of

attention through active involvement does not occur with the partner. In naturalistic observation, there are regularly interactions where an infant and partner both attend to each other and to a defined target object, but either direct interaction with the target does not occur or both parties' actions are not aligned towards the same goals. For example, a mother and infant are playing with an assortment of toys. The mother looks at the infant and asks, "Can you give mommy the red block?" and points to the block the infant is playing with. The infant then looks at the mother, then at the toy, looks again to the mother, and finally throws the toy in the opposite direction of the mother. In this case, the mother's goal is to receive the red block. However, it seems that the infant has a different goal or does not relate to the mother's goal, so mutual intentions cannot be ascertained. In such examples, one might be able to argue that attention has been *aligned*, but *coordination* of attention and actions does not occur. Such failed attempts might represent important scaffolding attempts, and learning events, which could become more frequent over early child development as an infant learns how to socially navigate the fulfillment of their own individual goals and desires. This level of engagement is labeled *Shared Joint Attention* (*Shared-JA*).

Table 2.4 presents the 14 remaining component combinations that are not possible engagements based upon the definitions of individual components. Combination 19 is not possible because a *mutual interaction goal* cannot occur on its own as it depends upon both infants' and partners' active attention. The second rejected combination, number 20, cannot occur because an infant cannot be independently attending to an object and a partner at the same exact moment. "For example … if an infant playing with a toy was suddenly startled by an adult's voice or movement and so looked up to the adult's face … [then this is] only a case of two entities grabbing the infant's attention alternately" (Carpenter et al., 1998, p. 4). Without any shared attention or goals this is only the simultaneous occurrence of *Objects* and *Onlooking*, which is not possible, and would result in the final coding of possibly two separate engagement levels. If this were similar to multitasking (Section 2.4.2), then the external object would not be considered a target. Combination 21 is rejected for the same reasons,

except that this involves only a communication partner, and not an infant. A mutual interaction goal would only be possible if these distinct attentions were dependent on each other, and thus creating a sequence of events leading up to joint engagement.

Table 2.4. Rejected combinations of interaction components. Components present in each combination are marked (✓), and components not present in each combination are marked (--). Combinations are rejected based upon the definition of engagement (Section 1.2.1), and the discussion of attention and mutual interaction goals (Section 2.3.2).

	Infant Attends to Partner	Partner Attends to Infant	Infant Attends to Target	Partner Attends to Target	Mutual Interaction Goal
19	--	--	--	--	✓
20	✓	--	✓	--	--
21	--	✓	--	✓	--
22	✓	--	--	--	✓
23	--	✓	--	--	✓
24	--	--	✓	--	✓
25	--	--	--	✓	✓
26	✓	--	✓	--	✓
27	✓	--	--	✓	✓
28	--	✓	✓	--	✓
29	--	✓	--	✓	✓
30	--	--	✓	✓	✓
31	✓	✓	✓	--	✓
32	✓	✓	--	✓	✓

The remaining 11 combinations are all rejected because they include a *mutual interaction goal* when one is not possible based upon the other components present within these combinations. Combinations 22 through 26 are rejected because a *mutual interaction goal* cannot be applied to an interaction where only one interactant is somehow engaged with the environment. This component by definition requires more than one individual in common engagement. Combinations 27 and 28 are rejected

because the attention of the infant and that of the partner are unidirectional, meaning that their goals are not mutual, making their attention and goals separate from the other individual. Combination 29 is rejected for the same reasons as 22 through 26 – only one individual is actively involved with the environment.

Combination 30 is rejected because while both infant and partner are attending to the same target object, neither participant is attending to the other; even in this variation, at least one participant must also attend to the other individual as well as the target in order for a *mutual interaction goal* to be applicable. The final two combinations are harder to reject; however, as one interlocutor is not attending to the target as well, then one cannot be sure what that individual's goal is, as noted in the explanation of Combinations 11 and 12. In the case of combination 31, the infant could have a goal related to any level of joint engagement, but the partner would only be able to share a goal in a *Persons* engagement; vice versa can be said for combination 32. Again, this violates the definition of *mutual interaction goals*, and therefore these last two combinations are rejected.

2.4 Investigating Different Levels of Cultural Sociodemographics

The main goal of this section is to highlight cross-cultural differences in engagement that would be in direct opposition to engagement level classifications in semi-structured observation studies, and lend support to the preceding component-based analysis. While children of every culture learn language, it cannot be assumed that all children are exposed to language in similar fashions over the same time period of linguistic development. In Section 2.4.1, a presentation of the cross-cultural and intra-cultural differences in interaction styles, caregiving and infant language socialization are discussed. From here, Section 2.4.2 addresses how cultures can be stratified into comparable groups, but still represent the varying cultural structures of different prototypical learning environments. Then, in Section 2.4.3, a brief review is presented concerning how infant vocabulary size can be measured. Finally, in Section 2.4.4, I

discuss the possible expectations of rural and urban non-industrial community observation data regarding infant engagement, social networks and language learning.

2.4.1 The Cross-Cultural and Intra-Cultural Divide

One of the best documentations of the cross-cultural study of language development is Slobin's edited volume (1967). Yet, as Lieven (1994) points out, the studies in this volume vary in what is said, if anything, in regard to the environmental context and socialization process of different children and their cultures. However, those that focused on non-Western languages (Japanese, Kaluli and Samoan) *did* approach the topic of environmental and social context (cf. Lieven, 1994). This does not entail that research in understudied cultures always have very different environmental contexts, but more likely that the prevalence of studying industrial middle-class families of industrial urban societies have assumed their environment is standardized or normal, which is not an assumption that should be drawn.

Studies of infant engagement and language acquisition need to take account of the cultural environments in which young children interact with others (Küntay, Nakamura, & Ateş Şen, in press). In the end, studies of industrial cultures are only able to provide us with data on the subjects of said culture, and cannot be generalized to include non-industrial societies or historical paradigms. Environments in non-industrial cultures are more often polyadic rather than mother-infant pairs (Akhtar & Gernsbacher, 2007; Lieven, 1994). Therefore, appropriate and standard representations of daily life in non-industrial societies are needed (Küntay et al., in press), where the infant's environment is more varied in terms of social engagement and communication partners.

Socialization towards children and attitudes about child rearing can differ greatly across cultures (Chavajay & Rogoff, 1999; Hoff, 2006; Lieven, 1994; Keller et al., 2005; Küntay et al., in press; Schieffelin & Ochs, 1986). Specifically, there are large sociodemographic differences in caregiving, healthcare, family size, community structure, and daily lifestyle when comparing industrial and non-industrial cultures

(Abels et al., 2005; Greenfield, 2009). For instance, various types of communities live in extended family contexts within close-knit communities; this is more applicable in traditional cultures, where the extended family and unrelated members of the community play a regular role in the daily life and socialization of infants (Lieven, 1994). As a result, multi-party interactions are more frequent in non-industrial communities, and infants tend to have multiple caregivers, including siblings (Bakeman et al., 1990; Brown, 2011; Gaskins, 2006; Harkness, 1977; Zukow-Goldring, 2002). Industrial society families have a more nuclear structure, which may not regularly involve the same amount of exposure to other communication partners or secondary caregivers, despite using day-care or other facilities (Hoff, 2006). Only some studies on infant engagement have tried to address these possible differences, by including data on engagement outside of mother-infant pairs (Bakeman & Adamson, 1984; Barton & Tomasello, 1991; Barton & Tomasello, 1994; Carpenter et al., 1998; Tomasello & Farrar, 1986). However, even in these other scenarios, partners still interacted in pairs or only members of the immediate nuclear family were included.

Focusing on less studied cultures requires an understanding of that culture's *language socialization* – "the process through which a child or other novice acquires the knowledge, orientations, and practices that enable him or her to participate effectively and appropriately in the social life of a particular community" (Garrett & Baquedano-Lopez, 2002, p339). This process of language socialization would require specific types of face-to-face interactions and styles of child-directed speech. Literature suggests that face-to-face interactions are much less frequent in Africa than compared to other industrial and non-industrial communities (Keller et al., 2005). For example, many studies have found that the amount of child-directed speech is relatively little in African cultures (Blount, 1972; Rabain-Jamin, 1989), as well as in many other non-industrial communities (Brown, 1998; de León, 1998; Gaskins, 2006; Lieven, 1994; Ochs & Schieffelin, 2011). In addition, industrial cultures are usually high on the United Nation's Human Development Programme's Human Development Index (HDI), and mothers in high HDI countries engage in significantly more book reading, story telling,

naming and counting activities which displayed more significant correlations to cognitive caregiving rather than to socio-emotional caregiving (Bornstein & Putnick, 2012). This raises the questions whether these different amounts of face-to-face interactions and child-directed speech would relate to differences in *speed* of learning (Hart & Risley, 1995), or whether there are other explanations, possibly cultural, in case the speed of learning is indeed similar. In fact, there are possibly many explanations behind differing amounts of child-directed speech or a face-to-face interaction, which suggests there are most likely other aspects of the culture or environment that have not been taken into consideration during analysis.

North American mothers, when addressing an infant, tend to speak mostly about objects, while Asian mothers seem less object-oriented, and their speech contains proportionately more verbs than nouns (Tamis-LeMonda, Bornstein, Cyphers, Toda, & Ogino, 1992). As Hoff (2006) notes, some of this difference can be explained syntactically, but some seems more of a reflection of how mothers present the world differently to their children. In a related study, Chavajay and Rogoff (1999) analyzed cultural variations in time-sharing of attention between infants and their caregivers in two communities: a Guatemalan Mayan community and an American middle-class community. Their results showed Mayan caregivers and their toddlers were more likely to attend simultaneously to spontaneously occurring competing events, than their U.S. counterparts. On the other hand, U.S. caregivers and their toddlers were more likely to instead alternate their attentions between competing events, and U.S. caregivers specifically were more likely to focus attention on one event at a time. Chavajay and Rogoff (1999) suggest that such differences may directly relate to the different cultural dynamics of the two environments – meaning that infants are not only able to learn by mothers' presentations of the world, but also that infants learn to navigate the world and their social network in a similar fashion as their caregivers.

Another example of language socialization comes from Harkness' (1977) study of Kokwet children from Kenya and the effects of birth-order on interaction styles. She finds that Kokwet only-childs and last-borns were more likely to interact with adults

than early-born children with younger siblings who were more likely to interact with other children. Thus, Kokwet parents have a tendency to interact more with the youngest child in the family. This might suggest that they are more concerned with early infant development than with later childhood development, possibly instilling a sibling caregiving system instead for older infants. Her analysis also shows that interactions only between children involve less speech than interactions between children and adults, and there was a positive relation to the amount adults spoke with children and the amount the young children spoke themselves later in development. Furthermore, Harkness' (1977) conclusions suggest that adults and children can each have a beneficial effect on a child's language development through their own unique particular styles of verbal interaction. This further supports the selection of non-industrial communities and inclusion of engagements with all available communication partners, as an infant may learn specific strategies from their mother and other strategies from different communication partners.

So far, it has been assumed that all cultures think of infants as linguistic novices, both wanting to and capable of learning language. Yet can it be assumed this is cross-culturally similar in caregiving beliefs? Some cultures – such as the Mayans of Mexico (Brown, 2011; Shneidman & Goldin-Meadow, 2012) or the Warlpiri of Australia (Bavin, 1992) – do not regard infants as potential or appropriate communication partners, resulting in adults being less attentive to or expressive with infants. A primary caregiver's responsibilities and daily interactions will not and cannot solely involve the moderation of an infant's development. Even in McLoyd's (1998) analysis of low-SES American families, the stresses of the day-to-day struggle, and coping with deteriorated living conditions, undermined caregiving skills and contributed to disorganized family life.

Ethnographic field studies of child socialization (Kagitcibasi, 1997; Lancy, 2008; Schieffelin & Ochs, 1986) have shown that cultures can differ on whether or not they are *child-centered* or *situation-centered*. The majority of industrial cultures invoke a child-centered approach to parenting, where children are directly addressed in

conversation from early infancy, implying the child is less likely to be an outsider of social engagement. Rogoff (2003) makes the point that children of traditional societies, such as indigenous Americans, often observe ongoing events that are not designed for them, in the hopes that these children will develop a keen, cultural sense of observing the activities and events around them. Silva, Correa- Chávez, & Rogoff (2010) also show this to be true, where Mayan children spend more time as active observers in a situation-centered culture, and are more likely to learn from those observations than are children from the United States (cf. Shneidman & Goldin-Meadow, 2012). This is due to the fact that in situation-centered caregiving, parents neither engage infants as potential conversational partners nor do they simplify their speech (Heath, 1983). Children are instead expected to learn language themselves through observation, as well as trial and error (Heath, 1983; Schieffelin & Ochs, 1986). Moreover, traditional views of child development emphasize the need for exploration (Bakeman et al., 1990), which would involve a wider social network than just that of the mother-infant dyad.

Such differences in how a culture approaches caregiving, and how different individuals enact these beliefs, makes me aware that the cultural models of caregiving applied in various non-industrial communities are different from the Western standards that exist in the literature. It could be possible that some of the differences noted within industrial cultures offer an idea of how non-industrial communities may also differ from the standard, urban industrial paradigm. Furthermore, intra-cultural differences in industrial cultures may also be mirrors for non-industrial intra-cultural results. Hoff, Laursen, and Tardiff (2002) showed that higher SES mothers talk more to their children than do lower SES mothers, that the speech of higher SES mothers more frequently is uttered for the purpose of eliciting conversation than the speech of lower SES mothers, and that the speech of lower SES mothers more frequently is uttered for the purpose of directing their children's behavior than the speech of higher SES mothers. In fact, Heath (1990) has described low SES children living in public housing with single mothers, who have little education, as living in virtual silence. Thus, the assumption might be made that different types of industrial and non-industrial culture,

just as with varying SES-levels within one culture, influence what children can and do experience – their learning institutions such as child care centers and schools, the people in the family and community with whom the child interacts, the environment in which interactions occur, and the dynamics of the interactions themselves (Hoff, 2006). These effects of different SES levels distinctly entail that language socialization is exclusive to each cultural group and community. Thus, the results of various studies on infants' vocabulary development are only able to provide an individual representation of socialization, and more comparative analyses are needed, which is one goal of this dissertation.

2.4.2 Prototypical Learning Environments

Differences in socialization practices have not only been explained in terms of cultural variances, but also in terms of *sociodemographic* differences (Greenfield, 2009). In an ecological account, Greenfield (2009) argues that differences in sociodemographic dimensions (e.g., lower vs. higher education, subsistence farming vs. commercial lifestyles, cf. also Abels et al., 2005), as well as cultural values, determine to a large extent the learning environment of children. Greenfield proposes two prototypical learning environments, which resemble *non-industrial rural* communities and *industrial urban* societies. In addition to these, Keller (2012) proposes non-Western, non-industrial urban communities as a third prototypical learning environments. These communities have adopted a more industrial-like lifestyle, but still adhere to the cultural traditions of rural agricultural communities. It could be assumed that while urban and rural non-industrial settings share very similar cultural ideals and practices, the differences in life structure could cause an entire community to adopt a slightly different, and somewhat co-constructed, practice of parenting (Harwood, Schoelmerich & Schulze, 2000).

In the well-known, urban industrial learning environment, interactions around infants are generally child-centered, where infants are treated as competent communication partners whose needs and desires are met by mothers being overly

sensitive to infants' state of mind (Ainsworth, Blehar, Waters, & Wall, 1978). To do so, mothers favor styles of engagement that are face-to-face, involve object stimulation, and allow for more extensive conversations (Keller, 2012). These types of engagement may be more prevalent due to the fact that mothers in industrial societies generally receive high levels of formal education, there is an overabundance of caregiving books and classes available to parents, and reproduction ages are later than in traditional cultures. Keller (2012) points out that educated industrial individuals believe infants develop at an individual pace, so motor stimulation is considered inappropriate and does not regularly occur. Overall, in urban industrial cultures, infants seem to be treated as individuals who can regulate aspects of their own development themselves and, as such, develop their own expectations about the world as individuals.

Compared to industrial urban societies, the prototypical rural environment involves more body stimulation, more social stimulation, and a wider variety of communication partners (Keller, 2007). In the rural prototype, mothers tend to interact with children as a group, rather than individuals (Chavajay & Rogoff, 2002). Also, rural mothers tend to have less knowledge of child development (LeVine et al., 1994), and rural children tend to receive less formal schooling (Schliemann & Acioly, 1989). All of these characteristics relate to more situation-centered caregiving, which is the usual situation in non-industrial rural communities. Turning to the urban non-industrial prototype, there is a mixture of characteristics from either of the other prototypical learning environments. As is the case for urban industrial mothers, urban non-industrial mothers have higher education levels than their rural counterparts. Due to higher education, it can be expected that urban non-industrial mothers speak more than rural mothers do to their infants (LeVine et al., 1994). On the other hand, urban non-industrial families are larger than industrial families of nuclear size, which is the same in the rural non-industrial area. Based upon the characteristics, it is reasonable to consider urban non-industrial caregiving as being more child-centered than their rural counterparts, but probably not as much as industrial urban communities.

Due to the different learning situations, children show different developmental trajectories in these prototypical environments (Abels et al., 2005; Keller, 2007). While a great amount of work in child language acquisition has been conducted with an interdisciplinary approach that concerns cross-cultural comparisons, work on intra-cultural differences is much less prevalent. Since it is known that there are cultural differences in caregiving styles, I do not exclude the possibility that this notion could also apply to intra-cultural class and lifestyle differences. For these reasons, I investigate differences in infants' engagement levels between urban and rural non-industrial communities, and how the proportion of these engagements relate to potential word learning and language development.

2.4.3 Measuring Infant Vocabulary

One of the most standard ways to assess an infant's language acquisition development is through a measurement of the infant's vocabulary size, which is even used at times to estimate infant IQ (Marchman & Fernald, 2008). As infants are developing social skills and interactions abilities, it is impossible to interview infants directly regarding their linguistic competence and cognitive abilities. Options for vocabulary measurement ranges from field notes or timed recordings of observations, to continual real-life home video recording spanning infancy into toddlerhood, to longitudinally collected parental interviews. Each option of vocabulary measurement has constraints and also possible pit-falls. Measuring vocabulary from field notes or recorded observations only provide a small representation of activities and interactions, thus also a small variety of language. Specifically, recorded observations are purely representative of normal daily interactions, and they cannot cover all possible topics of conversation, which does not provide an optimal measure of vocabulary (Pine, Lieven, & Rowland, 1996; Tardif, Gelman, & Xu, 1999; Tomasello & Mervis, 1994). Furthermore, recorded child-directed speech may also not be truly representative when compared to observations from field notes, which can contain more speech than that from video recordings of the same communities (Shneidman & Goldin-Meadow,

2012). In regard to continual real-life recordings (e.g., video equipment installed in a home for full-time observation), the pit-falls mainly relate to the amount of information being retrieved. Data analysis for this situation is extremely time consuming, especially if analyses cannot be run in parallel. Due to the amount of collected data in continual real-life recordings (e.g. 90,000 hours from Roy, 2009), organizing and analyzing the data is a monumental task. This in itself may be why there are limited examples of such data. In addition, the collection of data is rather intrusive for any families involved because privacy is minimized, and individuals must start/stop recording procedures themselves.

In this dissertation, parental checklists are used to measure infants' vocabulary over development. By following this method, parents provide information regarding their knowledge on what words their child speaks (expressive language), words their child understands but does not speak (receptive language), or words the child does not know at all. As noted in Section 1.2.4, an accepted standard for parental checklists of vocabulary is the MacArthur-Bates Communicative Development Inventory (Fenson et al, 1994; Fenson, Pethick, Renda, Cox, Dale, & Reznick, 2000a; Fenson, Bates, Dale, Goodman, Reznick, & Thal, 2000b). The MBCDI has been adapted in over 60 languages[2] and possible geographic variations of these languages; direct translations of the MBCDI are not applicable, as the vocabulary must be made culturally applicable to the language of study. The different MBCDI wordlists contain various parts of speech – nouns, verbs, adjectives, social greetings, questions – and also some conventionalized gestures and early grammatical onset questions. Unfortunately, the wordlists cannot account for all parts of speech, and do contain more nouns than other word categories, which may not be equal for all cultures and languages. For example, children in Argentina know more words for people, and children in the US know more words for objects (Cote & Bornstein, 2005).

[2] *http://www.sci.sdsu.edu/cdi/adaptations.htm*

Expressive language is considered a more stable representation of vocabulary size than receptive language, because receptive language is a more subjective measure of vocabulary, where parents have been shown to both underestimate (Houston-Price, Mather, & Sakkalou, 2007) and overestimate (Law & Roy, 2008) their child's receptive vocabulary. Therefore, many correlation analyses prefer MBCDI expressive vocabulary scores as the dependent variable. While a parental checklist method can lead to biased responses, it is much more representative than tokens taken from selective observations (Fenson et al., 2000b). Ultimately, continual real-life recordings and dense data recordings would be most beneficial to child language acquisition research (Lieven & Behrens, 2011; Roy, 2009); however, until there are superior automated tools designed for analysis, such data is too overwhelming for most studies to analyze and present. For these reasons, it was decided that an MBCDI parental checklist would be best suited for the CASA MILA project, especially as this method has been used in previous related studies (Carpenter et al., 1998; Childers et al., 2007). Since, there are no available adaptations for the target languages in this project, such adaptations need to be constructed, and are discussed in detail in Section 3.2.3.

2.4.4 Expectations Regarding Infant Engagement in Non-industrial Communities

In the rest of this dissertation, I will be performing an intra-cultural comparison of naturalistic observations in a non-industrial society. To do so, these naturalistic observations are analyzed based upon the engagement level categorization presented in Section 2.3. In this way, I am able to measure the proportion of time infants spend in the various different types of engagement levels, and compare these across sites at different ages and also compare proportional distributions within sites across ages. I correlate these proportional measurements of engagement with expressive vocabulary scores, as measured using an adaptation of the MBCDI. These correlation analyses are initially completed irrespective of communication partner (see Chapter 5), and

subsequently of each type of communication partner (i.e., mother, sibling, group, etc.), as well as communication partner per each type of joint engagement (see Chapter 6).

While this is an exploratory study, I am able to raise some expectations regarding the results based upon the preceding literature discussions. However, this should not imply that I am raising or testing any specific hypotheses. Based upon the discussion of cross-cultural and intra-cultural differences in sociodemographics and caregiving beliefs, it is only possible to posit some expectations as to what might be found in regard to infant engagement in a non-industrial culture, and within different SES communities of that culture. Furthermore, as a purely naturalistic study, the application of any hypotheses could restrict data collection in a way similar to the methodological constraints of semi-structured observation.

First, in regard to community demographics, I might expect that parents of the rural non-industrial area will have lower levels of education than their urban counterparts, and will follow a more traditional subsistence lifestyle, each of which entails the rural community would have a lower SES than the urban area. These SES differences could result in rural infants receiving less linguistic input and thus smaller vocabularies than urban infants. Second, in regard to proportion of time infants spent in engagement, I could expect to find non-industrial infants spending more time in activities that do not involve objects, such as levels of solitary and dyadic engagement, as object-stimulation is more common in industrial cultures (Bornstein & Putnick, 2012; Keller et al., 2005). On the other hand, the urban non-industrial environment probably focuses more on object-stimulation than the rural prototypical environment (Keller, 2012). This could create higher frequencies of child-directed speech and gestures, which – extrapolating from Hart and Risley (1995) or Rowe and Goldin-Meadow (2009) – could in turn relate to larger vocabularies in urban non-industrial prototypical environments in comparison to the rural counterpart.

As industrial cultures have smaller family sizes, it could be expected that non-industrial infants will have more chances to interact with communication partners besides only their mother (Keller et al., 2005; Keller, 2012). Given the greater hardship

of daily lifestyles in non-industrial cultures, having a larger social network could result in the use of secondary or sibling caregiving systems, instead of relying on mothers as the primary and only caregiver. Furthermore, most caregiving systems in industrial cultures are child-centered; however, given the above expectations, it is quite likely that non-industrial cultures have a greater likelihood of being situation-centered rather than child-centered, given difficulties in daily lifestyle and dynamics of infant social networks. Studies show that when expert input (e.g., from caregivers or teachers) is reduced, language development is slower (Bates et al., 1975; NICHD Early Child Care Research Network, 2002). It could be assumed this might be similar in rural non-industrial communities where fathers work away from home, mothers support their household by subsistence farming, and siblings provide additional care, thus reducing input from competent interaction partners. Results from analyzing communication partners' joint engagement with infants can shed new insights on this. For example, if the community were child-centered then I would expect to find more frequent engagement with mothers than with other possible communication partners, as well as finding significant positive correlations between engagements with groups and expressive vocabulary scores. On the other hand, if the community is situation-centered, then a less stable representation of how frequently infants interact with different communication partners may be expected, as well as finding significant negative correlations between engagement with non-caregivers and expressive vocabulary scores.

2.5 Summary

The first objective of this chapter was to revisit the categorization of infant engagement levels that is used within child development research, and based off of Bakeman and Adamson's seminal study (1984). My reasons for doing so were to verify whether or not the methods involved in previous research had prevented the categorization of engagement levels from being complete and encompassing all

possible infant engagements. First, the differences between semi-structured observation data and naturalistic observation field data were addressed. It became apparent that providing interaction instructions to parents, or supplying novel toys to elicit object-oriented activities cause the data obtained to represent a disproportionate amount of certain engagement. It could then be that this bias had an effect on engagement level categorization and analysis. Therefore, it is important to not only address the methods of research that a study uses, but also the relation between the methods used and the type of data these methods could elicit due to their design.

Second, some of the prominent literature on infant engagement and vocabulary development was reviewed. I find that research involving infant engagement mostly measures interaction abilities through semi-structured observation, which is only able to tell us about small aspects of engagement usage within a constrained environmental representation. Using semi-structured observation methods limit the environment in mainly three ways – who is interacting with infants, what types of engagement these interaction partners are instructed to focus on, and what targets may be present during these interactions. Applying constraints such as these causes the research to shift from retrieving naturalistic data to data that is either elicited or simulated, which is no longer natural. Furthermore, most research relied upon Bakeman and Adamson's (1984) categorization of engagement, but also manipulated the scale of engagement in different manners that could have readily skewed their results – leaving out solitary engagement categories; collapsing categories of unequal nature; applying different definitions and representations of engagement levels. It became obvious that a qualitative account of categorizing infant engagement was missing from the literature, as well as an appropriate representation of cultures and infants social networks.

Third, I chose to implement an analysis of the components of engagements and the processes involved within engagement, which allowed me to set aside most conflicting research conditions and constraints. By implementing a step-by-step approach, based upon all applicable combinations and accumulations of any given interaction's components, I was able to further the spectrum of analysis set forth by Bakeman and

Adamson (1984). I developed a complete outline of which different combinations of components relate to each distinct type of engagement. In doing so, not only did I achieve this chapter's main goal, but also defined two novel categories of engagement to be analyzed: *Observing* and *Shared Joint Attention.* These categories were brought to light by looking past only active infant engagement, and biases associated with industrial culture's infant socialization practices. By taking into account the passive/active differences in being a bystander allowed the division of *Onlooking* and *Observing* engagement levels. In a similar fashion, by breaching the role of goal-oriented behavior within social interactions allowed for further analyses of joint engagement categories. By specifically analyzing the role of goals in triadic joint engagement allowed for the differentiation of *Shared-JA* from *Coordinated-JA*. Ultimately, I was able to create an extended version of infant engagement level categorization that encompasses a wider range of possible interaction dynamics.

Fourth, in order to understand global variations in infant engagement and language socialization, I provided a discussion of cross- and intra-cultural sociodemographics. Examples from a wide variety of cultural and social comparisons showed that there is a large range of factors that can affect infant language acquisition. However, children in each example did learn their native language, so there must be some way to appropriately categorize cultures so that cultural sociodemographics can be somewhat comparable. From the work of Greenfield (2009), Abels et al. (2005) and Keller (2012), three proto-typical ecologies of human society were identified: non-industrial rural communities, non-industrial urban communities, and industrial middle-class communities. This encompasses not only the issue of cross-cultural differences in infant socialization, but also the effects of intra-cultural lifestyle differences, which in turn affects how infant engagement is recognized and categorized in the field of child development research. In addition, a discussion was presented concerning how to measure infant vocabulary development, and which possible methods were appropriate, manageable representations. Currently, standardized parental checklists of vocabulary, such as the MBCDI, offer one of the best methods. Thus, an adaptation of

the MBCDI is applied through the CASA MILA field research. Finally, based upon the preceding discussions throughout the chapter, I offered some possible expectations regarding the results of collecting and comparing naturalistic observation data of infant engagement and vocabulary development from a rural and urban non-industrial community.

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From this point, I am able to turn to my main focus to the CASA MILA field study methods, which are to retrieve and analyze naturalistic data of infant engagement in different prototypical non-industrial learning environments. Based upon the theoretical analysis presented in this chapter, it is pertinent that the home scenarios used for data analysis are fully naturalistic, that a normal representation of the infants social network is included, and that parents' engagement with their children are not affected by any expectations of the research or instructions to interact in any specific manner. In order to assure this is done, and to provide a more standard approach to language acquisition data collection, the next chapter outlines in detail the methods implemented in field data collection, analysis procedures, and the verification of coding schemes used in this dissertation and associated works.

METHODS

3

This chapter is devoted to the presentation of the methods used for data collection and analysis in this dissertation, and extensively covers the methods of the field study – how sites and participating families were selected, the materials used, the adaptation of a word list to measure vocabulary development, and the procedures of both data collection and data analysis. The data was collected longitudinally through both unobtrusive video recording of naturally observed interactions, as well as parental interviews. As discussed in Section 2.1, while semi-structured observation techniques and simulated play offer information about infants' engagement capabilities, naturalistic observation data offers a better representation of engagement in dynamic cultural environments. For these reasons, longitudinal data were retrieved from the field for two non-industrial communities when infants were around the ages of 1;1, 1;5 and 2;1. These ages represent major linguistic turning points in the second year of infant life, which respectively are: a child's first words, a dramatic increase in vocabulary, and the beginning of two-word phrases and early syntax. In order to cover all major linguistic turning points, a longitudinal study was the most appropriate.

3.1 Field Sites

The CASA MILA project chose to work with a non-industrial African country that has been understudied both culturally and linguistically. While there are many non-industrial areas of the world, Africa offers the opportunity to research understudied countries, which are characterized by extended family living situations, community cohesion, linguistic solidarity, and limited exposure to Western media/technology. As this project is exploratory, the exact location of a non-industrial field site was not overly critical. Mozambique was selected because it is a country in which African traditions are still a major part of daily life, even after its colonial past and recent industrial culture's influences through media and technology (Ndege, 2007), and offered an ideal location for studying both rural and urban non-industrial communities. The country is located in southeast Africa (Figure 3.1), bordered by the

Indian Ocean to the east, Swaziland and South Africa to the southwest, Zimbabwe to the west, Malawi and Zambia to the northwest, and Tanzania to the north. It was a Portuguese colony from 1505 until 1975, and was the scene of intense civil war from 1977 until 1992. The country has been economically stabilizing since independence and civil war, but it is still considered very low on the HDI scale – 184th out of 187 countries (Human Development Report, 2013).

Figure 3.1: Map of African continent, Mozambique is highlighted in red in the southeast. Retrieved from *http://harambeeusa.org/projects/past-projects/mozambique/* - Copyright © 2010 by Harambee USA Foundation

Wona Sanana, a Mozambican grassroots NGO, and Associação Communitário Ambiente da Mafalala (ACAM), a suburb community center of the capital city, mediated between the field site communities and our research group. Each organization assisted in the procurement of two local individuals per site to work as research assistants for family visits, translations and additional data procurement for regional comparisons. These research assistants all were proficient in reading and writing in the local languages as well as Portuguese, and all assistants had some level of secondary education.

Three adjacent villages near the small town of Chokwe in the Gaza province were selected as the rural site; and two neighboring, bilingual suburbs of the Maputo capital made up the urban site (Figure 3.2).

Figure 3.2: Map of Mozambique highlighting the rural field location near the town of Chokwe in the Gaza Province, and the urban field location in the capital of Maputo in the Maputo Province. Retrieved from *http://www.cowi.com/menu/specialfeatures/specialfeaturesarchive/mozambiqueafricassuccessstory/africanbridgeconstructionprojectwithaidsprevention/Pages/chokwemappopup.aspx* - 'Map detailing Chokwe, Mozambique.'

These two sites are about 225 km apart by road. The families from the rural community were all native Changana speakers – a Southern Bantu language spoken in parts of Mozambique, and also in South Africa, where it is instead called Tsonga (Lewis, 2009); this was in most cases the only language spoken in the household. In the urban community, most families are bilingual in Portuguese, Mozambique's official language, and Ronga, another Southern Bantu language that is mutually intelligible with Changana. It is often the case that most parent-child dialogue is in Portuguese, and infants develop their Ronga language skills after toddlerhood in peer and sibling playgroups and other community events. Since approximately half the children in the world live in multilingual environments (De Houwer, 1995; Tucker, 1998), then we can consider bilingual exposure to be a regular aspect of modern child language

acquisition, and should also be represented within the field study. As the urban non-industrial prototypical learning environment is considered somewhat of a middle ground between the other two prototypical environments, it seemed appropriate that bilingualism would be represented in this field site.

The rural and urban sites are both impoverished communities, representing low-SES classes of Mozambique. Families in the rural area live in mud/brick homesteads in villages that are spread out over a distance of a few kilometers. A typical homestead (Figure 3.3) consists of a few houses in which grandparents and up to three distinct and related nuclear families might live. The majority of daily activities take place outside of these structures, in the open-air grounds that make up most family homestead land plots. Gardens may exist in small plots along the homestead, but most farming is completed in *machambas* (agricultural fields) often located in a separate section of the village area.

Figure 3.3: Typical representation of rural Mozambican homesteads in villages surrounding Chokwe.

Families in the urban area live in self-constructed, one-floor houses with small courtyards in densely populated suburbs of the capital city (Figure 3.4). Urban households are mostly built around one extended family, including up to four generations in the same household. Also, due to the urban setting, households are

more likely to house a few distant relatives that are relocating to the city for work. Due to more confined spaces, urban daily interactions and routines occur inside the home, outside in the home courtyard, and/or in local public spaces and markets. Rather than working in agriculture, families in the urban area rely more on local market sales and civil servant positions.

Figure 3.4: Typical representation of an urban household in the Mafalala suburbs of the Maputo capital.

3.1.1 Participants

For each field site, the representatives from Wona Sanana or ACAM made contact with each 'chefe do bairro' (community leader) for their local informed approval to complete research within their community. Once permission was received, the mediator, community leader, and research assistants asked for volunteers within each community.

The families who volunteered were informed that the general goal of the study was to investigate how Mozambican infants learn their first words in their mother tongue. Also, information was provided to families regarding the general home visitation procedures, when visits would occur, and the length of participation in the study. Of

those families interested in participating, we selected those with infants between the age of 1;0 and 1;2. A local research assistant explained again the purpose of the study and guidelines of the visits to the caregivers in their native language. All research was conducted in accordance with the Helsinki Declaration of Human Rights. It was explained to all families that participation in the project was entirely voluntary, and participants could withdraw at any time, for any reason, with no repercussions. There were no physical or psychological risks associated with participation, and all information is anonymous. In addition, it was explained that this research would offer no immediate benefits to the families volunteering for the study.

All caregivers made appointments for the following two weeks to begin the family field visitations. Additionally, each family completed a signed consent form. Initially, we recruited 21 families in the rural sites and 24 families in the urban sites. However, not all volunteers remained part of the study for various reasons: two infants passed away, one mother passed away, five families moved outside of the field sites, three families decided not to continue participating, and six families dropped out for various other reasons (e.g., work commitments, lack of interest, illness, etc.). There were 14 families in each site that participated for the entire duration of the field study, and only the data collected from these families is presented in this dissertation.

3.1.2 Demographics.

In Table 3.1, I present data and results taken from sample groups of 14 infants each in the non-industrial sites. There is an acceptable representation of both male and female infants, all within one month of 1;1 at commencement. As the data is presented below, there are no significant differences between urban and rural infants' demographics as well as parental education levels, which allows one to assume that by quantifiable factors these sites are acceptably comparable. Since we did not control for the number of people present, and most family members were present during filming, the average household size is an approximate representation of the people present during field data collection.

Table 3.1. Information about selected infants (gender, average age, family size, number of siblings, birth order) and their parents (age, education level, occupation). Parent's education data from one urban family is missing.

Infant participants – Demographics	**Rural (n=14)**		**Urban (n=14)**	
Female infants	7		5	
Male infants	7		9	
Average age (SD)	1;1.8 (0;0.26)		1;1.6 (0;0.28)	
Average Family size (SD)	8.2 (5.8)		7.4 (4.4)	
Average number of siblings (SD)	2.3 (1.5)		3.5 (2.5)	
Average birth order (SD)	3.2 (2.4)		2.5 (1.5)	
Average Mother's age (SD)	28.4 (7.8)		27.5 (5.3)	
Average Father's age (SD)	35.7 (11.6)		33.1 (8.6)	
Parents - Education level	**Mother (n=14)**	**Father (n=14)**	**Mother (n=13)**	**Father (n=13)**
No education	6	5	1	0
5-year early primary school	5	7	5	4
Additional 2-year primary school	3	1	6	5
Higher education	0	1	1	4
Parents - Occupation	**Mother (n=14)**	**Father (n=14)**	**Mother (n=14)**	**Father (n=14)**
Paid occupation	0	9	2	10

The majority of rural parents have either completed no education or only the lower levels of education, except for one father with higher education. Urban parents have all received some education, except one mother, and five parents have achieved higher education levels. A Fisher's exact test was utilized to verify whether the education levels differ significantly between non-industrial communities, and found that it

appears not (p=0.115)[3]. However, when looking at the raw data, one can easily infer that overall the education of parents in the urban area is higher than that of the rural area. This difference in education levels between urban and rural families applies to both mothers and fathers – with rural parents being represented in the lower education categories 1 and 2, and urban mothers and fathers being represented predominantly in the categories 2 and 3. On the basis of these differences, we consider urban sites to have a slightly higher socio-economic status (SES) than rural sites, as SES is most frequently indexed using maternal education (Ensminger & Fothergill, 2003). In regard to employment, the majority of fathers from the rural area are working permanently in South Africa or Maputo, and the mothers follow a predominantly subsistence farming lifestyle. In the urban population, on the other hand, fathers work a variety of jobs locally, and most mothers work in local markets and two mothers have salaried occupations. Thus, urban infants have more access to both parents, which might suggest that their environment is more dynamic with more possible primary caregivers.

3.2 Materials

This section presents the materials used during fieldwork. For observational data, recording equipment was used to digitally record interactions. For ethnographic information, questionnaires were constructed. To measure infant vocabulary a parental checklist was adapted for use. Finally, for deeper ethnographic analysis, a semi-structured interview was constructed.

[3] It is conceivable that the small sample size here does not provide an accurate comparison (the data requires a sample size of N=497 to obtain a power 80% for p =0.05 and the observed effect size of d=0.09).

3.2.1 Naturalistic Data: Recording Equipment

Data was collected using a Canon HD Legria HFS100 System – an 8.0MP Full HD CMOS sensor, a Canon HD Video Lens (58mm filter diameter) with 10x optical zoom and the DIGIC DV III processor – positioned on a tripod, and using a Sennheiser MKE 400 compact uni-directional microphone with windscreen. Videos were later downloaded and processed on MacBook laptop computers using iMovie '09 (version 8.0.6).

3.2.2 Ethnographic Data: Questionnaires

At each of the three data collection times, mothers were asked a series of questions in order to collect both familial and caregiving data. Three questionnaires were used one for each data collection point. These questionnaires were slightly different, although some questions were asked at every collection period. At the first visit, mothers were asked the most questions in order to retrieve as much background data as possible (Appendix 1). Questions covered the health of both mother and infant, household size and status, linguistic information, secondary caregiving, language teaching techniques, infant socialization skills, infant play patterns, and the day-to-day routine of families. At the second visit (Appendix 2), mothers were asked if there had been any major changes in the household – if people had left or passed away, any new births, or if the family moved house – and if the infant had experienced any specific health problems related to hearing, vision, or severe illness. In this second questionnaire, mothers were asked about what media/technology the family had, as well as the daily diet of the infant. As with the first questionnaire, mothers were asked again about their current language teaching techniques. At the third visit (Appendix 3), mothers were asked the same questions about general changes in the household, specific health issues, household technology, and language teaching techniques. New questions in this third questionnaire addressed the family structure of the mother – birth order and number of siblings – as well as their child's level of social motivation and interaction.

3.2.3 Vocabulary Data: Parental Checklist

Before beginning with fieldwork, it was necessary to first adapt the MacArthur-Bates Communicative Development Inventory word lists for Mozambican culture. As these word lists were originally created to measure vocabulary size of English speaking American infants, some words were not appropriate for either environmental, cultural, or SES differences between industrial and non-industrial societies. It is important to note that an adaptation is not a translation of an existing word-list, but the creation of a culturally acceptable and comparable representation of early vocabulary. In fact, adaptation is a process in itself – identifying culturally inappropriate English words, choosing culturally appropriate replacements, testing translations with research assistants, and piloting the adaptation with other native families.

To create an adaptation of the MBCDI, our starting point was an original list of 113 English words, consisting of the entire MBCDI Short Form I (89 words), and some additional vocabulary (24 words) from the MBCDI Short From II-A and II-B (Fenson et al., 2000a). Words from Form II were added in order to create one word-list that was applicable to all three data collection periods: Form I is designed for infants only between 0;8 and 1;4, whereas Form II is for infants between 1;4 and 2;6. Because the MBCDI was administered through face-to-face interviews, we chose to measure vocabulary with shorter lists rather than long lists of words. Instead of adapting the MBCDI for the three different languages separately, we constructed one culturally broad adaptation of the list into Portuguese first and subsequently translate these into the other two languages[4]. Due to bilingualism in the urban area, it was necessary to assess both Portuguese and Ronga simultaneously to assure an accurate comparison. Children in bilingual environments develop language skills similarly to monolingual children when bilingual performance in both languages is taken into consideration together (Junker & Stockman, 2002; Pearson, Fernandez, & Oller, 1993), which is

[4] Both Vogt and myself studied the languages of Changana and (Mozambican) Portuguese to a level of conversational usage.

sometimes referred to as an infant's total conceptual vocabulary (Guitiérrez-Clellen, Restrepo, Bedore, Peña, & Anderson, 2000; Patterson, 1998).

Vogt and I first carefully considered whether the 113 items on the original, English list were culturally appropriate for Mozambican communities[5]. We identified 38 words that were not, and replaced these with words more appropriate to the culture, lifestyle and environment of Mozambican families. All words replaced fulfilled the syntactic-semantic properties of the original item. Examples of items that we replaced include *goat* for *duck*, *ox/rat* for *lion*, *cellphone* for *television*, and also *bring* for *help*. The reasons for replacing these items are that goats are more common than ducks, and most children have encountered neither lions nor a television. We made sure to counterbalance these terms for differences across sites. For example, the replacement for *lion* in the rural adaptation was *ox*, and in the urban adaptation it was *rat*. In each case, we chose an animal that was more common to the infants' environment. In addition, some replacements were based upon problems of explanation. The translation provided by the local informants for *help* did not convey the same meaning as it does in English, and is also not a word as commonly used in Changana/Ronga (at least not with or by children). We therefore decided to change the word to *bring*, keeping it within the same syntactic category and a prominent word in child-directed speech. This first adaptation, in Portuguese, was verified and further translated into Changana and Ronga with the help of local assistants. We confirmed translations, when possible, with a Ronga–Portuguese dictionary (Sitoe, Mahumana, & Langa, 2008).

Where necessary, we further adapted items or translations such that they fit better with the responses of local research assistants. The resulting adaptations were, again, tested with local informants, and the list was considered complete and culturally sound after these several iterations. During the data collection for the research project, we noticed that the research assistants either did not ask certain items in a consistent way or in the way intended, or that respondents were not able to separate the word from

[5] Both Vogt and myself have experience living in different sub-Saharan countries with traditional communities, especially in Mozambique for Vogt, which provided us each with first hand knowledge of daily life.

the action. We therefore removed five additional items from the list: vocalizations such as *beheh* (sound of a goat), *ow,* and *uh-oh*; other words removed were easily confused with the action they also refer to, such as *patty cake* and *laughing*. This resulted in the final adaptation containing 108 culturally appropriate words.

As this was a new adaptation of the MBCDI, a norming study was necessary to ascertain normal vocabulary development for infants within and surrounding the non-industrial field site areas. The same local research assistants, who assisted with field research, carried out the parental MBCDI data collection for the norming study in both communities among 378 rural and 260 urban mothers with infants between 1;0 and 2;2 years old, which coincides with the age span of the infants from the observation study. These results, evaluated by Vogt, are provided in Appendix 4.

3.2.4 Caregiving Data: Semi-structured Interview

After completing all three visitations of the longitudinal study, mothers were interviewed in a semi-structured style about their personal thoughts on caregiving and child language learning. Questions asked concerned the important aspects of general caregiving, the role of both parents, the role of the larger community, and mother's viewpoints on teaching both social and linguistic aspects of the native culture. The interviews were recorded in their entirety on video to include caregiver's use of any gestures or other body language to further explain an answer.

3.3 Procedure

Each participant family was visited at three different collection periods over the course of one year (between approximately 1;1 and 2;1), where each collection period consisted of a first (Section 3.3.1) and a second visit (Section 3.3.2) approximately one week apart. These visits occurred when the infant was around the average ages of 1;1, 1;5 and 2;1. In order to be as unobtrusive as possible, only one researcher and one local assistant were present at these visits. Local assistants were responsible for

explanations and translations made in the native languages of Changana (rural area), and Ronga or Portuguese (urban area).

Before each data collection period, research assistants were trained how to administer the questionnaires and MBCDI checklists, as well as informed what types of responses were expected. This made it easier for assistants to ask further probing questions if the caregiver's response did not address the topic clearly. The families were supplied with no foreign toys or objects, as this can change the normalcy of interactions. A pack of locally sold biscuits was provided as a snack for the infant, and given to their mother to distribute as seen fit. Since infants regularly have small snacks during the day, this was not considered inappropriate and did not offer irregular interactions as parents received the biscuits for distribution. Parents received no monetary compensation, but were offered small gifts, such as an infant t-shirt, an adult baseball hat and a family photo album, respectfully distributed at the end of each subsequent visitation as a sign of respect and gratitude for their participation.

3.3.1 First Visit of Each Collection Period

Families were visited at their own home per appointments made when they first volunteered to participate. Upon arrival, researchers and assistants were offered seats with the family, and once everyone was settled, the eldest family member present would greet the researchers. This is a conventional process of greeting guests, and we abided by these traditions. Family members were informed of the visitation process and procedures before beginning, and asked if everything was clearly understood. The first visit of each period contained the following phases in this order:

3.3.1.1 Questionnaire

Mothers were asked to provide information concerning the background of the families, the household situation, health issues, and mothers' perceptions of infants' cognitive development (See Appendices 1, 2 and 3). The questionnaires were administered in

face-to-face interviews by the research assistants in their mother tongue due to illiteracy within the sample populations. We (i.e., myself and Vogt) monitored the dialogue pertaining to each question to ensure that all queries were phrased correctly by assistants, understood fully by the responding parent, and that the most appropriate response was selected. Where necessary, we provided comments and/or explanations to the research assistants to assure the proper response was recorded.

3.3.1.2 Accommodation session

After collecting questionnaire data, we conducted an accommodation video session of 30 minutes, to allow the infant and other communication partners to become accustomed to the researcher's individual presence as strangers, and that of the recording equipment itself. In order to ensure natural interactions, and not fabricated ones (Hughes et al., 1993), the caregivers and others present were *only* given three instructions:

- To continue with their regular daily routines as if we were not present.
- To not leave the general household area.
- To not position or move the infant participant for our viewing benefit.

The camera was positioned anywhere from 5 to 15 meters away from the participant and family members (Figure 3.5), and focused continuously on the participant. The majority of household activities occur outside of the house, in the open areas immediately surrounding the families' homes. Given the hot environment of Mozambique in general, most activities occur within any of the shaded areas around a household (Figure 3.5). For this reason, and the length of time spent filming, researchers selected a separate shaded area along the perimeter of the household from which to record interactions.

Depending on housing conditions and space restrictions in the urban environment, filming occasionally had to be done by hand, anywhere from 2 to 5 meters from the

participant and family members. While videotaping, researchers made minimal movement from their starting position, and kept their gaze obscured from the infant by wearing a hat and observing through the camera viewfinder. These techniques allowed researchers to minimize any possible input the infant might receive, thus drastically cutting down the chance of the infant observing or interacting with the researcher.

Figure 3.5: Visual representation of naturalistic observation recording at a rural family's homestead.

After completing filming, we thanked the families for their time and cooperation. An appointment for the following week was made, and confirmed via telephone, if possible, the day before the second visit.

3.3.2 Second Visit of Each Collection Period

At the second visit in each collection period, usually the week after the first visit, the family greeted researchers in the same manner as the first visit. Then, caregivers and other family members were reminded of the same three instructions from the accommodation session the week prior. Immediately following, the video session started, which was used for data analysis. We assumed that starting the observation immediately without first asking questions would help ensure that the engagements recorded were naturalistic, and not influenced by the questions asked of the caregivers

or our presence. In addition, as the first visitation ended with video recording, it was more cohesive to begin the second visit with this same process. The observation recording took between approximately 45 to 75 minutes, which was to ensure that there would be 30-minutes of usable video data. Bakeman and Adamson (1984) relied on 10 minutes of video data per condition, Carpenter et al. (1998) used the same quantity of video data, and Childers et al. (2007) analyzed 15 minutes of video data. As these studies are semi-structured observations and involve more constrained scenarios of engagement, we decided to increase the amount of analyzed video data to 30-minutes since our data involves naturalistic observation and there may be more transitional segments of time between interactions. Written field notes were made of every 5-minutes of recording because there are many obstacles in using naturalistic observation data that could cause part of the data to be unusable or not code-able. Once the accumulation of usable data from field notes surpassed 40 minutes, recording stopped. A simple example of field-notes is provided in Table 3.2.

Table 3.2. Hypothetical example of live field notes.

Time	Comments
0:00 – 5:00	Family adjusting to presence of researcher and came
5:00 – 10:00	Child playing w/ sibling, mother
10:00 – 15:00	Eating snack
15:00 – 17:00	Running around w/ peers
17:00 – 20:00	Infant off-camera, inside house
20:00 – 25:00	Playing game w/ family
25:00 – 30:00	(cont'd)
30:00 – 35:00	Eating; Change clothes
35:00 – 40:00	Infant is blocked from camera by other child
40:00 – 45:00	Too much wind to hear
45:00 – 48:00	Breastfeeding w/ mother

At the end of each second visit, MBCDI parental checklists were administered. This was completed last because it was not only time-consuming, but also so that the vocabulary from the checklist did not become an unnatural focus of the observational data. Local research assistants administered the MBCDIs with primary caregivers through face-to-face interviews. For each word, caregivers were first asked whether or not their child spoke that word. If the caregiver responded that the child did not speak the word, they were then asked if the child understood the word when it was used in dialogue or instructions. Sometimes, parents chose to ask other members of the household for confirmation in regard to the infant's knowledge of a specific word.

The researcher present closely monitored MBCDI interviews to ensure that caregivers understood the questions asked of them, and that assistants did not misunderstand a response. An example that was continuously difficult, and eventually removed, was the word *laugh.* Occasionally, parents responded by saying, "Of course my child laughs," which pertains to the action, not the vocabulary word. In case of misunderstandings, researchers interrupted and reminded the parents that the words being asked pertain only to known vocabulary, and not to their child's actions, experience or demeanor. Because of this confusion, words that represented actions were regularly clarified when asking parents. Very few items on the adapted MBCDI wordlists fell under this category, and other word classes offered no confusion to mothers. Depending on parental responses and necessary dialogue, administering the MBCDI took between 15 and 30 minutes to complete. After completing the MBCDI checklists, we ended the second family visitation. Parents and family members were informed that we had completed the necessary research for the appropriate collection period, and we would be returning when infants were about 1;5 and 2;1, to continue with subsequent research.

3.3.3 Semi-Structured Interview at Close of Field Study Participation

At the end of the second visit of the third collection period, which marked the end of field research, a short semi-structured, face-to-face interview was administered (Appendix 5) concerning mother's beliefs about caregiving, infant socialization and learning. I chose to do such an interview in order to obtain a deeper ethnographic understanding of the non-industrial communities studied. Such an interview technique allowed mothers to speak freely about what they do with infants and why, which can add valuable information later when trying to understand the implications of data analysis results.

3.4 Data Analysis

This section discusses how field data was analyzed. I describe the way the videos were analyzed and how inter-rater agreement was assessed in Section 3.4.1. Next, in Section 3.4.2, I cover the statistical analyses implemented for data analysis in later chapters. Finally, I discuss the way parental checklists and parental interview responses are analyzed in Section 3.4.3.

3.4.1 Video Analysis

The analysis of video data is a structured and step-by-step process, which is reflected in the layout of this section – selecting data, use of coding schemes, and validation of coded data. First, we must review how analyzable data is compiled. Video data retrieved during each second visit to families was used for data analysis, while the videos taken for accommodation sessions were excluded from analysis. This meant that for each collection period – from 1;1, 1;5, and 2;1 – there was one video used for data analysis for each volunteer family from both non-industrial communities. This video data was of various lengths, ranging from 45 to 75 minutes, and the targeted amount of engagement for analysis was 30 minutes per collection period.

To analyze the videos of naturally observed infant engagement, we first had to select extensive code-able fragments summing up to approximately 30-minutes per video, second we coded engagement levels using my categorization, and third all joint engagement levels were coded for communication partner type, based upon a six-code system representing individuals based upon age-ranges, mothers and groups as well. These three steps are presented in Section 3.4.1.2. I also present how the categorization presented in this dissertation can be re-formatted in order to assess the benefit of using naturalistic observation data as well as an extended version of infant engagement level categorization. All coding was completed in ELAN[6] (Wittenburg, Brugman, Russel, Klassmann, & Sloetjes, 2006), which is a professional tool for the creation of complex annotation on video and audio resources.

Additionally, within the broader scope of the CASA MILA project, the 30 minute fragments were coded for multimodal behavior of both infant and communication partners. The multimodal behavior coded includes: gestures, eye-gaze, CDS and child speech. Furthermore, all speech was transcribed in the local language with the help of local assistants and translated into Portuguese; Vogt and I made the final English translations. These additional tiers are beyond the scope this dissertation, and therefore will not be presented (for further information, consult Vogt et al., 2013; Vogt & Mastin, 2013a).

3.4.1.1 Selecting video data

From each video session approximately 30 minutes (*Mean* 27:57; *SD* 01:52) of natural, clear interactions were compiled. This compilation was made up of selections of prolonged duration, which provided data of clear situations in which the infant (and their communication partner) displayed 'naturalistic' behavior (e.g., not sleeping, not off camera, not interacting with or disturbed by the researchers) that was recorded

[6] *http://tla.mpi.nl/tools/tla-tools/elan/*

properly (i.e. while the infant was on camera, and no other conditions disturbed the recording).

While conducting naturalistic observation data collection, there are a variety of circumstances that can lead to unusable video time, most of which relates to the environment and community setting of these recordings. For this reason, the 'live' field notes were taken, as mentioned in Section 3.3.2, in 5-minute segments during recording, and documented what was occurring during observation recordings. All field notes were used as a general map to what would happen during each video.

In the example from Table 3.2, the first 5-minute segment is excluded, one 3-minute segment is excluded, and a longer 10-minute segment is also excluded. During the 3-minute exclusion the infant is entirely off-camera so one cannot ascertain what if any engagement levels are occurring. If the infant's perspective could not be reasonably ascertained, then such segments were left out of the selection. Turning to the 10-minute excluded data, there are a few different reasons for exclusion – one reason is because another person is blocking the camera's view of the infant, and the other reason is because of the filming environment. It may be possible that during these 10 minutes there are some brief interactions that are visible and code-able; however, it could be that these interactions are taken out of context if surrounding video material is excluded. For this reason, data that occurred in continual and lengthy stretches of engagement was preferred.

Field notes gave warning to extended periods of unviable data or where normal behavior was frequently interrupted, but shorter periods also occurred and were excluded as need be (e.g., something blocks camera view of infant, infant leaves view momentarily). In addition, segments were excluded where the infant tried to interact in any way with the researcher, or attended to the researcher's presence for longer than 10 seconds. These instances were excluded so as to limit the amount, if any, of infant engagement with researchers. The result of this selection process is that there was not any preference to select or omit any specific type of engagement, as this would

skew the data and cause problems with understanding the contextual information possibly contained with an interaction.

3.4.1.2 Coding scheme

As mentioned previously, the video data collected from field research is coded on various levels in ELAN, but for this dissertation only two levels of analysis are discussed. First, the coding scheme of individual engagement level categories are presented and defined. Second, the procedure for coding engagement levels is discussed. Third, the categorization and coding of communication partners are presented, which is depended on engagement level coding and handled in sequence.

Engagement levels. The following engagement level categories and their descriptions resulted from the 18 possible component combinations analyzed in Section 2.4.3:

1. Unengaged. The infant is present, but is not interacting with any specific partner, object or activity. This applies to situations when the infant scans the environment, but the infant's attention is not fixed on anything. Furthermore, when an infant is moving towards a non-human object, or towards a human partner, but does not reach said target due to a change in attention, then this is also considered unengaged.
2. Onlooking. The infant fixes his/her attention on a partner (or even animal), but makes no effort to engage with said partner. What is distinct about this level of engagement is that whatever the infant is focused on, it is animate but is not actively interacting with a target object. A basic example of this is when an infant's attention is drawn towards a person or animal that is moving across their field of vision, but no target object is attended to. This category also applies to when the participant fixes their gaze on the researcher for a period of less than 10 seconds; when this period of fixated gaze on the researcher exceeds 10 seconds, then the entire interaction is not coded since it is considered a disruption to the natural occurrences.

3. Objects. The infant is manipulating or interacting with a specific non-human object(s), but does not include or attend to any possible partners that are present in the immediate environment. Typically, the infant's attention is focused on an object (target) through eye-gaze and/or physical manipulation. Examples of this include playing with toys, eating food by themselves, and even slapping a hand against the surface of an object.
4. Observing. The infant is observing an activity or event that is being undertaken by others within their vicinity. A basic example is when a mother is preoccupied with a given household chore (e.g., laundry), and these actions overtly captivate the infant's attention, sometimes to the point of imitation or even mimicry. This is different from the category of *Onlooking*, because the partner is now attending to or interacting with a target object/event. However, the action being undertaken by the partner is not for the benefit of attracting the infant's attention, nor is he or she necessarily aware of the infant's attention.
5. Persons. The infant is involved in a dyadic (or polyadic) event with a communication partner(s), directly through touch, person play, or reciprocated speech. This applies to times of breast-feeding as well, due to the direct human contact and intimacy between infant and caregiver. Crucial is that the interaction does not involve an overt external target object or event. Only when a tool is used as an extension of a person, such as when a caregiver cleans the infant's face with a cloth, this is applied to this category because the object is not a target object, and thus does not result in a triadic interaction. In addition, episodes where an infant tries to create a triadic event including a target object, but the partner does not take note of the target at all, are also coded as *Persons* engagement, provided the partner responded to the infant in some interactional manner, since that was the maximum state of engagement achieved.

6. Passive Joint Attention. A communication partner shares the infant's attention to a target or activity, but the infant does not attend to the initiator or any other partner. The prime example of Passive-JA usually involves a partner showing a target of interest to the infant and enticing them to play with said target, but the infant's attention does not exceed the target introduced to her/him. The main point here is that the infant does not display overt awareness (checking) that the partner is attending to the target as well. Though this is defined in terms of the infant's perspective, these roles can be reversed, where the partner is not overtly aware of the infant's attention on a target that the infant introduced to the partner.
7. Shared Joint Attention. At this level of engagement both the infant and a communication partner attend to the same target object or activity; in addition, both infant and partner are aware that the other's attention is focused on each other and the same target object or activity, but neither coordinate their attention to create a triadic event involving a mutual interaction goal. For example, an infant is attending to an activity undertaken between two peers and a toy (the infant is in *Observing* engagement), a communication partner also attends to the activity, the infant and partner then both check the attention of the other, become aware they are both attending to the same target, and continue attending jointly to the external activity. At this level of engagement, both parties are aware of the other's attention on an external target, and this attention is shared, but there is no overtly understood or shared interaction goal that is mutually coordinated.
8. Coordinated Joint Attention. The infant and a communication partner are actively involved with a target object or activity. Their attention is shared, they are both aware of the other's attention, and this shared attention has been directed towards a mutual interaction goal through the use of explicit cues, gestures and/or directions. For example, an infant walks up to her/his mother holding a target, the infant looks at the target, then at the mother and extends

the target; the mother looks at the target and then to the infant (or vice versa) and either takes the target that is being offered, directs the infant's attention to another partner by a hand gesture or nod, or responds to the child verbally through speech or physically through touching or holding the infant. Also, the offering/requesting for breastfeeding is considered *Coordinated-JA*, and if the infant settles into the action, then this becomes a *Persons* interaction because the target (the mother's breast) has been obtained. (Not doing so would skew results towards greater amounts of *Coordinated-JA* than is actually occurring.)

9. Unknown Attention. The infant is present, but line of visual interest cannot be ascertained. This applies when something or someone obstructs the field of view, the infant hides their face, the infant is too far away from the camera, or the video footage is out of focus. While this level of engagement is used for coding purposes, it is neither included in the 30-minute criterion nor in any statistical analyses. These occurrences are not the same as extensive exclusions of video as discussed in 3.1.4.2, but are shorter and regular moments where the infant's point of view cannot be ascertained, and generally only last a few seconds.

Coding procedures. Either Vogt or myself coded videos individually. Engagement levels were coded first, followed by communication partner type afterwards for only joint engagement levels. Following Bakeman and Adamson (1984), a minimum of two seconds of fixated attention or interaction is required for each category of engagement; otherwise segments of less than two seconds are not differentiated from the surrounding types of interaction. For example, if an infant is interacting with a toy alone (*Objects*) and looks up at a passing partner in their field of vision (*Onlooking*) for less than two seconds, and returns to playing with the toy (*Objects*), then the occurrence of *Onlooking* is not coded, and is absorbed into one lengthy *Objects* engagement. Interactions which were hard to interpret, or were more complex, were marked during individual coding and examined later jointly, in order to make a mutual,

final coding decision. General issues concerned: whether or not an interaction was one unique engagement or multiple engagements; if an individual's point of view could be verified; what goals were involved and how; what referent does an action or interaction refer to; and how to deal with group engagement. One specific example was when an infant is crawling across the ground. This ultimately depends on what the infant's goal is, if there is even a discernable goal at all. It was decided that if an infant followed a direct path to a target and attempted to interact with the target, then the engagement would be either *Objects* or *Persons*, and was coded as such from the time the infant began to approach the target. However, if the infant did not reach any target, or changed their path, or wandered aimlessly, then the infant was *Unengaged* during their movement, as this was considered a mobile manifestation of 'scanning one's environment' (Bakeman & Adamson, 1984).

Another example of general coding issues relates to the aspect of *corresponding behavioral responses* in joint engagement. Imagine that an infant is playing alone on the ground, their mother kneels down and introduces another toy, the infant watches the manipulation of the toy, glances up at the mother's body (but not her face), and then takes the toy and plays with it in the same fashion as the mother. Under Bakeman and Adamson's (1984) categorization, this interaction would be classified as *Passive-JA* because the infant does not make eye contact to verify the direction of the mother's attention. However, one must presume that the infant has some level of associated awareness, and may be able to recognize the communication partner's attention by multiple other aspects of the interaction: the partner is actively manipulating the toy; the body posture of the partner as 'kneeling down' to the infant localizes their possible field of attention; any additional speech or vocalizations. In this example, we consider the infant's upward glance toward the mother as attending to the mother, and desire for the infant to play with the object. As the infant then takes the toy into ownership and plays with it as the mother did, this is considered an appropriate corresponding behavior relating to their mutual interaction goals, thus resulting in a realization of this interaction as *Coordinated-JA* based upon my categorization of engagement levels.

Whether or not there is eye-gaze coordination cannot always define joint engagement categories, as it is not sufficient in itself for all types of engagement (Carpenter & Liebal, 2011).

Engagement roles. The type of communication partner that infants interacted with was coded subsequent to engagement levels, and only coded for categories of joint engagement: *Persons, Passive-JA, Shared-JA,* and *Coordinated-JA*. Two other categories of engagement involve other individuals, *Onlooking* and *Observing*, but those were not included in this analysis as these two engagements are not interactive. The only partner label that was based upon kinship relation was that of the primary caregiver, which was the mother, whereas, other partner labels were differentiated by age-range. The following communication partner categories were used as the coding scheme for annotations when the infant is actively involved in joint engagement:

1. *Peer*: a communication partner less than 6 years of age
2. *Sibling*: a communication partner between 6 and 16 years of age
3. *Adult*: a communication partner over 16 years of age
4. *Mother*: the primary caregiver
5. *Multiple* + *Mother*: more than one interacting communication partner, including the primary caregiver
6. *Multiple*: more than one interacting communication partner, NOT including the primary caregiver

We designated people over the age of 16 as adults because the youngest mother in the study was 16. In addition, since we had no records for the exact ages of all people present in videos, ages had to be estimated at times, and a judgment of age was based upon both physical appearance and social maturity. For the analysis of infant social networks, Chapter 6, two additional versions of this six-level partner categorization are applied to data analysis. One of these versions is a two-level analysis that compares

mothers with all other communication partners. The other is a 24-level analysis, which looks at each partner category by type of joint engagement.

To create the two-level categorization, I used the six-level analysis outlined above and summed categories together. The *Mothers-Total* category is created by combining the proportion of time spent in engagement with the *Mother* and with *Multiple+Mother*. It was decided to include *Multiple+Mother* in the category of *Mothers-Total* even if there are other partners involved because mothers may be supervising or orchestrating the entire interaction in these group interactions. The *Others-Total* category combines proportions of the remaining four partner categories: *Peers, Adults, Siblings* and *Multiple* group engagement. To create the 24-level categorization, I allocated the proportions of engagement spent with the six-level partner categorization by each of the four different joint engagement levels (*Persons, Passive-JA, Shared-JA,* and *Coordinated-JA*) coded for partner type. Based upon the increasing complexity of engagement, as well as the increasing age of communication partner categories, thus implying also competency, it seems appropriate that a more extensive separation of interaction variables might yield more informative results.

Reconstructing coding categories in previous research. In order to assess the value of using naturalistic observation data, rather than data of semi-structured observation methods, I compare our engagement level proportions to results of both an industrial and non-industrial study in Section 4.2. To do so, I re-analyze the naturalistic observation data from age 1;1 with the classifications of engagement levels used by Bakeman and Adamson (1984) and replicated by Childers et al. (2007). The same comparison is not made with Carpenter et al. (1998) because the age of their infant subjects is not comparable. While this assessment involves the application of Bakeman and Adamson's (1984) original classification of engagement levels, some adjustment of the categorization (Section 3.4.1.2) is needed. However, applying their classification does not exclude any of our coded observation data of engagement levels, thus

allowing for the closest possible comparison of this non-industrial observation data to other methods of data collection in different cultures.

To replicate Bakeman and Adamson (1984), I add the category of *Observing* back to the communal category of *Onlooking*, and also add the category of *Shared-JA* back to the communal category of *Coordinated-JA*. Additionally, the same comparison is provided for Bakeman and Adamson's (1984) developmental changes between 1;0 and 1;6 with my data from 1;1 and 1;5, again applying their engagement level categorization. Direct statistical comparisons are not possible as the results from previous studies focus on different cultures, apply different methods, and only provide mean percentages without standard deviations or original data. However, some descriptive comparisons can be made through a cautious set-up.

As seen in Section 2.2, Childers et al. (2007) provide this same comparison to Bakeman and Adamson's (1984) results based upon a six-level engagement categorization; however this comparison was only a small part of their discussion and not fully actualized. The comparison made in Section 2.2 is justified because the studies by Bakeman and Adamson (1984) and Childers et al. (2007) only differ based upon industrial versus non-industrial cultural environments, while implementing similar methods. On the other hand, the data presented in this dissertation differs from Childers et al. (2007) mostly from a methodological standpoint. Thus, it is possible to extrapolate some differences between Bakeman and Adamson's results (1984) and those presented herein, only if Childers et al.'s results (2007) are used as a mediator. Furthermore, any assumptions drawn from this descriptive data comparison can as of yet not be justified entirely.

In Section 5.3, I also provide an analysis to assess the differences between correlations to vocabulary development using an extended or a manipulated classification of engagement level categories as seen in Table 2.1 (Section 2.2). To do so, I apply the 'adjusted' tri-level categorization of Childers et al. (2007) and the two triadic engagement categories used by Carpenter et al. (1998) to the non-industrial naturalistic observation data, and analyze how different the results are when

correlated with the same MBCDI scores. To replicate Childers et al.'s (2007) tri-level classification, I first complete the same additions as done to replicate Bakeman and Adamson (1984), then further combine the categories of *Unengaged* with *Onlooking, Objects* with *Persons,* and *Passive-JA* with *Coordinated-JA.* To replicate Carpenter et al.'s (1998) classification of engagement levels, I only had to add *Shared-JA* to their category of *Joint Engagement**, as well as *Observing* to the category of *Passive-JA* in order to equal their *Attention Following* category. The categories of *Unengaged, Onlooking, Objects* and *Persons* engagement are not included in their correlation analysis, and thus not needed for this assessment.

3.4.1.3 Inter-rater agreement analysis

After Vogt and I each coded the video data from 1;1, we each selected five videos each, at random, to exchange and code an arbitrarily selected 5-minute segment to calculate inter-rater agreement (~12% of all 1;1 data). A Cohen's kappa analysis of error showed a result of 0.62 for engagement level coding, and a result of 0.77 for communication partner coding, which are both considered substantial scores for inter-rater agreement (Landis & Koch, 1977).

In regard to the agreement for engagement level coding, some may consider this amount of agreement low, however the three other studies from which main comparisons are made each obtained inter-rater agreement scores that were not very different from our own: Bakeman and Adamson's (1984) Cohen's kappa ranged from 0.5 to 1.00 over the different conditions; Carpenter et al.'s (1998) Cohen's kappa mean was 0.75; and Childers et al.'s (2007) Cohen's kappa for infants at 1;2 was 0.62, and for toddlers at 2;1 it was 0.53.

For communication partners, this Cohen's kappa (0.77) may also seem less than expected since these categories are dependent and tied to engagement level coding. Due to the fact that partner codes are based upon age-range, ages had to sometimes be estimated by researchers. This meant that if one researcher decided a partner was probably 5 years old, then that partner was continually coded as a *Peer*. But if the other

research decided this partner was probably 7 years old, then that partner was continually coded as *Sibling*, which is certainly different from the other researcher, and would remain so for all codes involving that partner. This age-estimation difference most likely accounts for a majority of inter-rater disagreement.

In addition to assessing inter-rater agreement for how data was coded for engagement levels, it was also worthwhile to evaluate the use of an extended engagement level categorization. The main goal was to assure that the different possible combinations of interaction components that represent engagements, as presented in Table 2.3, were each identifiable to novice coders. Thus, overall, this experiment could test more than one possible representation of each engagement level. To do this, a small-scale experiment was designed. The experiment tested the presence of goals in infant engagement using video examples of different infant engagements form both an industrial and non-industrial community. In this manner, I was able to ascertain if the differentiation of novel categories, as well as the entire spectrum of engagement levels, was intuitive when individuals unfamiliar with this topic of research were presented with coding tasks. The results from this experiment (see Appendix 6) lend support to the categorization of engagement that is created by a component-based analysis including mutual interaction goals as an explicit component of possible infant engagement. The data show that the participant's responses are applied reliably, which suggests that educated persons with normal social and cognitive development have the ability to interpret mutual interaction goals and some aspects of coding infant engagement after only a brief training session.

3.4.2 Statistical Analysis

Once coding was complete, the data was exported from ELAN. For each of the eight engagement levels the proportion of time spent engaged was calculated by dividing the total duration of each category by the total duration of all engagement levels coded in each video. This normalization was done because the total duration of code-able data in each video did not sum up to exactly 30 minutes (*Mean* 27:57; *SD* 01:52). With these

proportions I compare engagement levels between urban and rural sites at each collection period, as well as the developmental changes between these collection periods, for significant differences. Since this data relies upon a rather small sample size, the data does not pass all assumptions of normality, so I therefore use non-parametric methods for statistical analysis. In the case of comparing proportions across non-industrial sites, a Mann-Whitney U test is used, and when comparing proportions within sites, a Wilcoxon Signed-Rank Test is used. All significant differences for p-values are indicated following the standard conventions: $^{+}p<.10$; $^{*}p<.05$ and $^{**}p<.01$.

The second part of the analysis of engagement level proportions using this categorization involves correlations with vocabulary size. To calculate correlations between the proportions of time spent in engagement levels and vocabulary size, I used the Spearman's RHO correlation coefficient. This test was chosen for two reasons – first, the sample size is too small for calculating an accurate Pearson's correlation coefficient; second, due to individual variation, the data benefits from ranking (Elliot & Woodward, 2007). Correlations are analyzed between engagement level proportions from each collection period with concurrent and later MBCDI vocabulary scores. Correlations were also run between the proportions of engagement levels per communication partner, and infant's vocabulary scores at all concurrent and later collection periods. This created the following three separate organizations of joint engagement proportional distributions that were correlated with vocabulary scores from the three data collection periods:

1. 1;1 Proportions: 1;1, 1;5 and 2;1 Vocabulary
2. 1;5 Proportions: 1;5 and 2;1 Vocabulary
3. 2;1 Proportions: 2;1 Vocabulary

Usually one would apply a correction for multiple comparisons in such an analysis, but since this is an exploratory analysis of an under-studied culture, I cannot be certain of what possible correlations or patterns may emerge. For this reason, I do not apply a

correction for multiple comparisons. Thus, the alpha-power could be considered higher than $p<.05$ when taking all correlation analyses into account simultaneously.

Given the fact that multiple regression analysis has become increasingly popular with exploratory data on child language acquisition research, I did attempt to provide both preceding correlation analyses via multiple regressions. Unfortunately, due to a number of factors – the hierarchical nature of engagement levels and communication partners, the range of individual variation, the small sample size, and the number of different predictors – multiple regressions was not an applicable analysis for this data. Due to the fact that engagement is part of a spectrum of possibilities, there is a high colinearity of predictors for engagement levels as well as communication partners. Since there is a range of variation within such a small sample size, I'm not able to remove outliers from the data, and the multiple regression analysis is not able to take these into account. In addition, as the data is non-parametric, correlations were based off of Spearman's RHO, but multiple regression analysis is based off of Pearson's correlates. Finally, and most important, is that for a multiple regression analysis involving either engagement levels (8 predictors) or communication partners (6 predictors), the sample size is much too small. Table 3.3 presents the sample size requirements for multiple regression analysis of behavioral research data.

Table 3.3. Sample size required to test the hypothesis if the population multiple correlation equals zero with a power of .80 (alpha = .05). Adapted from Green (1991) Table 1.

Number of Predictors	Sample sizes based on power analysis Effect size		
	Small	Medium	Large
1	390	53	24
2	481	66	30
3	547	76	35
4	599	84	39
5	645	91	42
6	686	97	46
7	726	102	48
8	757	108	51

For our study, this means that to evaluate even large effect sizes, a sample size of at least *n=51* is necessary. For these reasons we only analyzed relations between proportions of time spent in types of engagement and vocabulary size using Spearman's RHO correlations.

3.4.3 Parental Interview Data

Responses from MBCDI parental checklists were tallied at the end of data collection during each second visit of each collection period of the study. Each infant's MBCDI score for every checklist was maximally *n*=108, with no division of words by grammatical type. While it was important to distinguish between words spoken and those understood, only the expressive language score is used for analysis within this dissertation because the measure is considered more reliable than receptive vocabulary, which parents can easily under- or over-estimate scores (Section 1.2.4).

All parental interviews occurred between the mother and the local research assistant, with close supervision by one of the main researchers present. Questionnaire

responses usually involved the selection from a scale of responses, which sometimes required further clarification. This data is certainly quantitative, as it was restricted to more specific responses, but the further clarifications offer some qualitative aspects.

To add to the qualitative information, open-ended semi-structured interviews were completed at the end of data collection with each mother. Each question from this interview primed responses from mothers to include concrete descriptions or examples. Interview videos were transcribed and translated by the same local research assistants that facilitated each interview. I then tallied mothers' responses based upon repeated keywords, concepts or examples, which are presented in Section 6.1.

ENGAGEMENT LEVEL PROPORTIONS IN RURAL AND URBAN NON-INDUSTRIAL COMMUNITIES

This chapter addresses the proportional distribution of engagement levels of infants at three developmental stages (1;1, 1;5, and 2;1) living in rural and urban non-industrial communities. Section 4.1.1 provides proportions of the eight engagement levels defined in Section 3.4.1.2. Results show that there are significant differences in proportions of engagement levels across non-industrial sites, as well as significant differences across data collection times periods within only the urban site. Section 4.1.2 provides an in-depth discussion of the significant results and site differences.

Section 4.2 provides a descriptive comparison between the naturalistic observation data, and the data retrieved using semi-structured observation methods in an industrial and a non-industrial study. To do so, in Section 4.2.1, I first classify my naturalistic observation data using the original engagement categorization of Bakeman and Adamson (1984). Childers et al. (2007) provided the same comparison, which was discussed in Section 2.2. As there are too many factors that differ between the CASA MILA design and that of Bakeman and Adamson (1984), only a piece-meal, descriptive comparison is applicable. By using this process, in Section 4.2.2, I provide a discussion on the effect of different methods (naturalistic observation vs. semi-structured observation) to study engagement in various cultures (industrial vs. non-industrial).

Finally, in Section 4.3, I provide a summary of the various results presented and discussed in this chapter. While the proportional distribution of engagement levels is able to shed more light on the cross-cultural issue of engagement, as well as the difference in data collection techniques, a deeper analysis is necessary concerning the relation between different engagement levels and vocabulary development, which is discussed in Chapter 5.

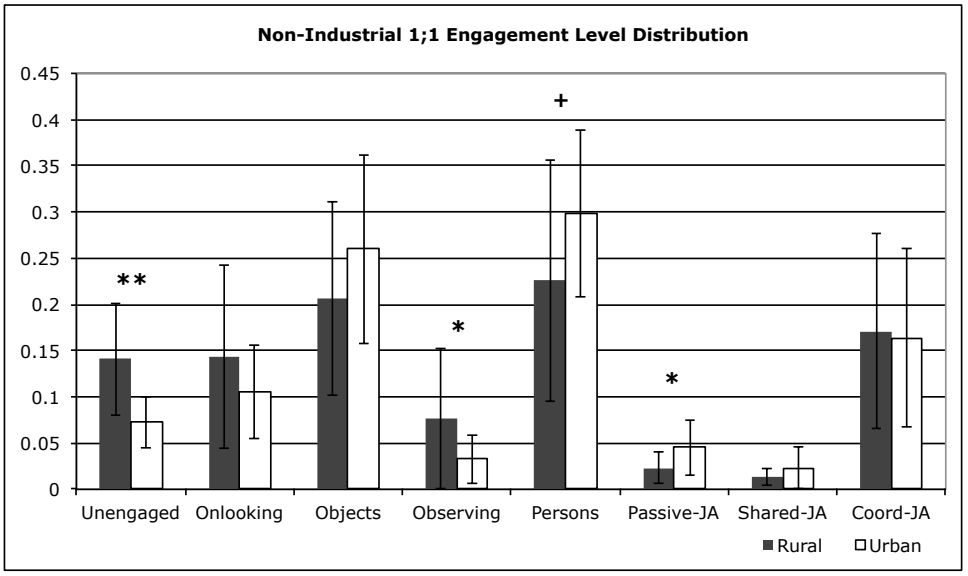
4.1 Proportional Distribution of Engagement Levels in Mozambican Sites

This section looks at the statistical differences between rural and urban non-industrial sites in terms of engagement levels' proportional distribution at three collection

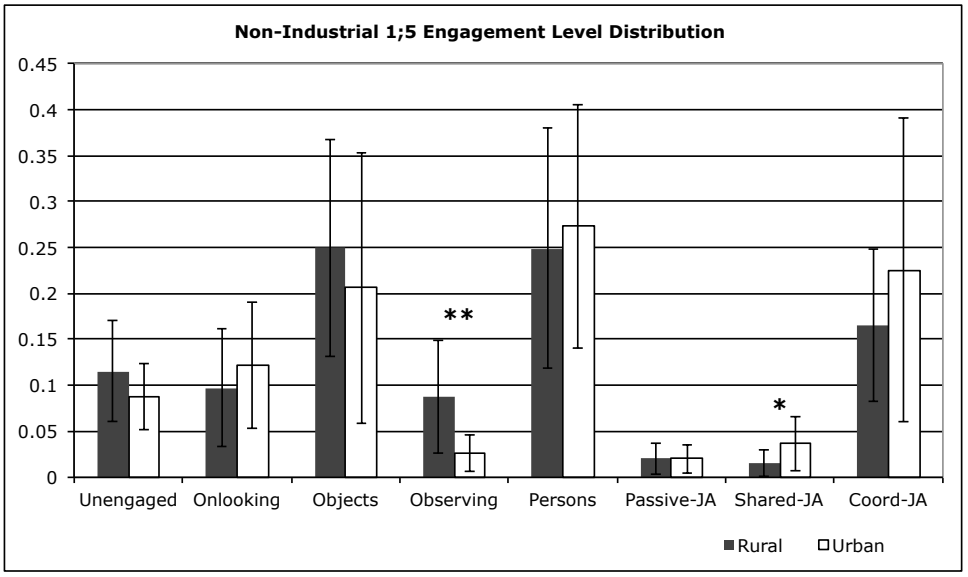
periods over the second year of infant development (1;1, 1;5, and 2;1). Proportions are based off of the 30-minute video data compilations (Section 3.4.1.2) collected observationally at each second family visit (Section 3.3.2) of every collection period. The mean *occurrences* engagement level in both sites for all collection periods are provided in Appendix 7.

4.1.1 Results

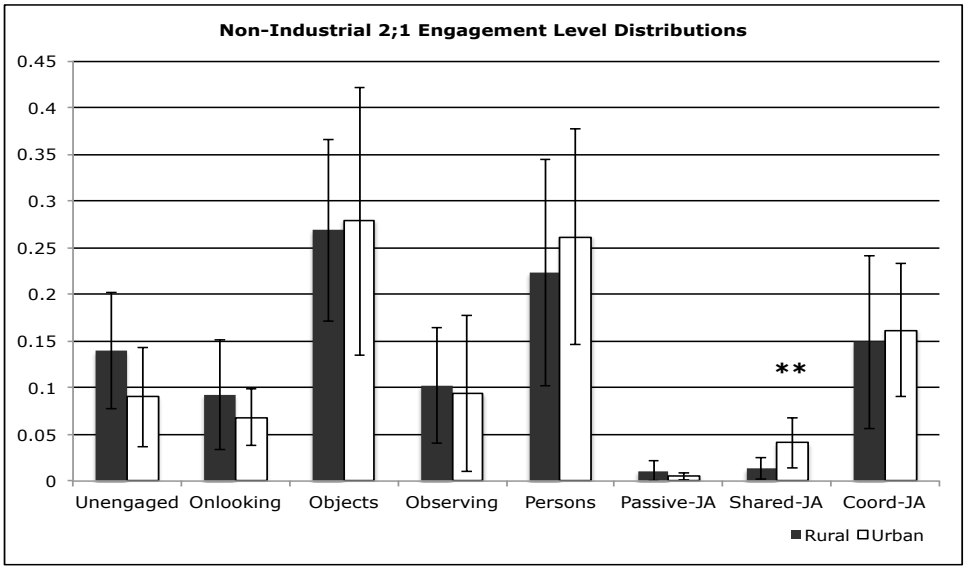
Figure 4.1 presents data on the proportions of time spent in engagement levels at 1;1, 1;5 and 2;1 as compared across rural and urban sites. Mann-Whitney U tests are applied for this analysis. At 1;1 (Figure 4.1a), three engagement levels' proportions are significantly different between sites. Infants in the rural area spend significantly more time *Unengaged* ($U=32$; $p<.01$) and *Observing* engagement ($U=49.5$; $p<.05$) during naturalistic observation, whereas urban infants spend significantly more time in *Passive-JA* engagement ($U=54$; $p<.05$). The higher mean proportion of *Persons* engagement in the urban community nears a significant difference ($U=57$; $p=.06$).


Non-Industrial 1;1 Engagement Level Distribution
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
**
*
+
*
Unengaged
Onlooking
Objects
Observing
Persons
Passive-JA
Shared-JA
Coord-JA
Rural
Urban

(a)


Non-Industrial 1;5 Engagement Level Distribution
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
**
*
Unengaged
Onlooking
Objects
Observing
Persons
Passive-JA
Shared-JA
Coord-JA
Rural
Urban

(b)

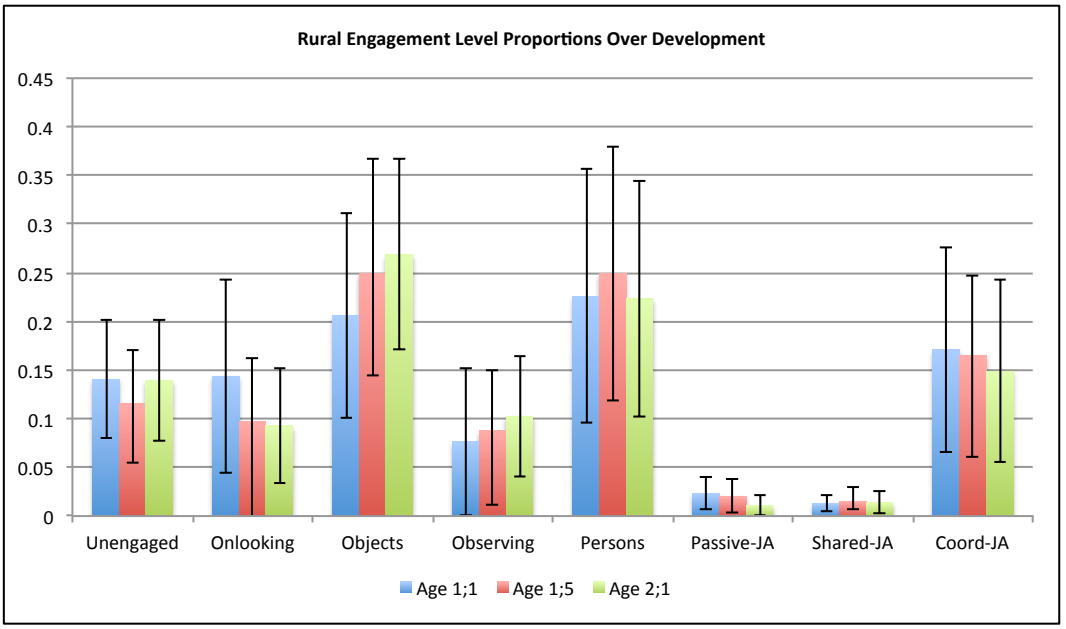


(c)

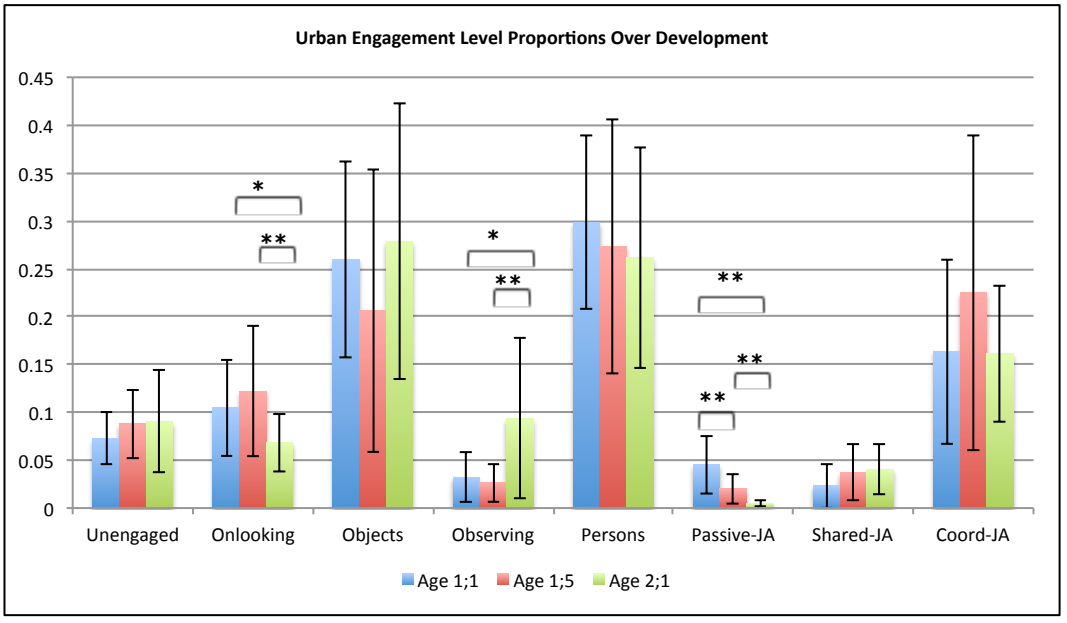
Figure 4.1: Mean proportions of time spent in engagement levels from naturalistic observation data at (a) 1;1, (b) 1;5, and (c) 2;1 in non-industrial rural and urban sites. Bars indicate the average proportion of time that infants engage in a certain engagement level. Error bars indicate standard deviation. A two-tailed Mann-Whitney U test was used to compare sites. *p<.05; **p<.01

Four months later, at 1;5 (Figure 4.1b), *Observing* engagement in the rural site is still significantly more frequent than in the urban site (U=31; p<.01), and now *Shared-JA* engagement in the urban site is significantly more frequent than the rural site (U=51; p<.05). And finally, at 2;1 (Figure 4.1c), only *Shared-JA* engagement in the urban site remain significantly more frequent (U=32; p<.01).

Figure 4.2 displays the development of engagement level proportions for rural and urban sites respectively. A Wilcoxon Signed-Rank test was used for within site comparisons across collection periods. In the rural area (Figure 4.2a), while there is a change between most engagement level proportions at each collection period, there are no significant differences of proportions between 1;1 and 1;5, between 1;5 and 2;1, and also between 1;1 and 2;1.



(a)



(b)

Figure 4.2: Mean proportions of all engagement levels analyzed within site across all collection periods for each site individually. Error bars signify standard deviations. Significance of differences are evaluated using a Wilcoxon Signed-Rank Test. *p<.05; **p<.01

In regard to the urban site, Figure 4.2b shows that there are significant differences between proportions of three engagement levels over development. Again, a Wilcoxon Signed-Rank test was used for within-site comparisons. Between 1;1 and 1;5, *Passive-JA* significantly decreases ($Z=-2.982$; $p<.01$). Between 1;5 and 2;1, *Onlooking* significantly increases ($Z=-2.731$; $p<.01$), *Observing* significantly increases ($Z=-3.107$; $p<.01$), and *Passive-JA* significantly decreases again ($Z=-2.982$; $p<.01$). Over the duration of the study, between 1;1 and 2;1, *Onlooking* significantly decreases ($Z=-2.291$; $p<.05$), *Observing* significantly increases ($Z=-2.417$; $p<.05$), and *Passive-JA* significantly decreases ($Z=-3.296$; $p<.01$).

4.1.2 Discussion

The first results to discuss concern the merits of analyzing engagement levels in both a rural and urban non-industrial sites across different ages. Results in Figure 4.1 show that infants in the two communities do have a similar pattern of engagement level distributions, but there are significant differences between engagement level proportions in these non-industrial sites. In the rural area, infants spend significantly more time in forms of solitary engagement – *Unengaged* at 1;1, and *Observing* engagement at 1;1 and 1;5 – whereas, in the urban area, infants spent significantly more time in forms of triadic engagement – *Passive-JA* at 1;1, and *Shared-JA* at 1;5 and 2;1. Over development, the data shows that there are no significant differences in rural engagement level proportions between data collection periods (see Figure 4.2a). In the urban area (see Figure 4.2b), however, there are three patterns of significant change over development: *Onlooking* and *Passive-JA* engagement both significantly decrease by 2;1, whereas *Observing* engagement significantly increases by 2;1.

A plausible explanation for these significant differences between engagement level proportions are based upon daily community lifestyles – specifically, the rural area relies upon subsistence farming for sustenance and income. Subsistence lifestyles are more demanding physically, require a greater distribution of labor, and entail a greater

amount of time invested in work. Because of this, adults must carry out more of the labor, whereas other family members are responsible for household or caregiving chores (Greenfield, 2009; Keller, 2012). This is specifically true in rural Mozambique: fathers work in South Africa, mothers work in local fields, and siblings, who are regularly available due to less accessible schooling, take care of lesser, daily household tasks. It could be assumed that the rural area implements a less child-centered approach to caregiving, as solitary engagement is more prominent than in the urban site (e.g., *Observing* engagement), which is less common in child-centered communities (Hoff, 2006; Schieffelin & Ochs, 1986). Furthermore, as presented in Section 2.4.2, the rural area herein follows Keller's (2012) milieu of traditional cultures as embodying social responsibility with action autonomy – meaning that the needs of the group are addressed through a distribution of responsibilities individually, usually based around age. As infants are unable to provide for their household, and other individuals have daily tasks to complete, this might result in an environment where infants spend more time in solitary engagement, rather than as active interlocutors, which would explain the significantly higher rural proportions of *Unengaged* and *Observing* engagement.

In a prototypical non-industrial urban area, on the other hand, daily life is more focused on individual specialization and intra-community markets, and education levels are slightly higher than in the prototypical rural area (Keller, 2012), which is precisely what is found in our Mozambican urban site. This cultural milieu has been described by Kagitcibasi (1997) as embodying mostly shared psychological autonomy with psychologically sanctioned social responsibilities – meaning that infants are actively involved by others in engagements that focus on communal interests, all the while learning the network of family responsibilities. This is not drastically different from the rural practice of social responsibility with action autonomy because there are still deep cultural roots shared with the traditional culture, since most of the population has migrated into an urban area over the last two or three generations (Keller, 2012). Such sociodemographics could account for the significantly higher urban engagement level proportions – *Passive-JA* and *Shared-JA* engagements could

occur more frequently in caregiving systems focused on the interests and goals of children in regard to object stimulation, such as industrial child-centered socialization (Bornstein & Putnick, 2012; Carpenter & Liebal, 2011; Keller, 2007; Keller, 2012; Keller et al., 2005), which provides more chances to try to coordinate attention and goals. It is also interesting to note that in our data *Passive-JA* and *Shared-JA* are continuously two of the least frequent engagements to occur, although many of the significantly different proportions between sites involve these categories of engagement. Yet a similar result occurred in Bakeman and Adamson's (1984) analysis of the distribution of *Persons* engagement between collection periods significantly decreasing from 7.6% to 4.6%. This raises less concern given the similarly infrequent amounts of *Passive-JA* and *Shared-JA* in our own data, especially since small mean proportions would generally also in turn have less variation across individual families in each community.

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The second aspect of results to discuss is the novel engagement level categories from the extended categorization. Both *Observing* and *Shared-JA* are represented as significantly different in these individual and longitudinal comparisons. In regard to *Observing* engagement, the data shows that this engagement occurs significantly more in the rural site than the urban site at both 1;1 and 1;5 (Figure 4.1). However, by 2;1 there is not a significant difference between sites because urban infants have significantly increased the amount of time spent *Observing* at 1;1 by both 1;5 and 2;1 (Figure 4.2b). This suggests that *Observing* to partners' goal oriented interactions is a more regularly occurring form of engagement during rural infant's second year of life.

In regard to *Shared-JA*, the results show that urban infants spend significantly more time than their rural counterparts in this form of engagement at both 1;5 and 2;1, and this significance increases with age. This could suggest that urban infants are exposed to more triadic engagement overall, and that as age increases, urban infants have a more likely chance of trying to coordinate attention given the concurrent, developmental significant decreases in urban *Passive-JA* engagement. Or, it could also

be the case that if the urban area implements a more child-centered approach to caregiving, then goals might have a greater chance of not being understood and aligned since communication partners are following into the infant's pre-existing attention (Tomasello & Todd, 1983**)**. In a situation-centered community, communication partners are more likely to direct infants' behavior and attention, allowing infants less freedom, and downgrading their role as a goal-oriented individual (Kagitcibasi, 1997; Lancy, 2008; Schieffelin & Ochs, 1986).

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Turning finally to the longitudinal development, the most interesting result is that there are no significant differences in engagement level proportions in the rural area between any of the data collection times periods. This allows for two possible assumptions that are not mutually exclusive. First, that the dynamics of infant engagement, regardless of other factors, may be continuous and stable in the rural area over development. This could be applicable based upon the regulated daily lifestyle of subsistence-based farming, where household tasks and chores vary only slightly between day-to-day activities. As was observed during field research, daily schedules in the rural area were rather standard, except when rain or other bad weather did not permit for working in the fields and families remained in the household area. It is very well possible that caregivers, and other members of the extended family, have adopted a certain style of engaging infants throughout at least the second year of life, and that this style does not change between different communication partners. If this is the case, then the 30-minute video data may actually be a very appropriate representation of standardized infant engagement in the rural area.

Second, it may be that changes in interaction dynamics, such as with whom infants are interacting with in their social network, are more varied over development, but do not significantly affect engagement level proportions. Specifically, it could be the case that the proportions of infant engagements remain stable over development, but that the time spent with different communication partners changes over time. This could be possible if the entire community applied the same form of infant socialization that was

not child-centered, which would also result in regulated proportions of different engagement levels since communication partners direct infants' engagements. This assumption may seem less likely in comparison to the previous, especially because one may not expect that the social network could hold the majority of engagement level dynamics since different individuals and groups are involved. Yet, this viewpoint, rather than the previous, would seem more in line with an individualist perspective, which is not the case in prototypical rural learning environments where communal beliefs supersede others. It may be the case, instead, that a combination of both assumptions is responsible for the seemingly stable proportions of rural infant engagements.

In the urban site, however, there are significant changes in three engagement level proportions over development – decreases in *Onlooking* and *Passive-JA*, as well as an increase in *Observing* engagement. These significant changes do not seem uncommon or unnatural given what we do know about infant development in general (Carpenter & Liebal, 2011; Hoff, 2006). One might expect infants to become more interactive as they grow up – less *Onlooking* –and become more actively aware of their communication partners' goals – more *Observing* and less *Passive-JA*. Such changes are in alignment with infant socialization practices of non-industrial urban learning environments (Keller, 2012), where communities enact more child-centered caregiving, which in turn would relate to infants' focusing on others' goals later in development.

4.2 Comparing Engagement Level Proportions with Previous Research Results

In this section, I assess the added value of studying infant engagement via naturalistic observation of non-industrial communities, rather than by semi-structured observation methods. To make this assessment, in Section 4.2.1 I will compare the proportional distribution of engagement levels presented in Section 4.1 with results

from an industrial (Bakeman & Adamson, 1984) and a non-industrial (Childers et al., 2007) semi-structured observation study. As there are too many factors that differ between the CASA MILA design and that of Bakeman and Adamson (1984), a direct comparison is not applicable (Section 3.4.1.2). Yet, I can extrapolate some assumptions about the differences between methods and cultures by implementing a step-by-step analysis – comparing an industrial and a non-industrial study that use similar methods, then comparing the same non-industrial study to the non-industrial results taken from Mozambique using a different methodology, and then making a final comparison between the original industrial study results and the Mozambican data. In Section 4.2.2 these comparisons will be discussed further.

4.2.1 Results

In Section 2.2, I first presented a comparison of engagement level distributions found in the studies from Bakeman and Adamson (1984) and Childers et al. (2007). This comparison was originally presented in Table 2.2, and is provided again below as Table 4.1 to carry out the first step of the descriptive comparison.

Table 4.1. Comparing percentages of time spent in the six engagement levels from the original results of Bakeman and Adamson's (1984) data at 1;3 from the Mother-only condition of USA infants, and the results from Childers et al.'s (2007) data at 1;2 of non-industrial infants using the same engagement level categorization. Data is presented as percentages based upon the full length of video data analyzed. (Adapted from Childers et al., 2007, Table 2, p. 214)

	Bakeman and Adamson (1984) Industrial / Mothers Only	**Childers et al. (2007) Non-Industrial / All Partners**
Mean age of infants	1;3	1;2
Demographic	Urban	Rural
Unengaged	6.1	8.8
Onlooking	14.0	16.5
Objects	40.7	24.3
Persons	4.6	4.5
Passive-JA	23.1	18.8
Coordinated-JA	11.2	25.9

To facilitate a cross-cultural comparison, Childers et al. (2007) replicated Bakeman and Adamson's study (1984), both in terms of procedures and analysis of engagement levels. There were only two main differences between the studies: first, Childers et al.'s study was with a rural Ngas community in Nigeria, while Bakeman and Adamson's study focused on American infants; and, second, in Childers et al.'s study, the infants were unrestricted in terms of interacting with anyone present during data collection, while in Bakeman and Adamson's study the infants only interacted with their mothers in the condition reported. In terms of their results, the two major differences that can be seen involve a much higher percentage of *Objects* engagement in the industrial culture's data, and over twice as much *Coordinated-JA* in the non-industrial sample. Also, the percentages of *Persons* engagement are the same, even though Childers et al. (2007) do not control for the number of people present during data collection.

The second step, presented in Table 4.2, compares the percentage of engagement level distributions of Childers et al. (2007) results from a non-industrial rural culture using semi-structured observation methods, and the results obtained in Section 4.1.1 using a naturalistic observation method instead. To facilitate this comparison, I re-

categorized our data from the eight engagement levels categories into the six engagement levels used by Bakeman and Adamson's (1984), following the method explained in Section 3.4.1.2. The major differences between engagement level percentages occur in all categories of joint engagement: *Persons* engagement occur up to six times more frequently, and *Passive-JA* engagement occurs four to eight times more frequently in the Mozambican data, whereas *Coordinated-JA* occurs more frequently in the Childers et al. data.

Table 4.2. Comparing percentages of time spent in engagement levels from naturalistic observation data at 1;1 from both non-industrial sites to the original results from Childers et al.'s (2007) semi-structured observation data at 1;2 of non-industrial rural infants using the six engagement levels of Bakeman and Adamson (1984). Data is presented as percentages based upon the full length of video data analyzed.

	Childers et al. (2007) Non-industrial / All Partners	**Our Data Non-industrial / All Partners**	
Mean age of infants	1;2	1;1	1;1
Demographic	Rural	Rural	Urban
Unengaged	8.8	14.1	7.2
Onlooking	16.5	22.0	13.7
Objects	24.3	20.6	25.9
Persons	4.5	22.6	29.8
Passive-JA	18.8	2.3	4.5
Coordinated-JA	25.9	18.4	18.7

As the third step, Table 4.3 presents a comparison between Bakeman and Adamson's distribution of engagement levels in a semi-structured, industrial study, and the distribution of engagement levels in the observation data of non-industrial communities in Mozambique. Four categories of engagement have drastically different percentage distributions when comparing these two studies. *Objects* and *Passive-JA* engagement occur much more frequently in the industrial sample than in either non-industrial sample. On the other hand, *Persons* and *Coordinated-JA* engagement occur much more frequently in both the non-industrial sites than in the industrial study. The percentage of *Unengaged* and *Onlooking* engagement in the industrial sample are

closer to the percentage of those in the urban non-industrial area rather than the rural area.

Table 4.3. Comparing percentages of time spent in engagement levels from the original results of Bakeman and Adamson's (1984) data at 1;3 from the Mother-only condition of USA infants, and the results from non-industrial infants at 1;1 using the same engagement level categorization, but naturalistic observation methods. Data is presented as percentages based upon the full length of video data analyzed.

	Bakeman and Adamson (1984) Industrial / Mothers Only	**Our Data Non-industrial / All partners**	
Mean age of infants	1;3	1;1	1;1
Demographic	Urban	Rural	Urban
Unengaged	6.1	14.1	7.2
Onlooking	14.0	22.0	13.7
Objects	40.7	20.6	25.9
Persons	4.6	22.6	29.8
Passive-JA	23.1	2.3	4.5
Coordinated-JA	11.2	18.4	18.7

One might argue that a single comparison across ages is not a sufficient enough comparison to support observational data from different cultures. To address this, Table 4.4 is provided, which compares the developmental results from non-industrial naturalistic observation with those of Bakeman and Adamson (1984). I do not provide a longitudinal comparison to Childers et al. (2007) because they do not have comparable ages of infant data.

The developmental comparison with Bakeman and Adamson (1984) yields three general points of interest. First, none of the significant changes in engagement level distributions over development apply across sites or cultures. Second, there are still no significant changes in the rural area. Third, when applying the naturalistic observation data to the classification of engagement levels from Bakeman and Adamson (1984), urban non-industrial *Passive-JA* engagement between 1;1 and 1;5 are still the only engagement level to show a significant proportional change between collection periods ($Z=-2.982$; $p<.01$).

Table 4.4. Comparison between developments of engagement level proportions in both Mozambican sites compared with the results from Bakeman and Adamson (1984) at comparable ages, from the Mother-only condition.

	Our Data Non-industrial / All Partners				Bakeman and Adamson (1984) Industrial / Mothers Only	
	Rural		Urban		Urban	
	1;1	1;5	1;1	1;5	1;0	1;6
Unengaged	14.1	11.5	7.2	8.8	13.1	2.9**
Onlooking	22.0	18.5	13.7	14.9	12.9	7.5
Objects	20.6	25.0	25.9	20.6	43.4	36.7
Persons	22.6	25.0	29.8	27.3	7.6	4.6*
Passive-JA	2.3	2.0	4.5	2.0*	19.3	21.5
Coordinated-JA	18.4	18.0	18.7	26.2	3.6	26.6*

Note: Significant differences over development are measured within studies, are marked as significant at the later collection period. Comparisons within the Mozambican data are made using a Wilcoxon Signed Rank Test, and those from Bakeman and Adamson (1984) are made using a repeated measure Anova. *p<.05, **p<.01.

Table 4.4 shows that there are large differences in distributions of some engagement levels between the naturalistic observation results and Bakeman and Adamson's data (1984) at the latter collection periods (1;5 and 1;6 respectively). Bakeman and Adamson's data at 1;6 depicts infants of industrial cultures engaging now in less *Unengaged* and *Onlooking* than in Mozambique, still more *Objects* and *Passive-JA* engagement, still less *Persons* engagement, and now much more *Coordinated-JA* engagement. Also, the percentage of industrial *Coordinated-JA* has equaled that of urban non-industrial communities. The largest overall change in both the urban non-industrial data and the industrial data is the increase in *Coordinated-JA*, but in the rural non-industrial data this is the increase in *Objects*.

4.2.2 Discussion

Tables 4.1 through 4.4 showed that there are distinct differences between results obtained using semi-structured observation methods in various cultures and

naturalistic observation results of non-industrial cultures. When comparing the percentage of engagement levels, noteworthy differences show up in proportions of time spent engaged with *Objects, Persons, Passive-JA,* and *Coordinated-JA* engagement.

In Table 4.1, where culture was the factor of comparison, there were two main differences – the percentage of *Objects* engagement in Bakeman and Adamson's industrial data (1984) is greater by a factor of 1.7, and *Coordinated-JA* in Childers et al. (2007) non-industrial rural data is greater by a factor of 2.3. As both studies used instructions for parents to simulate play with any provided toys, it seems that these differences would be cultural. The difference in regard to *Objects* engagement could be warranted based upon cultural differences, because infants' caregiving in industrial cultures is directed toward more object-oriented exploration (Bornstein & Putnick, 2012; Carpenter & Liebal, 2011; Greenfield, 2009; Keller et al., 2005; Keller, 2012). The difference in the percentage of *Coordinated-JA* engagement is unexpected, and is possibly also due to the cultural differences in Childers et al.'s (2007) study of a rural African community. Since non-industrial rural infants are raised toward greater levels of action autonomy (Keller, 2012), they may instigate *Coordinated-JA* engagement more often than infants of urban industrial environments, who are raised in more child-centered communities. It could also be argued that the wider variety of communication partners available in Childers et al. (2007) could result in more opportunities for *Coordinated-JA* with multiple different communication partners. For example, I have often observed in both industrial and non-industrial communities, when an infant receives a new toy, they often show their new toy to almost anyone present, even sharing it with others at times. However, this would instead be a byproduct of the interaction between methods and culture.

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In Table 4.2, observation methodology is the main factor of comparison (our naturalistic 1;1 data vs. Childers et al.'s semi-structured 1;2 data). First, there are obvious differences between the proportion of two engagement levels when comparing methods: much larger proportions of *Persons* engagement and much

smaller proportions of *Passive-JA* in the naturalistic data. As these two differences are drastically unlike proportions from the semi-structured study, these are most likely due to biases toward initiating triadic engagement because of Childers et al.'s instructions to simulate play. This assumption is reached by the fact that the total amount of joint engagement between the studies is not drastically different, but in the Mozambican data there is much more dyadic than triadic joint engagement. Second, the comparison shows there are slightly larger proportions of *Coordinated-JA* engagement in the semi-structured observation data. However, since both non-industrial studies showed higher proportions of *Coordinated-JA*, this is probably due to a cultural difference, which was possibly accentuated in the results of Childers et al. (2007) due to semi-structured methods. Aside from these three engagement levels, the results from Childers et al. (2007) study are not very different from the naturalistic observation data. As this is also a non-industrial study, it is reasonable to expect some similarities. Since infants in either study did not behave too differently by themselves, due to the similar amounts of solitary engagement, then it most likely was the caregivers' choice of engagement with infants that was affected by the methods implemented. Thus, in regard to the data presented by Childers et al. (2007), the use of naturalistic observation data seems less biased than that from semi-structured observation methods.

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Table 4.3 compares Bakeman and Adamson's (1984) data with that of both sites from the naturalistic observation data. The proportion of *Unengaged* in the industrial study's results is similar to that of the non-industrial *urban* area, but in the rural area this proportion is twice as great: rural non-industrial infants spend significantly more time *Unengaged* than industrial infants might. This larger proportion in the rural non-industrial site is most likely a difference of methodology, if there is a cause, because the proportion of *Unengaged* is also less in Childers et al. (2007), which points to an affect of parental instructions since this society is also rural and non-industrial. In terms of *Onlooking* engagement, there seems to be no difference between Bakeman and

Adamson (1984) and the Mozambican data. Since there was also no difference with the proportion of *Onlooking* from Childers et al. (2007) as well, this type of engagement seems to be unaffected by culture. However, in terms of methods, '*Onlooking*' in this analysis involves the combination of our individuated *Onlooking* and *Observing* engagement categories. Based upon the definition of *Onlooking* that Bakeman and Adamson (1984) and Childers et al. (2007) relied on in their own analyses, this may not have involved the exact same types of interactions. Thus, it could be possible that infants in semi-structured studies engaged in more *Onlooking* than infants in the naturalistic data, since this category of '*Onlooking*' in the re-assessment also included *Observing* engagements.

The rest of engagement level percentages are drastically different between studies. First, there is much more *Objects* engagement in the industrial study, which could occur either because of the Western bias towards object oriented tasks, or due to the inclusion of novel toys during the study of Bakeman and Adamson (1984). Since the proportion of *Objects* engagement in our data is similar to that of Childers et al. (2007), this is most likely a cultural difference between studies. Second, there is substantially more *Persons* engagement in both the rural and urban non-industrial communities, which could occur because of the greater number of people present in the non-industrial data. On the other hand, this probably occurs because mothers in the industrial study were instructed to interact with the novel toys provided, which would automatically reduce the possibility of *Persons* engagement, which does not include target objects. As this small amount of *Persons* engagement also occurs in the Childers et al. data (2007), the latter explanation of methodology is more probable. Third, the proportion of *Passive-JA* engagement is much higher in the industrial sample. As mothers in the industrial study were instructed to play with their children and the novel toys, there will obviously be many instances of a mother placing a toy in front of a child and demonstrating it's behavior. As the toys were entirely new to the child, but the communication partner was not, it is possible that cultural aspects of object preference furthered the bias towards engagement via *Passive-JA*, which are not much

different from solitary *Objects* engagement. This would mean that infants were possibly more interested in interacting with the toys as provided, rather than with their mother and the toys jointly in coordinated activities. As the proportion of *Passive-JA* in the Childers et al. (2007) study was only slightly less than that of Bakeman and Adamson (1984), it seems that this greater proportion is due to an effect of methods – both in terms of instructions and of providing toys.

Finally, the higher proportion of *Coordinated-JA* in our study is interesting, also since Childers et al. (2007) had even higher percentages of this engagement levels. Different explanations can be put forward here. It is possible that Bakeman and Adamson's (1984) strict requirement for coordination of eye-gaze as a precondition for assigning *Coordinated-JA* could have excluded many interactions that were included in our coding scheme for engagement levels in naturalistic observation. Or, due to the instructions Bakeman and Adamson (1984) offered to mothers, and the Western tendency of following into a child's pre-existing frame of attention, there might be a lesser chance of infants checking their mother's gaze, especially since infants know that their mother is the only one present interacting with them. This rationalization would also result in a shift from less *Coordinated-JA* engagement to more *Passive-JA* engagement. Conversely, in non-industrial cultures, infants in both rural and urban prototypical communities are brought up with more autonomous relations to their environment, which could relate in turn to less amounts of *Passive-JA* and greater amounts of infant driven *Coordinated-JA*. Also, as prototypical industrial culture's infant socialization involves more child-directed speech than non-industrial communities (Greenfield, 2009; Schieffelin and Ochs, 1986), it could be the case that infants in Bakeman and Adamson's (1984) study did not need to check the attention of their mother as often as Mozambican infants may. Finally, if *Coordinated-JA* takes more time to develop due to its multiple components, then the length of video data retrieved could explain this difference between studies. As the naturalistic observation data relies upon 30-minutes of video, in comparison to Bakeman and Adamson's (1984) 10-minutes of data, this seems possible. However, given that there is even more

Coordinated-JA in Childers et al. results (2007), and they collected 15-minutes of data, this explanation seems less probable than the former explanation via cultural confounds.

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Concerning developmental comparisons in Table 4.4 between the naturalistic observation data and that of Bakeman and Adamson (1984), there are distinct differences between significant developmental changes in engagement level proportions. I do not find a significant change in time spent *Unengaged,* in *Persons*, or in *Coordinated-JA*, which Bakeman and Adamson (1984) do find to have significant changes over development. Instead, only the decrease of urban non-industrial *Passive-JA* engagement is significant. It should be noted that naturalistic observation proportions of *Unengaged*, *Persons* and *Coordinated-JA* engagements do not change much at all over development, except for the increase of urban *Coordinated-JA* by an insignificant factor of 1.4. Moreover, *Persons* and *Coordinated-JA* engagement in the naturalistic data were already much greater than that of Bakeman and Adamson (1984) to begin with and remains so. These greater proportions probably occur because, as already discussed earlier, social responsibilities and communal psychology play a larger role in non-industrial communities (Greenfield, 2009; Keller, 2012).

4.3 Summary

This chapter aimed to analyze types of infant engagement and interactions with focus on the proportions of time spent in engagement levels, recorded unobtrusively during spontaneous free interactions in home environments of non-industrial communities. In doing so, I intended to provide a standardized way to analyze studies of infant engagement and vocabulary development. An analysis of the proportions of engagement levels using the extended categorization (i.e. both solitary and social behavior), provided a real-world view of infant engagement from naturalistic observation data. From these results I am able to conclude that the distribution of

infant engagement levels in urban and rural non-industrial societies are of two different prototypical learning environments. Furthermore, as there are significant differences in longitudinal engagement level proportions within the urban site, but none within the rural site, suggests that other, external factors may account for more variation and change over development.

In regard to the novel categories, results not only showed their presence, but also significant differences in proportion of time spent in these interactions in each rural and urban site at various collection periods. Such results are promising, and support the claim that engagement level categorization based upon controlled, Western methods of data collection cannot account for all possible levels and types of infant engagement. Analyzing the benefit of using naturalistic observation data, on the other hand, was harder to interpret. Some of the differences between engagement level distributions can be interpreted in terms of different data collection styles, while other differences are based upon cultural aspects, and some may even be a combination of both factors. It seems that if there is a cultural preference towards object-stimulation and child-centeredness in studies of industrial societies, then the use of semi-structured observation methods might amplify this bias. On the other hand, some of these differences could arise due to the socialization practices implemented in the non-industrial communities, rather than solely the research methods.

At this point, it cannot be ascertained which factor, or a combination thereof, causes these differences in engagement results. In order to do so, more naturalistic observation data of infants in industrial communities is needed, as well as a standard method for data analysis. It is next important, in Chapter 5, to analyze what if any relation these engagement level proportions may have with an infant's vocabulary development. In addition, an analysis of the different types of engagement undertaken with various communication partners is also necessary, and is addressed in Chapter 6.

5

RELATIONS BETWEEN ENGAGEMENT LEVELS' PROPORTIONS AND VOCABULARY

This chapter focuses on the correlations between the proportions of time spent in engagement levels and infants' expressive vocabulary from both concurrent and any later collection periods of the longitudinal data. First, in Section 5.1, an analysis of expressive vocabulary scores (i.e., MBCDI scores) for both the rural and urban community are presented and discussed. Second, in Section 5.2, I present the results of Spearman's correlations between proportions of time spent in engagement levels and vocabulary scores. Engagement levels are assessed in this way to determine if the amount of time spent in any certain types of engagement has a *potential* relationship with language acquisition. As discussed in Section 3.4.2, multiple regression analysis was not applicable to this data because the sample size is too small and the data is too variable, which does not allow for a trustworthy regression analysis. Section 5.3 turns to comparisons with previous research to address the benefit of using an extended classification of engagement levels. Rather than just comparing the results of naturalistic observation data with those results from studies with other methodologies, this comparison involves the application of other studies engagement level categorizations to our data. The results of this assessment suggest that a full-spectrum analysis of engagement level categorization is more informative than merging categories of engagements or measuring interaction abilities from solely social interaction frequencies. Finally, in Section 5.4, a summary of overall results is presented.

5.1 Mozambican Infants' MBCDI Expressive Vocabulary Scores

This section presents infants' vocabulary scores from the adapted MBCDI parental interviews. As discussed in Section 2.4.3, while MBCDI measurements account for both expressive and receptive vocabulary, only the former is relied upon for relation analyses due to known parental biases in reporting receptive language. In Section 5.1.1 the expressive vocabulary scores are presented for infants at all collection periods.

Following that, in Section 5.1.2, a discussion occurs concerning the differences between vocabulary scores in the two non-industrial sites.

5.1.1 Results

Results of infants' mean expressive vocabulary scores from the adapted MBCDI parental checklists are presented in Table 5.1.

Table 5.1. The measure of expressive vocabulary from the MBCDI that the rural and urban non-industrial infants produced at 1;1, 1;5 and 2;1 for non-industrial sites. Results are given in averages with standard deviations. Total score possible was 108 for each collection period. A two-way Anova was used to calculate statistical comparisons across sites. Note: *p<.05; **p<.01.

	At 1;1 Average (SD)	At 1;5 Average (SD)	At 2;1 Average (SD)
Rural	3.35 (1.08)	17.71 (12.23)	50.85 (23.59)
Urban	10.14 (7.25)**	29.00 (19.61)*	72.92 (23.18)**

A two-way Anova shows a significant main effect of site and age: overall urban infants have a substantially larger expressive vocabulary than rural infants ($F(1,78)=9.349$; $p<.01$) at every collection period. Also there is a main effect of age ($F(2,78)=81.283$; $p<.001$). A Post-hoc Tukey analysis showed that the MBCDI scores across the three collection periods – 1;1 vs. 1;5; 1;1 vs. 2;1; 1.5 vs. 2.1 – all differ significantly from one another ($p<.05$) in each of the three comparisons. There was no interaction between age and site ($F(2,78)=0.131$; $p=.877$).

5.1.2 Discussion

MBCDI expressive vocabulary score results in Table 5.1 shows that for the urban non-industrial site scores are significantly higher than those of the rural infants for all three collection periods. In theory, there are four different plausible explanations for this. First, the most plausible explanation is that the different sociodemographics of these

two prototypical environments have an accumulated effect on word learning –slightly higher urban SES level, as evidenced by more urban education, and both urban parents live at home – which would each contribute to greater amounts of child-directed speech and variation in speech, that in turn aids in vocabulary development (Hart & Risley, 1995). Moreover, these sociodemographic differences could in turn affect the mode of infant socialization that either community applies to caregiving, such as being child-centered or situation centered (Greenfield, 2009). Given that these differences were already prevalent in the preceding chapters, the difference in vocabulary scores is actually not that shocking. Thus, as was the case for culture, the weight of the evidence suggests that SES affects children's opportunities for communicative interaction and the availability of language input with the consequence that, even after effects of language style are taken into account, the rate of children's language development differs as a function of SES.

Second, it is not impossible that the adaptation of the MBCDI was more culturally appropriate for the urban area than the rural area. However, the adaptation and piloting of the MBCDI (see Section 3.2.3) took place with local research assistants in both sites, and the adaptations were counterbalanced with terms appropriate to each site or to both sites, which makes this a less plausible explanation. A deeper statistical analysis of the norming study data (see Appendix 4) is required to investigate whether the MBCDI contains a cultural bias; such an analysis is planned for the near future.

Third, as was discussed in Section 2.4.3, caregivers have been known to both overestimate and underestimate their children's vocabulary scores (Houston-Price et al., 2007; Law & Roy, 2008). It could be the case that urban mothers, in an attempt to make their children and their parenting appear more advanced, overestimated their infant's vocabulary capabilities more than rural mothers. Since the naturalistic observation data only contains a small representation of daily life and vocabulary, it is difficult to ascertain whether or not an overestimation did occur in the urban data more than in the rural data. However, this would only be the case if all mothers of urban infants were overestimating their child's vocabulary, since the reported

vocabulary scores do not differ significantly from those obtained in the norming study (see Appendix 4), this is highly unlikely. It could be just as possible, though, mothers in the rural area underestimated their infant's vocabulary. Based upon the regression analysis presented in Appendix 4, it seems that rural mothers did underestimate their infants' vocabulary at 1;1, but also seem to have overestimated it at 2;1, when compared to the vocabulary scores of the norming study, even if not significantly different. These issues with mothers' estimation of vocabulary are a limitation of all parental checklists, and the additional analysis of the MBCDI that is planned will help address this.

Fourth, it is possible that bilingualism in the urban area causes vocabulary scores to become slightly inflated, creating a significant difference in vocabulary. But also this explanation is not likely. While infants in a bilingual environment tend to have smaller vocabularies for each individual language (Oller & Eilers, 2002), their overall bilingual vocabulary size (L1∪L2 vocabularies = Total Conceptual Vocabulary), tends to be the same as monolingual infants (Guitiérrez-Clellen et al., 2000; Junker & Stockman, 2002; Patterson, 1998; Pearson et al., 1993). Since the urban MBCDI adaptation was administered bilingually measuring total conceptual vocabulary by registering responses from both languages, the bilingual nature of the difference in vocabulary size is not relevant. There is an additional reason why bilingualism may not be a relevant variable here: Most urban caregivers report to raise their children in Portuguese, because this is the lingua franca of the capital as well as education systems in Mozambique. In our naturalistic observations, most urban infants were, indeed, most frequently addressed in Portuguese. Based upon personal observations and discussions with urban research assistants, it seems to be the case that children learn the indigenous languages at slightly older ages during childhood, by interacting with other peers and adolescents outside of the household area. However, we also observed that among each other adults and older children also often spoke the indigenous language, so some learning through overhearing may occur. For children in bilingual homes in our study, exposure to one language (Portuguese) is likely to be dominant,

and if the less dominant language constitutes less than 25% of the linguistic input, then children tend not to acquire the less dominant language (Pearson, Fernandez, Lewedeg, & Oller, 1997). If this is in fact the case in the urban Mozambican sample, then bilingualism is not a contributing factor. Additional field research is necessary to address this, but it has not become possible as of yet.

Thus, the most likely explanation for the differences measured in vocabulary size using the MBCDI are thought to be caused by differences in SES and related aspects of rural and urban sociodemographics. In the remainder of this chapter, I investigate to what extent differences in infant engagements within the social environments can explain differences in vocabulary development.

5.2 Correlating Mozambican Infant Engagement with Expressive Vocabulary

This section presents and discusses the relation between proportions of time spent in each engagement level and infants' vocabulary size in rural and urban non-industrial communities. First, in Section 5.2.1, results are presented for correlations between the expressive vocabulary scores presented in Section 5.1.1 and the categorization of engagement levels posited in Section 3.4.1.2. Following this, in Section 5.2.2, I discuss these results, differences between sites, and the implications these results have for non-industrial language learning.

5.2.1 Results

Table 5.2 shows that when proportions of time spent in engagement levels are correlated with expressive vocabulary scores at each collection period, there are significant correlations and patterns. In the rural area, no correlations were found between the proportions of engagement level categories at 1;1 with measured vocabulary at 1;1. In regard to the relation between engagement levels at 1;1 and vocabulary scores at 1;5, results show a negative correlation with *Coordinated-JA*

engagement (*rs*[14]= -0.538, *p*<.05). Turning to correlations with vocabulary at 2;1, the data now show a strong positive correlation with *Persons* engagement at 1;1 (*rs*[14]=0.723, *p*<.01). Although *Coordinated-JA* engagements still have a negative relation with vocabulary scores, this is no longer significant. There were no significant correlations between any engagement level proportions at 1;5 with vocabulary scores at either 1;5 or 2;1 in the rural community. In regard to correlations between engagement level proportions at 2;1 and concurrent vocabulary scores, only *Observing* shows a significant positive correlation with vocabulary (*rs*[14]= 0.659, *p*<.05).

In the urban area, there are again no correlations between engagements at 1;1 and vocabulary scores at 1;1. When engagement levels at 1;1 are correlated with vocabulary at 1;5, *Objects* engagement show a significant negative correlation (*rs*[14]=-0.706, *p*<.01), while *Persons* engagement show positive correlations (*rs*[14]=0.772, *p*<.01). When engagement levels at 1;1 are correlated with vocabulary at 2;1, *Persons* engagement remain significant (*rs*[14]=0.598, *p*<.05). In addition, *Coordinated-JA* engagements now show significant positive correlations with vocabulary size (*rs*[14]=0.660, *p*<.05). Also, rather than *Objects* engagements, the data now shows significant negative correlations between *Onlooking* (*rs*[14]= -0.552, *p*<.05) and vocabulary. Correlations between engagement level proportions at 1;5 and vocabulary scores of the same time only show *Objects* engagement as a significant negative correlation to vocabulary (*rs*[14]= -0.532, *p*<.05). The urban proportions of engagement levels at both 1;5 or 2;1 show no significant correlations with vocabulary scores at 2;1.

Table 5.2. Spearman's correlations between engagement levels' proportions and vocabulary sizes at all collection periods using the categorization set forth in this paper. Note: *p<.05; **p<.01.

Engagement Level	Rural Vocabulary			Urban Vocabulary		
	1;1	1;5	2;1	1;1	1;5	2;1
Unengaged						
1;1	0.134	0.064	-0.324	-0.518	-0.242	-0.374
1;5		0.244	-0.158		-0.206	0.066
2;1			-0.143			-0.096
Onlooking						
1;1	0.139	0.055	-0.181	-0.048	-0.297	**-0.552***
1;5		0.173	-0.147		-0.072	-0.363
2;1			-0.235			-0.325
Objects						
1;1	0.060	0.033	-0.101	-0.160	**-0.706****	-0.459
1;5		-0.046	-0.359		**-0.532***	-0.033
2;1			-0.489			0.193
Observing						
1;1	0.081	0.314	0.187	0.040	0.268	-0.231
1;5		0.099	0.223		-0.015	0.000
2;1			**0.659***			-0.206
Persons						
1;1	0.236	0.200	**0.723****	0.073	**0.772****	**0.598***
1;5		-0.050	0.130		0.510	0.095
2;1			0.097			0.052
Passive-JA						
1;1	-0.406	-0.464	-0.227	-0.351	-0.189	-0.053
1;5		-0.415	-0.187		-0.288	-0.220
2;1			0.190			-0.154
Shared-JA						
1;1	0.012	0.363	0.366	-0.051	-0.287	-0.039
1;5		0.100	0.290		0.046	0.181
2;1			-0.568			-0.352
Coordinated-JA						
1;1	-0.307	**-0.538***	-0.474	0.142	0.129	**0.660***
1;5		-0.147	0.157		0.136	0.172
2;1			-0.123			-0.070

5.2.2 Discussion

The results concerning correlations between vocabulary scores and naturalistic observation data show interesting and conflicting results when we look at all correlation across development. Looking at such correlations individually does not provide the whole picture, thus it is best to visualize the correlations comparatively. Turning to Figure 5.1, we can understand more thoroughly the differences across sites over development. For ease of presentation, I will first discuss the general commonalities of correlation results between the rural and urban non-industrial sites. Then, I will discuss differences in results based upon two levels – first by solitary engagement levels, second by joint engagement levels.

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In both the rural and urban field sites, there were no significant correlations between any engagement level proportions at 1;1 and vocabulary scores at 1;1. There are also no significant correlations between engagement level proportions at 1;5 and vocabulary scores at 2;1. The most significant correlations found in both sites were based upon engagement level proportions at 1;1 and vocabulary scores at both 1;5 and 2;1. This pattern suggests, at least for this longitudinal layout, that infants' engagement style at 1;1 provides the most appropriate relational measurement to *later* vocabulary scores, whereas later developmental periods (i.e., 1;5 and 2;1) display relevant relational results for *concurrent* vocabulary scores. The only specific significant correlation shared between the rural and urban community was the positive relation between the proportion of time spent in *Persons* engagement at 1;1 and vocabulary scores at 2;1, which will be discussed further with other joint engagement levels later in this section.

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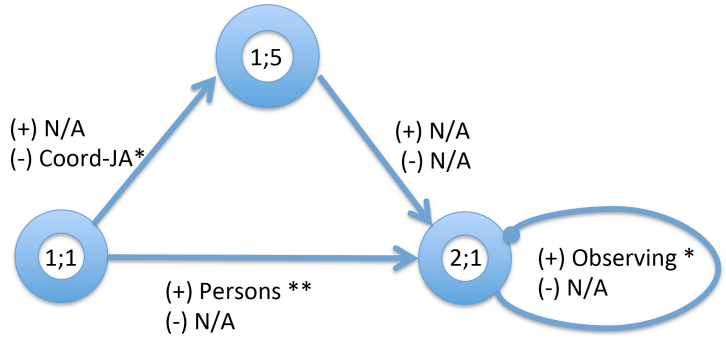
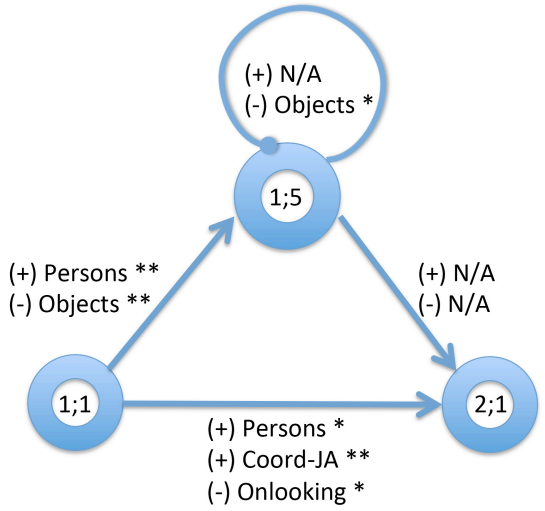
In regard to the relation between solitary engagements and vocabulary size, the results were different in each site. In the rural area, there is a significant positive relation between the amounts of *Observing* engagement at 2;1 and infants' vocabulary

scores at 2;1. Given that engagements in prototypical rural learning environments generally involve displayed actions for infants to mimic and master (Greenfield, 2009; Keller, 2012; Schieffelin & Ochs, 1986), it seems appropriate that the amount of time infants are *Observing* others would relate to word learning. Especially, since at both 1;1 and 1;5 the proportion of time rural infants spent *Observing* was significantly greater than infants in the urban area (Figure 4.1).

In the urban area, all significant relations between solitary engagements and vocabulary scores are negative relations. First, the proportion of *Objects* engagement at 1;1 and 1;5 have a significant negative relation to vocabulary scores at 1;5. Second, the proportion of *Onlooking* at 1;1 have a negative relation with vocabulary scores at 2;1. As *Objects* engagement involves no other communication partners, there is little likelihood that the proportion of time spent in such engagement would be beneficial to word learning. In a similar fashion, *Onlooking* involves no interaction between an infant and either an object or a communication partner, minimizing any possible word learning that could occur. Overall, correlation results in the urban area are reassuring, as social engagements (e.g., joint engagement) provide the basis for communication and word learning, whereas solitary behavior (e.g., *Onlooking* and *Objects*) does not provide such a setting.



(a) Rural



(b) Urban

Figure 5.1: Visual representation of the CASA MILA results concerning the correlations between proportions of time spent in engagement levels and vocabulary scores at all collection periods in both Mozambique sites. Positive (+) and negative correlations (–) are marked as such. Predictive correlations run along the lines between collection periods, whereas concurrent correlations are marked within the self-closing circles. Note: *p<.05; **p<.01. Coord-JA = *Coordinated-JA*

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Next, results concerning joint engagement correlations should be discussed. Between the two sites, the only shared significant results are positive correlations between *Persons* engagement at 1;1 and vocabulary development at 2;1, and those that differ directly between sites are the relations between *Coordinated-JA* engagement at 1;1 and vocabulary scores at later collection periods. Why do these two patterns occur?

First, in regard to *Persons* engagement, it may be the case, more so for non-industrial communities than for industrial ones, that the proportion of time spent in social joint engagement interactions excluding target objects or events are more important to facilitate learning culturally appropriate socialization, which includes the language used and with whom. From Section 2.4, we know that research on child socialization and cultural sociodemographics has shown that prototypical non-industrial learning environments involve more social stimulation (Abels et al., 2005; Greenfield, 2009; Keller, 2012), which could account for the positive correlation between *Persons* engagement and vocabulary scores. As urban non-industrial areas share traditional belief systems with their rural counterparts, it can be understood that *Persons* engagement would show similar types of relations to vocabulary. In addition, caregiving in non-industrial cultures is known to involve more body stimulation and motor exercises (Keller et al., 2005; Keller, 2007; Schieffelin & Ochs, 1986), which are also *Persons* engagement, and would explain these common relations to vocabulary development across sites in Mozambique. Vogt et al. (2013) found that within the rural area, *Persons* engagement involved many embodied gestures, which focus on movement and motor skills, whereas in the urban area this engagement involved mostly gestures pertaining to ritualized play interactions, which focus more on social knowledge and roles. Thus, even though the type of engagement was similar, the purpose of these engagements may not be exactly the same in either prototypical non-industrial area.

Second, in regard to *Coordinated-JA* engagement, there is a negative relation with vocabulary scores in the rural site, and a positive relation with vocabulary scores in the

urban site. The positive relation between *Coordinated-JA* engagement and vocabulary scores in the urban area is certainly not surprising. As the prototypical urban non-industrial learning environment shared some characteristics with industrial urban cultures, such as a preference for object stimulation and child-centered interactions (Keller, 2012), this significant correlation seems appropriate. Moreover, the shared positive relation with *Persons* engagement and the conflicting significant relation with *Coordinated-JA* engagement demonstrates that urban and rural non-industrial communities do represent separate, but not mutually exclusive, prototypical learning environments.

The fact that triadic engagements in the rural area have a negative correlation with vocabulary is unanticipated given its accepted status in previous research as a key feature that stimulates the acquisition of language (Adamson et al., 2004; Carpenter, 2009; Carpenter et al., 1998; Childers et al., 2007; Dunham et al., 1993; Markus et al., 2000; Morales et al., 2000; Mundy & Gomes, 1998; Tomasello & Farrar, 1986). In view of the data as we have analyzed it, there are two possible explanations. First, and foremost, if infants of rural non-industrial learning environments are not exposed to as much object stimulation as infants of different urban settings, then it is quite likely that rural infants are not accustomed to as many joint attention engagements involving objects. As there is not a significant difference across sites in the proportions of most joint attention engagements, then it is more likely that targets involved in rural infants joint attention relate to external *events* rather than *objects*. Another explanation may be that these negative correlations are due to a large number of *Coordinated-JA* engagements involving the removal of objects of interest, the redirecting of attention from current activities, or the presence of multiple partners vying for attention – all of which have been shown to negatively relate to learning (Behne, Carpenter, Call & Tomasello, 2005; Gaffan et al., 2009; Morales et al., 2000; Mundy et al., 2007; Tomasello & Todd, 1983). All of these can cause a negative impact on the infants' attention or behavior, and thus also impact infants' learning during the interaction. Thus, it could be the case that *Coordinated-JA* is not always the major contributor and

scaffold to language acquisition (Akhtar & Gernsbacher, 2007; Mundy & Gomes, 1998; Scofield & Behrend, 2011), and instead that other types of joint engagement, such as *Persons* engagement, significantly relate to word learning over early development.

Since the proportions of *Persons* and *Coordinated-JA* engagements themselves are not significantly different (Figure 4.1), it may be the case that the dynamics within these engagements are highly different across both communities. For example, in a related analysis of the same data, the amount of speech and gesture input that infants receive in the non-industrial areas is analyzed, and there are significant differences between sites (Vogt & Mastin, 2013a). In that analysis, results showed that the amount of child-directed speech in the urban area exceeds that of the rural area by a factor of 5.7, as well as the amount of child-directed gestures by a factor of 2.0. In fact, the amount of co-speech gestures addressed to rural infants was 2.3 times more in the urban area than in the rural area. All three of these factors were significantly greater in the urban area. Thus, many of the social engagement observed in the rural area was silent, containing gestures but little speech. Correlation results with vocabulary measurements showed significant positive relations in the urban area between vocabulary size, and speech and co-speech gestures, but no significant relations in the rural area to either amount of speech, gestures, or co-speech gestures (Vogt & Mastin, 2013a). Bearing this in mind, it can be understood why *Coordinated-JA* engagements would show negative correlations with rural infant word learning if those engagements, which by definition require some gestural interaction, are accompanied by very little speech that infants can learn from. Another aspect of the dynamics within *Persons* and *Coordinated-JA* engagements that is concealed from the current analysis is how these engagement levels are used in interactions with different communication partners that infants have. In the next chapter, I will investigate the roles that individuals or groups of individuals in the infants' social network have on vocabulary development. There I will further discuss these unexpected results.

5.3 Assessing the use of an Extended Engagement Categorization

I next assess the added value of investigating correlations between engagements and MBCDI scores when using an extensive categorization of engagement levels, versus using an engagement level classification that covers a smaller range of engagement. My aim is to show that correlation results are much more informative when engagement levels are analyzed as part of a continuum, rather than grouped together or analyzed in isolation. To do this, I apply the less extensive categorizations from Childers et al. (2007) and Carpenter et al. (1998) to *our naturalistic observation data* and present correlations results in Section 5.3.1 using these categorizations. Then in Section 5.3.2, a discussion is provided comparing these results with those obtained using my engagement level categorization in Section 5.2.1.

5.3.1 Results

Childers et al. (2007) and Carpenter et al.'s (1998) categorizations were reconstructed by the processes outlined in Section 3.4.1.2. For practical reasons, I only assess the different results based upon engagement level proportions from 1;1, as these provided the most results in the preceding section. As Bakeman and Adamson (1984) did not relate their study to vocabulary development, it was not necessary to replicate their categorization of engagement for this re-assessment.

Table 5.3 presents the correlations when Childers et al. (2007) tri-level engagement classification is applied to our data. Recall that these categories are formed by collapsing Bakeman and Adamson's (1984) categorization. Translating this to the extended engagement levels, these categories are classified as *Low-Level* (i.e. *Unengaged*, *Onlooking* and *Observation*), *Mid-Level* (i.e. *Objects* and *Persons*), and *High-Level* (i.e. *Passive-JA, Shared-JA* and *Coordinated-JA*). Results show that between proportions of the tri-level categorization at 1;1 and vocabulary at 1;5 only *High-Level* engagements in the rural area to have a significant negative relation ($r_s[14] = -0.591$,

p<.05), and no correlations in the urban area. Correlations of the same 1;1 proportions with vocabulary size at 2;1 show a significant positive correlation with rural *Mid-Level* engagements (*rs*[14]=0.798, *p*<.01), and a significant negative correlation with urban *Low-Level* engagements (*rs*[14]= -0.695, *p*<.01).

Table 5.3. Spearman's correlations between the proportions of time spent in engagement levels at 1;1 and vocabulary size at 1;5 and 2;1 assessed by the Childers et al. (2007) tri-level categorization. Note: *p<.05; **p<.01.

	Vocabulary at 1;5	Vocabulary at 2;1
RURAL		
Low-Level	0.134	-0.351
Mid-Level	0.371	**0.798****
High-Level	**-0.591***	-0.476
URBAN		
Low-Level	-0.249	**-0.695****
Mid-Level	-0.017	0.114
High-Level	0.004	0.457

Note: Low-Level = *Unengaged* + *Onlooking* + *Observing*; Mid-Level = *Objects* + *Persons*; High Level = *Passive-JA* + *Shared-JA* + *Coordinated-JA*.

Turning to Table 5.4, slightly different results are found using the Carpenter et al. (1998) engagement level classification.

Table 5.4. Spearman's correlations between the proportions of time spent in engagement levels at 1;1 and vocabulary size at 1;5 and 2;1 assessed by the categories analyzed in Carpenter et al. (1998). Note: *p<.05; **p<.01

	Vocabulary at 1;5	Vocabulary at 2;1
RURAL		
Attention Following	0.187	-0.015
Joint Engagement*	**-0.560***	-0.480
URBAN		
Attention Following	0.101	-0.279
Joint Engagement*	0.114	**0.623***

Note: Attention Following = *Passive-JA* + *Observing*; Joint Engagement* = *Shared-JA* + *Coordinated-JA*.

When correlating rural engagements at 1;1 using only the categories analyzed by Carpenter et al. (1998), with vocabulary at 1;5, results show that rural *Joint Engagement** (i.e., the combination of *Passive-JA* and *Coordinated-JA*) has a significant negative correlation (r_s[14]= -0.560, p<.05). In the urban area at 2;1, we find a significant positive correlation with *Joint Engagement** (r_s[14]=0.623, p<.05).

5.3.2 Discussion

Results from the preceding section concerning the use of different, engagement level classifications will be discussed in regard to two main point of interest. First, in Section 5.3.2.1, I will discuss the benefit of using the more extensive engagement level categorization in its entirety, rather than less extensive ones from previous research. Also within this section I will look specifically at any possible benefits that the two new engagement categories (*Observing* and *Shared-JA*) have in the correlation analyses. Second, in Section 5.3.2.2, general differences between original results obtained in previous research, versus those found when applying their classification to our data,

are also discussed. As results obtained in these previous studies do not involve the same statistical analyses, direct comparisons were not possible.

5.3.2.1 Benefits of Using an Extended Categorization of Engagement

Results provide a great deal of support for the extended categorization of engagement as significant correlations change and disappear when categorizations become less extensive. Both assessments evaluating previously used engagement level classifications show different results following a similar trend, but an extended categorization accounts for all of the results using either classification, thus providing a more informative analysis. This is specifically true in the urban area, and there are three examples that require mention. First, when using Childers et al.'s (2007) tri-level categorization in Table 5.3, there are no significant correlation between *Mid-Level* engagement (*Objects* and *Persons*) in the urban area and either vocabulary scores at 1;5 or 2;1. However, both *Objects* and *Persons* engagements in the rural area show significant relations to vocabulary at 1;5, and *Persons* engagement continues to be a significant correlate with vocabulary at 2;1. It must be the case then that these two categories' results cancel each other out when collapsed in Childers et al.'s (2007) *Mid-Level* category, especially since as individual engagement levels they have *opposite* relations to urban infants' vocabulary scores. Second, also when using Childers et al.'s (2007) tri-level categorization, there are no significant correlations between proportions of urban *High-Level* engagement from 1;1 with vocabulary at 2;1 (Table 5.3). However, when correlations are computed using either my own categories or Carpenter et al.'s (1998), the relation of *Coordinated-JA* engagement still remains evident in the results. A third example relates to solitary engagement. The results from both my own categorization, and Childers et al.'s, show that non-joint engagement behaviors (i.e., the *Low-Level* category that combines *Onlooking, Observing* and *Unengaged*) can have significant negative correlations to vocabulary development, which Carpenter et al. (1998) did not analyze.

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Turning next to the novel engagement levels, I will first discuss the various results for *Observing* engagement, and then turn to those of *Shared-JA*. While there were significant differences in the proportions of both *Observing* and *Shared-JA* engagement between sites (Section 4.1.1), only the proportion of *Observing* engagement in the rural area at 2;1 had a significant relation to vocabulary scores at 2;1 (see Table 5.2). When looking further in the general relation of these categories with vocabulary development, there are different patterns of results in each of the sites for each novel engagement level when analyzed individually (Table 5.2) or grouped with other engagement level categories (Tables 5.3 and 5.4).

When comparing our categorization results, Table 5.2, and those obtained using the categories of Childers et al. (2007), Tables 5.3, there is a notable differences when *Observing* is combined with *Unengaged* and *Onlooking* in Childers et al.'s (2007) category of *Low-Level* engagement. In regard to *Observing* engagement, results of the extended analysis in Table 5.2 showed no significant correlations between proportions of this engagement at 1;1 in either site and infants' vocabulary scores. There is, however, a pattern in the rural area where *Observing* has a positive relation between every data collection period and all vocabulary scores. When *Unengaged* and *Onlooking* are combined with *Observing* in Table 5.3, the positive relation between *Observing* engagement at 1;1 and vocabulary at 2;1 is lost. Turning to the urban area, our results in Table 5.2 show that *Unengaged* and *Onlooking* at 1;1 both have negative relations to later vocabulary scores, of which the relation between *Onlooking* and vocabulary at 2;1 is significant. When *Observing* is combined with these categories in Childers et al.'s (2007) *Low-Level* category in Table 5.3, the significant negative relation between *Onlooking* and vocabulary scores is amplified. When comparing our categorization results, Table 5.2, and those obtained using the categories of Carpenter et al. (1998), Table 5.4, there are some differences when *Observing* is combined with *Passive-JA* in Carpenter et al.'s (2007) category of *Attention Following*. Based upon our categorization in Table 5.2, *Passive-JA* engagements at 1;1 have negative relations to

later vocabulary scores in both the rural and urban site. When these two engagements are combined to create *Attention Following* in Table 5.4, for each field-site the negative relation between *Passive-JA* and vocabulary at 1;5 is lost. In addition, in the rural area, the positive relationship between *Observing* engagement and vocabulary at 2;1 is canceled out by the negative relation of *Passive-JA*. While these effects of category combinations do not relate to significant results, it is necessary to show how small adjustments of the coding scheme can affect statistical analyses. These differences between correlation findings, suggest that *Observing* should be measured separately from *Passive-JA,* and consequently other categories as well.

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In regard to *Shared-JA*, results from the extended analysis in Table 5.2 show conflicting results between areas. The proportion of *Shared-JA* at 1;1 has a *positive* relation to later vocabulary scores in the rural area, and a *negative* relation with later vocabulary scores in the urban area. Since there is no significant difference between proportions of this engagement in either area at 1;1, this relational difference is intriguing. As this category occurs quite infrequently, it may mean that its role in vocabulary learning is modest. At this point in time though, I cannot judge for certain why this is the case, and additional data collection would be necessary. When comparing our categorization results, Table 5.2, and those obtained using the categories of Childers et al. (2007), Table 5.3, there are distinct differences when *Shared-JA* is combined with *Passive-JA* and *Coordinated-JA* to form Childers et al.'s (2007) category of *High-Level* engagement. In the rural area the positive relation of *Shared-JA* is lost, and overtaken by the negative relation of the other two categories, most likely by *Coordinated-JA* given its comparatively much larger proportion. In the urban area, however, the proportion of *High-Level* engagement in Table 5.3 shows positive relations to vocabulary at both 1;5 and 2;1, the latter being significant. It seems that the proportion of *Coordinated-JA* cancels out the category of *Shared-JA*, resulting in a positive relation with urban infants' vocabulary scores. When comparing our categorization results, Table 5.2, and those obtained using the categories of Carpenter et al. (1998), Table 5.4, the same issue

arises when *Shared-JA* is combined with *Coordinated-JA* in Carpenter et al.'s (2007) category of *Joint Engagement**. In both the rural and the urban area, the proportion of *Coordinated-JA* cancels out that of *Shared-JA* in a relational analysis (this time as *Joint Engagement**). By not isolating *Shared-JA* the strength of the relation between *Coordinated-JA* and word learning is deflated. This is most likely due to the small increase in the proportion of *Coordinated-JA* when *Shared-JA* is added into the same category, since *Shared-JA* engagements are not very frequent (Figure 4.1).

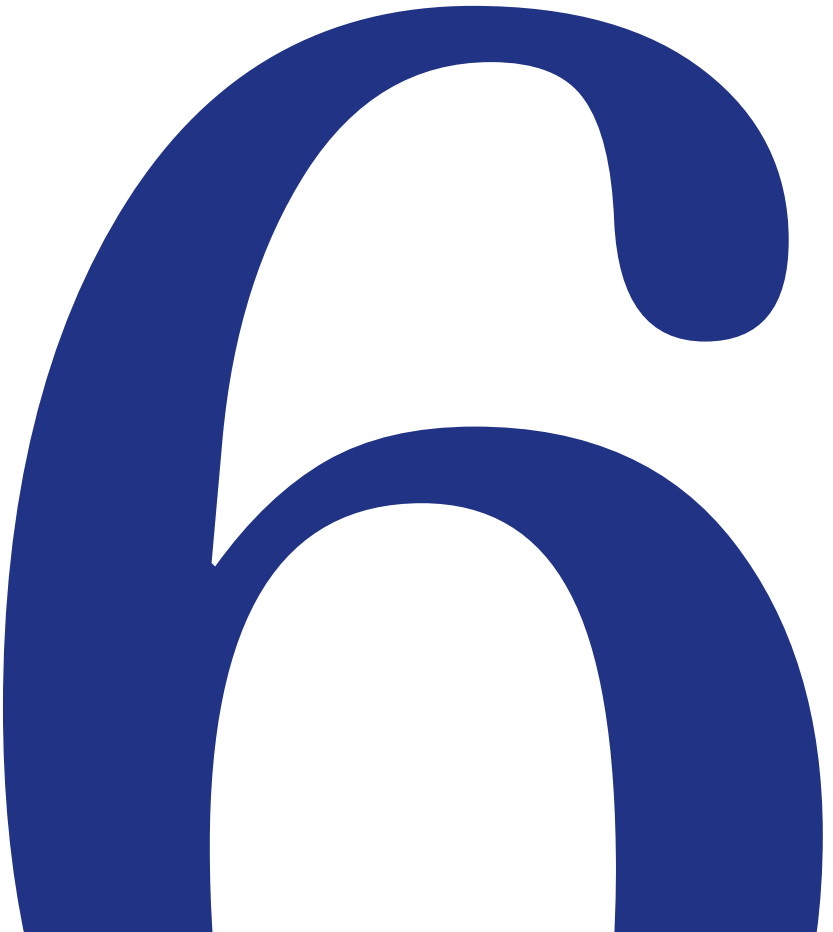
5.3.2.2 Results of Original Studies

There are again noteworthy differences when comparing the naturalistic observation data correlation results to those originally obtained in previous studies. In their own study, Childers et al. (2007) find that time spent in *Mid-Level* engagements was the best predictor of vocabulary size in their Nigerian study (see Section 2.2). I find a similar positive correlation between *'Mid-Level'* engagements and vocabulary scores at 2;1 in the rural area, but do not find such significant correlations in the urban site (see Table 5.3). However, this significant positive correlation from the rural area is only based on the strength of the individual, significant positive correlation between *Persons* engagement and vocabulary scores (see Table 5.2). Compared to Carpenter et al.'s (1998) original results (see Section 2.2), I also find a significant positive relation between time spent in what they refer to as *Joint Engagement** (*Shared-JA + Coordinated-JA* in this study) and vocabulary scores at 2;1 (see Table 5.4), but this is only in the urban site. In the rural area, however, I find a significant negative relation between *Joint Engagement** and vocabulary scores at 1;5 (see Table 5.4). This illustrates that an extensive analysis of engagement is crucial to understand how different solitary and joint engagement may be involved in and relate to language learning. Although both other studies analyze correlations between engagement and vocabulary, each study finds significant correlations for engagement level categories that are specific to their own set-up, because they either combine (Childers et al., 2007) or exclude (Carpenter et al., 1998) relevant categories.

5.4 Summary

From the results and discussion provided in the preceding sections, the following preliminary conclusions can be formulated. First, non-industrial urban infants have significantly higher MBCDI vocabulary scores, which are probably due to different sociodemographics – more object stimulation, more face-to-face interactions, more child-directed speech, and higher levels of parental education. Second, during the second year of Mozambican infants' development, it is dyadic *Persons* engagement, not triadic *Joint Attention* engagements, which have continual, significant positive correlations with vocabulary development. Third, within Mozambique, urban infants exhibit correlations over development similar to those found in some industrial society studies; however, rural infants exhibit surprising negative correlations between *Coordinated-JA* and vocabulary development, which may be due to either interactions with partners that are not the primary caregivers, or due to their different lifestyle and sociodemographics. Fourth, the use of a full-spectrum analysis of engagement levels provides more specific and accurate results in correlation analyses, which support the isolation of the two novel categories from other pre-existing engagement categories. Fifth, and finally, given the continual significant differences across and within non-industrial sites, it can be posited that rural and urban non-industrial communities do represent separate, but comparable, prototypical learning environments.

EFFECTS OF EVERYDAY COMMUNICATION PARTNERS AND GROUPS



This chapter focuses on an analysis of the proportion of time infants spend interacting with different types of individual communication partners and group interactions in the rural and urban non-industrial sites. In Section 6.1, to first address caregivers' views on infant socialization, I present ethnographic data concerning infant caregiving, which was accumulated from questionnaires and semi-structured interviews administered during field site visits with mothers (see Section 3.4.3). Results show there is much less variation in infant socialization practices and caregiving beliefs in the rural site than in the urban, suggesting the rural area may adhere to a more strict, and communal view of situation-centered caregiving.

In Section 6.2, I present the results of the proportional distribution of how frequently infants interact with various types of communication partners in their environment. The distribution analysis in Section 6.2.1 shows how frequently mothers interact with their infants in comparison to all other communication partners throughout development. Although it may seem obvious that mothers would interact most with their children, we cannot assume this to be true for every family, community or culture. In Section 6.2.2, the distribution analysis is expanded, and shows how frequently infants interact with the six different types of communication partners presented in Section 3.4.1.2, in order to investigate how secondary and tertiary caregiving may be distributed within infants' social networks.

From here, an in-depth correlation analysis between infants' expressive vocabulary scores (see Section 5.1.1) and the proportion of time spent interacting with different communication partners is presented in Section 6.3. Overall, this section has two primary aims. The first aim is to further analyze the caregiving practices and child-centeredness of each non-industrial community. The second aim is to look deeper into the significant engagement level correlation results of Section 5.2. Since *Persons* engagement had similar positive relations to vocabulary scores in each site, but *Coordinated-JA* had conflicting correlations, it is important to look at how these engagements are distributed among communication partners.

Finally, in Section 6.4, a general discussion is provided concerning the various results of the preceding three sections, as well as the representation of infant socialization in non-industrial prototypical learning environments, and how similar or different these rural and urban communities are from each other.

6.1 Ethnographic Data

Ethnographic information on infant socialization was collected through questionnaires and semi-structured interviews with caregivers (Section 3.4.3). Questions concerning infant socialization were based upon issues raised in previous studies (Keller et al., 2005; Schieffelin & Ochs, 1986), as well as local practices that had been observed during the field study. Table 6.1 represents a selection of responses concerning caregiving from the questionnaire responses at each collection period (See Appendices 1, 2, and 3), and from the semi-structured interviews (See Appendix 5).

Table 6.1. Ethnographic data about caregivers' views on infant socialization and child rearing.

Ethnographic data	Rural [n=14]	Urban [n=14]
Infant is a 'full' person at-		
Birth	--	6
< 0;6	3	5
0;6 < 1;0	--	--
> 1;0	11	3
Most important aspect of caregiving is:		
Body contact	--	1
Social Interaction	--	5
Nutrition	14	8
Breastfeeding until:		
Up to 1;6	4	7
After 1;6	10	7
Secondary Caregiver:		
Father	--	5
Grandmother	7	6
Sibling	7	3
Child's Future		
Family/Parental Care	8	2
Higher Education	3	8
Unknown	3	4
Role of Community		
None	6	5
Protection/Care	6	5
Education	--	4
Unknown	2	--

With this data, an understanding emerges that while non-industrial sites do share the same culture, this does not mean that they follow the same means of caregiving and have the same beliefs about infant socialization. First, and foremost, the data shows that each site has a different view of when an infant can be considered a person, and

thus part of the community. This question was asked because it was made apparent early in the study by one father that his child's first birthday was a milestone because "*Now he is really a person*," meaning that his son survived early infancy and devoting time to active development might no longer be a risky investment. Such a lack of parental investment and socialization could easily have a direct impact on the cognitive and linguistic development of an infant. By the data presented here, almost all urban mothers believe an infant to be a *full person* between birth and 0;6; however, in the rural area, most mothers believe this to be applicable well after 1;0. Given the fact that the Mozambican 'under 5' mortality rate was 142 per 1,000 in 2009 and is 1.3 times higher in the rural areas than in the urban areas (WHO Global Health Observatory, 2009), this difference between urban and rural views of infants seems understandable. It may be that for self-protection, rural mothers invest less time socializing with young infants until they are well past the age of 1;0, and predominantly focus on the primary health needs of their infant from birth to 1;0, and not so much focus is spent on socio-emotional caregiving. This difference could also relate to different perceptions of cognitive abilities in communication. For example, in rural and urban Javanese communities babies are rarely addressed by other adults (Smith-Hefner, 1988), and the K'iche' Mayan only consider it worthwhile to communicate with infants once the infant has started to learn their first words (Pye, 1992). This is much different in industrial cultures, where individuals, especially mothers, interact with infants conversationally from early on in infancy (Bloom, 1990; Ochs & Schieffelin, 1984).

All rural mothers believe that nutrition is the most important part of daily childcare, whereas urban mothers believe that nutrition, social interaction or body contact can each be the most important aspect of care. As the rural area's lifestyle is based around subsistence farming, daily food intake is a top priority, so it is not surprising this concern is replicated in childcare. However, such information could again suggest that while health is a concern in daily caregiving, body contact and social developments are less prominent. Responses also show that most rural mothers breastfeed until infants are past 1;6, but half of urban mothers wean their children

from breastfeeding before 1;6. This suggests that urban infants are receiving a supplementary diet, implying better nutrition and a slightly higher SES.

The data shows that in the rural area, a grandmother is listed as the secondary caregiver (i.e., second most important) for half of the participants, and siblings are secondary caregivers for the other half of the participants. Since most rural fathers are not working/living locally, it is reasonable that they are not available as secondary caregivers. Urban mothers usually rely upon either the infant's father or grandmother as secondary caregivers, and only a few mothers use siblings as secondary caregivers. This difference should not come as a great surprise given the differences in sociodemographics between the rural and urban communities. Especially since sibling caregiving is rather prominent across traditional rural cultures (Brown, 1998; Ochs & Schieffelin, 1984; Ochs & Schieffelin, 2011; Schieffelin & Ochs, 1986; Slobin, 1979; Zukow-Goldring, 2002).

We also see that there are different opinions from mothers regarding the goals of child rearing. Most rural mothers believe that the main goal of raising children is to ensure that parents are cared for in the elder years, whereas most urban mothers instead feel that the goal of child rearing is to provide children a more stable life through higher education. Although, it could be the case that urban children whose parents invest in their education are expected to achieve a higher SES, thus making it easier to also provide care to their parents later in life. Furthermore, rural mothers feel that the community either has no responsibility to childcare or that it is only there to provide additional protection. Some urban mothers, however, take this a step further, by believing that the role of the community can also be to provide education to children.

Bearing these familial and communal relationships in mind, Table 6.2 presents mothers' responses from the semi-structured interview (Appendix 5) concerning their opinions of what methods or styles of engagement allow for the best cognitive and linguistic development.

Table 6.2. Caregiver responses concerning the question, "What are the important aspects of language acquisition and socialization? How can you best teach your child language?" Note that caregivers could have mentioned more than one aspect of engagement or teaching, so results show the number of occurrences of each response from all interviews combined.

Socialization Method	Rural	Urban
Daily Routines	2	1
Imitation / Play	2	3
Display / Object naming	2	6
Repetition	2	2
Directions / Narration	2	1
Cultural practices	2	5
Correcting mistakes	1	1
Sibling Interaction	3	4

There are not many differences between sites as to what types of infant socialization methods are used and how many mothers mentioned any given method. Yet, there are three interesting points worth raising. First, urban mothers regularly remark more than rural mothers do about object naming. This is quite interesting, as I would have expected few mothers' responses to concern object naming in either community. Since Mozambique is very low on the HDI scale and object naming is considered significantly related to infant development in high-level HDI countries (Bornstein & Putnick, 2012), which suggests that in Mozambique less cognitive engagement would occur. However, the differentiation of the prototypical non-industrial sites seems well justified for our sample populations given the greater amount of responses concerning object naming in the urban site (Keller, 2012), although this does not necessarily imply that urban mothers actually enact greater proportions of object stimulation. This data helps in understanding the preceding correlation results between engagement type and vocabulary development – if urban mothers consider object naming in joint attention tasks to be important, then the positive correlations with *Coordinated-JA* support this claim; and if rural mothers do

not, then the negative correlations with *Coordinated-JA* could be the result of interactions lacking object naming and discussion.

Second, urban mothers respond more often than rural mothers do concerning culturally specific interaction procedures (e.g., social greetings or conventionalized gestures in interactions) as an important aspect of infant development. Based upon Keller's (2012) description of urban and rural prototypical environments, this difference at first seems out of place as one may expect cultural tradition to be more prominent in the rural area. Yet, these responses only reflect what mothers think is important for infants to learn, so it could be the case that due to more cultural isolation, the rural community does not view their culturally specific interaction procedures as standard, and not something to be learned. As the urban non-industrial prototype shares strong traditions with their rural counterparts, due to their recent migration into the urban areas, it may be the case, for preservation of cultural identity, that urban mothers are more consciously aware of this in their style about caregiving.

Third, both urban and rural mothers consider sibling interactions an important aspect of child socialization. Since non-industrial communities have larger family sizes than infants of industrial cultures (Greenfield, 2009), infant engagement with siblings is not only more readily possible, but more abundant. Since child-centered caregiving is more atypical of industrial cultures than non-industrial ones (Keller et al., 2005), the fact that siblings may not be very competent communication partners and may be competing for resources are probably not things taken into account, or considered detrimental, in non-industrial cultures.

Taking such ethnographic data into consideration, an idea begins to take shape of how caregiving functions within non-industrial infants' social networks. While these parental interviews provide more culturally sensitive information, I am unable to draw firm conclusions without more detailed, objective data on how infants navigate, and are led through, the social labyrinth that is their cultural environment.

6.2 Distribution of Communication Partners in Joint Engagement

This section presents two proportional distribution analyses of infants' social networks based upon who they interact with and how frequently. Section 6.2.1 presents the proportions of all engagement in which mothers are present versus the combination of all other possible communication partners and groups. Section 6.2.2 presents a proportional distribution analysis based upon the six-level partner categorization outlined in Section 3.4.1.2 (*Peers, Siblings, Adults, Mother, Multiple+Mother,* and *Multiple*). Finally, in Section 6.2.3, I discuss these results and what implications they may have.

6.2.1 Results of Two-level Partner Distribution

Figures 6.1 and 6.2 compare the proportion of all joint engagements (*Persons*, *Passive-JA*, *Shared-JA*, and *Coordinated-JA*) involving the infant's mother (regardless of being a 1-on-1 or group interaction), with the proportion of all joint engagements with all other communication partners combined.

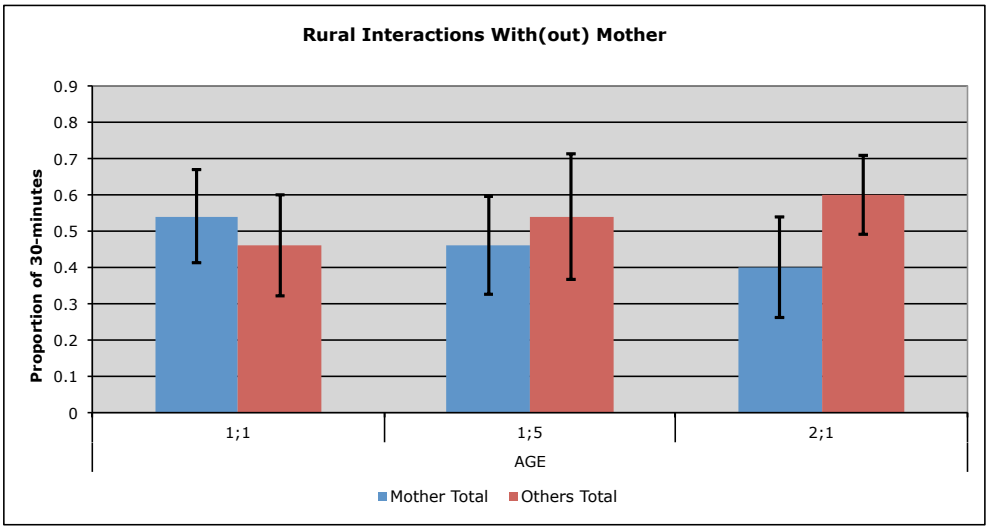


Figure 6.1: Mean proportions of rural infant joint engagement with mothers (in groups and dyads) as compared to all other communication partners combined. Error bars indicate standard deviation.

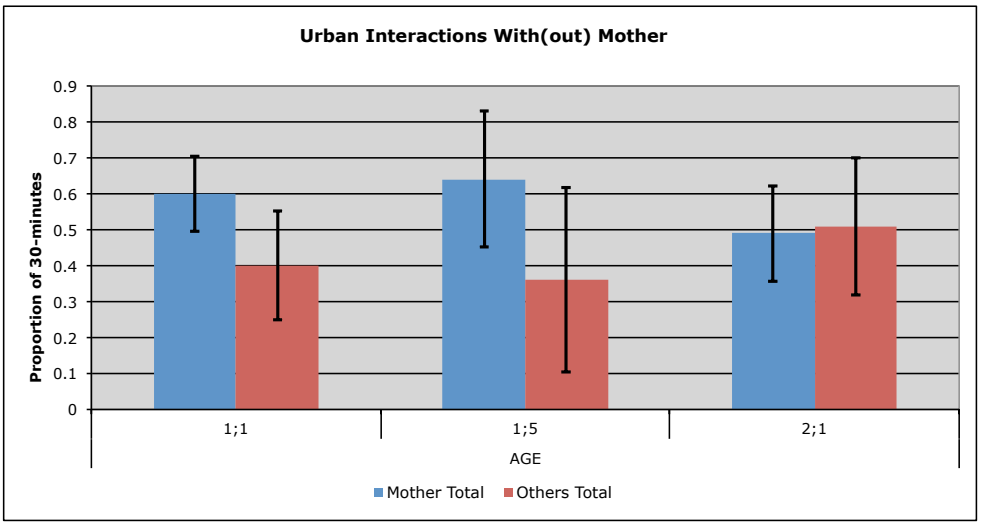


Figure 6.2: Mean proportions of urban infant joint engagement with mothers (in groups and dyads) as compared to all other communication partners combined. Error bars indicate standard deviation.

In both the rural and urban areas, mothers are the most frequent engagement partner at 1;1. However, mothers do not remain the most frequent communication partner across collection periods – by 1;5, rural mothers have been overtaken by all other partners combined and, by 2;1, urban mothers have been equaled by all other partners. Based upon Wilcoxon Signed-Rank tests, there are no significant differences across collection periods within sites, nor are there significant differences across sites based upon Mann-Whitney U tests for either two types of partner distributions at any collection period. There is only a near significant decrease in the proportion of rural *Mother-Total* between 1;1 and 2;1 (Z=-1.852, p=.064).

6.2.2 Results of Six-level Partner Distribution

Table 6.3 presents the mean proportional distribution of the amount of time infants in each community interact at each collection period with each of the six partner categories outlined in Section 3.4.1.2.

Table 6.3. Mean proportion of time (with standard deviations) from each collection period that infants in the rural and urban communities interact with each of the six different communication partner categories of Section 3.4.1.2. Proportions are based upon the amount of time interacting with each partner out of the entire 30-minutes of video data. Since solitary engagements are excluded, columns do not equate to 1.

Communication Partner Types	Rural Proportions			Urban Proportions		
	1;1	1;5	2;1	1;1	1;5	2;1
Peers	.027 (.010)	.041 (.015)	.039 (.012)	.042 (.012)	.046 (.022)	.079 (.023)
Siblings	.079 (.029)	.127 (.028)	.136 (.027)	.058 (.014)	.094 (.044)	.082 (.025)
Adults	.038 (.018)	.031 (.017)	.033 (.019)	.059 (.018)	.022 (.007)	.042 (.013)
Mothers	.209 (.034)	.145 (.023)	.134 (.031)	.217 (.039)	.216 (.060)	.210 (.045)
Multiple+Mother	.035 (.012)	.074 (.037)	.023 (.006)	.110 (.039)	**.143*** (.049)	.030 (.011)
Multiple	.042 (.016)	.033 (.009)	.032 (.009)	.050 (.016)	.035 (.012)	.017 (.005)

Mann-Whitney U tests were used to analyze significant differences across sites for each communication partner category and each collection period. There was only one significant difference between sites – at 1;5 the proportion of engagement with *Multiple+Mother* groups was significantly greater in the urban site ($U=53.5$, $p<.05$).

Figures 6.3 shows the proportions of social engagement spent with each type of rural communication partner as coded by the six partner categories presented in Section 3.4.1.2. Of all six partner categories, the only proportional distribution that

significantly changes across collection periods is the increase of *Sibling* engagement between 1;1 and 2;1 (Z=-2.04, p<.05).

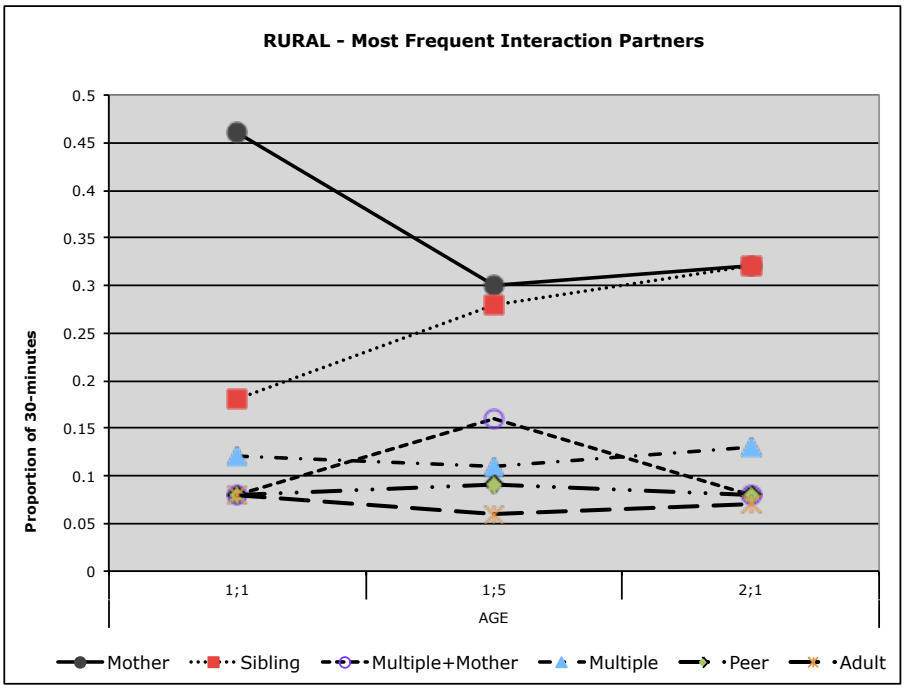


Figure 6.3: Proportions of rural infants' engagement with all six individual and group categories of communication partners. Proportions are represented here based on the amount of time spent in joint engagement rather than the full 30-minute video length.

Rural *Mothers* are, by far, an infant's most frequent communication partner at 1;1 – based upon a Wilcoxon Signed-Rank Test the difference between proportions of time spent with *Mothers* and *Siblings*, the next most frequent partner, is significantly different (Z=-2.480, p<.05). However, from 1;5 onward, *Mothers* and *Siblings* are interacting almost equally as frequent – at 1;5 there is no significant difference between these two communication partners (Z=-.408, p=.683), as well as at 2;1 (Z=-.220, p=.826). At 1;5, the third most frequent partner category is *Multiple+Mother*, but this proportion is also not significantly different from *Mothers* (Z=-1.852, p=.064); however, the proportion of *Mothers* engagement at 1;5 is significantly higher than the fourth frequent partner – *Multiple* group engagement (Z=-2.794, p<.01).

In contrast, urban *Mothers* are continually the most frequent individual interaction partner with their infants at each collection period, as is shown in Figure 6.4. This is much more frequent than any of the other partner categories, which are all less than 25% of engagement. In regard to significant changes within individual communication partner categories, the proportion of *Multiple+Mother* interaction at 2;1 is significantly less than at 1;1 (Z=-2.481, p<.05) as well as at 1;5 (Z=-2.919, p<.01). In addition, the proportion of engagement with *Adults* significantly decreases between 1;1 and 1;5 (Z=-2.197, p<.05).

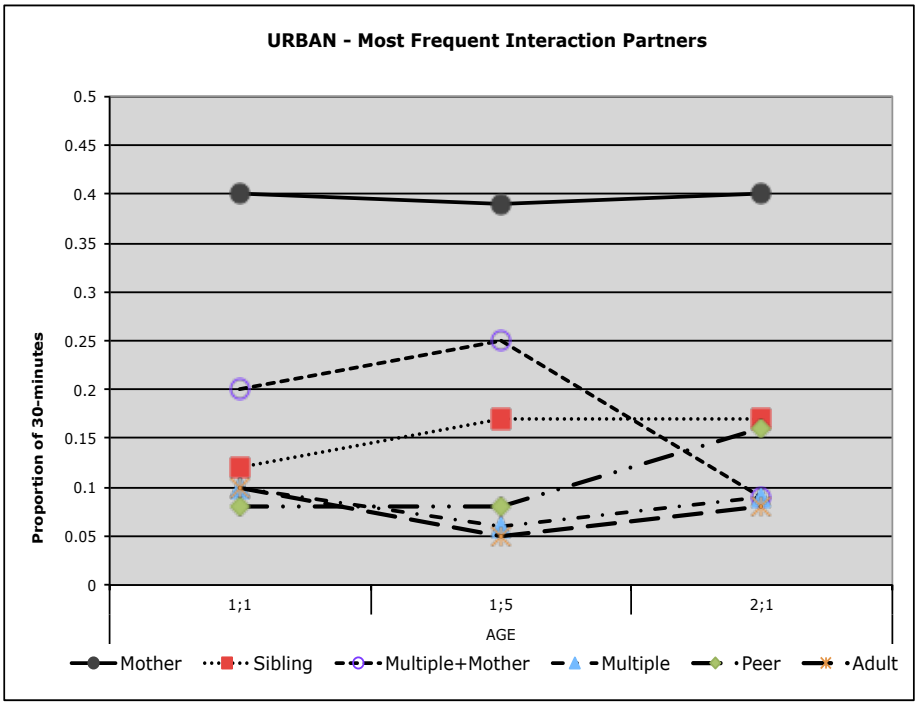


Figure 6.4: Proportions of urban infants' engagement with all six individual and group categories of communication partners. Proportions are represented here based on the amount of time spent in joint engagement rather than the full 30-minute video length.

At 1;1, the proportion of engagement with *Mothers* is almost significantly greater than engagement with the second most frequent partner category, *Multiple+Mother* (Z=-1.915, p=.056); the proportion of *Mother* engagement is significantly higher than

the proportion of engagement with the third most frequent partner, *Siblings* (Z=-2.919, p<.01). At 1;5, the proportion of *Mother* engagement is not significantly greater than either *Multiple+Mother* (Z=-1.475, p=.140) or *Sibling* engagement (Z=-1.664, p=.096), but is significantly greater than *Multiple* group engagement (Z=-2.291, p<.05). Given that *Mother* engagements are continuously around a mean of 40% of engagements, it appears that other categories must occur less than 15% on average in order to be significantly different. This is again the case at 2;1, where the proportion of engagement with *Mothers* is not significantly different from either *Peers* (Z= -1.852, p=.064) or *Siblings* (Z=-1.915, p=.056) which both represent over 15% of infants' engagement, but the next most frequent partner, *Multiple* group engagements, are significantly less than *Mothers* (Z=-3.296, p<.01).

6.2.3 Discussion

The first analysis was provided to affirm whether or not infants' mothers are the most frequent communication partners with infants in rural and urban non-industrial communities. Since prototypical non-industrial cultures often rely upon caregiving systems that are not the same as industrial cultures, such as sibling caregiving systems, it is important to ascertain how prominent a role mothers play in a community's caregiving style. The data do not universally support the notion that mothers interact with their child more than other possible partners.

❖

In the rural area, the data in Figure 6.1 shows that the presence of the mother gradually decreases, while interactions with other partners gradually become more frequent. This suggests a possible shift in caregiving systems from one where the mother is the primary caregiver, to a caregiving system distributed amongst secondary interactants. In order to realize which possible communication partner, or combination thereof, are taking over the primary care of infants requires us to look at the results of the six-level analysis. In Figure 6.3, there is a significant increase in *Sibling* engagement over the second year of life, and a general decrease of *Mother* engagement between 1;1

and 1;5, which ends with both *Mothers* and *Siblings* being equally frequent communication partners by 2;1. One could interpret this as a shift in caregiving responsibilities, especially since mothers were no less available than other communication partners were during data collection visits. Based upon mothers' responses in Table 6.1, we already know that in the rural area, grandmothers and siblings are both relied upon as secondary caregivers, but the data only supports this for the amount of time spent with *Siblings* and not with other *Adults* (e.g., grandmothers). It could be the case that grandmothers only interact frequently with infants when the mother is away from home, which was not a scenario included in this data collection. Yet, the fact that siblings are used as secondary caregivers and are one of the two most frequent type of communication partners interacted with, suggests that *Siblings* have more influence on development than alluded to in the interviews.

❖

Proportions of engagements with *urban* communication partners yield results that support my expectations – over infant development, mothers are the most frequent interactant in all three collection periods. Proportional results show that at 1;1 and 1;5 mothers, on average, interact with infants 20% more than other partners (Figure 6.2). At 2;1, the mean proportion of time that mothers engage with infants decreases the same amount as the proportion of engagements increases with all other partners, and the two-levels meet at approximately 50% of engagements each. Since there are many different possible communication partners in the *Others-Total* category, this change at 2;1 could be based upon small proportional increases from many partners, or a large increase from one individual communication partner category. Regardless, this shift in proportions towards equal amounts of engagement suggests that the social network of urban infants is moving towards a communal and equally distributed network. A more extensive analysis, as comes in the following discussion of six-level partner categorization, is still needed.

Based upon Figure 6.4, urban *Mothers* were continuously the most frequent communication partners by far over the entire longitudinal study when analyzed by a

six-level partner categorization. It could be interpreted from Figure 6.4 that at least until 1;5, urban mothers are focused on *supervising* social, group engagement because there is a significant decrease in *Multiple+Mother* engagement after 1;5, but individual *Mother* engagement remain stable and highly frequent across collection periods. It appears that urban *Mothers* support and monitor infant socialization by implementing *Multiple+Mother* engagement as a bridge between the mother-infant pair and the community. By 2;1, *Multiple+Mother* engagement has significantly decreased, and are among the least frequent categories of partner engagement. If this does represent a supervisory period, then a more child-centered approach to caregiving seems applicable to the urban community.

6.3 Correlations between Expressive Vocabulary Scores and Proportions of Time Spent with Different Communication Partners

The analysis presented in this section seeks to affirm findings from language socialization research – specifically, whether or not engagement outside of the intimate mother-infant pair would display positive and negative correlations with vocabulary development that reflect the socialization process that a specific community implements. Spearman's RHO correlation analyses are provided in three levels of increasing complexity, modeled in the same fashion as the distribution analysis. In Section 6.3.1, correlations are evaluated between expressive vocabulary and the two-way representation of communication partners, mothers versus other partners. In Section 6.3.2, correlations are next evaluated by the six-level categorization presented in this dissertation – *Peers, Siblings, Adults, Mothers, Multiple+Mother*, and *Multiple* only. In Section 6.3.3, correlations are evaluated by a 24-level categorization of partners – the six-level categorization of partners divided up amongst each of the four joint engagement levels involving partners. Finally, in Section 6.3.4, I discuss each level of analysis individually, in terms of infant socialization practices and how that may or

may not affect vocabulary development. A general discussion of the inter-relatedness of results is presented in Section 6.4.

6.3.1 Results of Two-level Partner Distribution

In Table 6.4, Spearman's RHO correlation results are presented concerning infants' expressive vocabulary scores and engagements involving the infant's mother (*Mothers-Total*) versus engagements not involving the infant's mother (*Others-Total*).

Table 6.4. Spearman's RHO correlations between expressive vocabulary scores and the proportion of time infants interact with mothers versus all others. Correlations are run between proportions at each collection period with vocabulary scores from the same and any subsequent collection period. $^{+}$p<.10; *p<.05; **p<.01

Partner Type	Rural Vocabulary			Urban Vocabulary		
	1;1	1;5	2;1	1;1	1;5	2;1
Mother-Total						
1;1	-.150	-.389	-.157	.205	-.288	.277
1;5		.257	.084		-.064	.092
2;1			-.163			-.090
Others-Total						
1;1	-.067	.305	.359	.174	**.719****	.295
1;5		-.187	.095		**.502**$^{+}$	.009
2;1			.165			.187

Results in the rural site show that there are no significant correlations between proportions of either of the two categories and vocabulary scores in any combination of collection periods. On the other hand, in the urban site, there is a significant positive correlation between the proportion of time spent interacting with other partners at 1;1 and vocabulary scores at 1;5 (r_s[14]= 0.719, p<.01). In addition, the proportion of time spent interacting with other partners at 1;5 and vocabulary scores again at 1;5 has a nearly significant correlation (r_s[14]= 0.502, p=.07). The proportions of time urban

infants spend interacting with mothers show no significant correlations with vocabulary scores in any combination of collection periods.

6.3.2 Results of Six-level Partner Distribution

In Table 6.5, Spearman's RHO results are presented concerning correlations between infants' expressive vocabulary scores and engagements involving any of the different communication partners and groups from the six-level categorization.

Results show that in the rural site, only the proportion of time infants interact with *Multiple* partners in a group at 1;1 has a significant negative correlation with vocabulary scores at 1;1 (r_s[14]= -0.564, p<.05). In regard to the urban area, results show that there is a significant negative correlation between the proportion of time interacting with *Peers* at 1;1 and vocabulary scores at 1;5 (r_s[14]= -0.690, p<.01), and a near significant negative correlation with vocabulary scores at 2;1 (r_s[14]= -0.517, p=.06). In addition, the proportion of time infants interact with *Multiple* partners in groups at 1;1 has a near significant positive correlation with vocabulary scores at 1;1 (r_s[14]= 0.490, p=.07).

Table 6.5. Spearman's RHO correlations between expressive vocabulary scores and the proportion of time infants interact with communication partners based upon a six-level categorization. Correlations are run between proportions at each collection period with vocabulary scores from the same and any subsequent collection period. $^{+}$p<.10; *p<.05; **p<.01

Partner Type	Rural Vocabulary			Urban Vocabulary		
	1;1	1;5	2;1	1;1	1;5	2;1
Peer						
1;1	-.263	.078	.399	-.366	**-.690****	**-.517**$^{+}$
1;5		-.227	-.155		-.035	-.030
2;1			-.066			-.201
Sibling						
1;1	.206	-.187	.256	.192	.331	.148
1;5		.134	.207		-.075	.143
2;1			.029			-.122
Adult						
1;1	-.135	-.178	-.413	.049	-.379	.215
1;5		.304	-.116		-.133	.061
2;1			-.367			-.084
Mother						
1;1	.088	.314	.384	-.158	.264	.018
1;5		.125	.245		.345	-.163
2;1			.057			.266
Multiple+Mother						
1;1	-.379	-.391	-.135	.189	.288	.229
1;5		-.402	-.057		.359	.233
2;1			-.018			.062
Multiple only						
1;1	**-.564***	.073	.081	**.490**$^{+}$	.061	.369
1;5		.127	-.204		-.387	.093
2;1			-.193			.038

6.3.3 Results of 24-level Partner Distribution

For the final correlation analysis in this set, I present correlations between a 24-level categorization of communication partners and expressive vocabulary scores within and across collection periods. To create this 24-level categorization, the proportion of time spent within each of the six-level partner categories is presented for each of the four joint engagement levels: *Persons, Passive-JA, Shared-JA,* and *Coordinated-JA* (see Appendix 8 for proportional distribution). In this way, a more fine-grain analysis of correlation can be provided, which is based on how often each type of communication partner interacts in which form of joint engagement. For ease of presentation, the correlations for the rural and urban non-industrial sites are presented separately in the following two sections. In addition, only significant correlations are provided here, and all correlation results are provided in Appendix 9.

6.3.3.1 Rural Site

Table 6.6 presents the significant correlations between the expressive vocabulary sizes of the rural participants and the proportions of rural infant-partner interactions divided by engagement levels.

Table 6.6. Spearman's RHO correlations between expressive vocabulary scores and the proportion of time rural infants interact with communication partners based upon a 24-level categorization. Correlations are run between proportions at each collection period with vocabulary scores from the same and any subsequent collection period. $^{+}$p<.10; *p<.05; **p<.01

Partner	Correlation	Engagement Level	Spearman's RHO
Adult	1;1 – 2;1	Coordinated-JA	-.594*
Mother	1;1 – 1;5	Persons	+.521^{+}
		Shared-JA	+.569*
	1;1 –2;1	Persons	+.816**
	2;1 – 2;1	Passive-JA	+.684**
Multiple+ Mother	1;1 – 1;5	Coordinated-JA	-.752**
	1;5 – 1;5	Shared-JA	-.573*
		Coordinated-JA	-.674**
Multiple	1;1 – 1;1	Passive-JA	-.743**
		Coordinated-JA	-.688**
	1;1 – 1;5	Persons	+.641*
	1;1 – 2;1	Persons	+.564*

First, there are no significant correlations with vocabulary based upon the proportion of time rural infants interact with either *Peer* or *Sibling* communication partners in any form of joint engagement. Turning to infant engagement with *Adults*, results show the proportion of time spent interacting at 1;1 in *Coordinated-JA* has a negative correlation with vocabulary size at 2;1 (rs[14]= -0.594, p<.05).

In terms of time spent interacting with *Mothers*, there are four correlations worth presenting. The proportion of time infants interact with *Mothers* at 1;1 in *Persons* engagement has a nearly significant positive correlation with vocabulary scores at 1;5 (rs[14]= 0.521, p=.06), and a significant correlation with vocabulary scores at 2;1 (rs[14]= 0.816, p<.01). Also, the proportion of time infants interact with *Mothers* at 1;1 in *Shared-JA* has a positive correlation with vocabulary scores at 1;5 (rs[14]= 0.569, p<.05). In addition, the proportion of time spent interacting with *Mothers* at 2;1 in *Passive-JA* has a positive correlation with vocabulary scores of the same collection period (rs[14]= 0.684, p<.01).

Turning now to group engagement including mothers, there are three significant negative correlations shown. The proportion of time infants interact with *Multiple+Mother* groups at 1;1 in *Coordinated-JA* has a negative correlation with vocabulary scores at 1;5 (rs[14]= -0.752, p<.01). Furthermore, the proportion of time infants interact with *Multiple+Mother* groups at 1;5 in both *Shared-JA* and *Coordinated-JA* have negative correlations with vocabulary scores also at 1;5 (respectively: rs[14]= -0.573, p<.05 ; rs[14]= -0.674, p<.01).

Finally, in regard to infant engagement with *Multiple* partners, excluding their mother, there are four significant correlations. The proportion of time infants interact with *Multiple* partners at 1;1 in both *Passive-JA* and *Coordinated-JA* have negative correlations with vocabulary scores at 1;1 (respectively: rs[14]= -0.743, p<.01 ; rs[14]= -0.688, p<.01). On the other hand, the proportion of time that infants interact with *Multiple* partners at 1;1 in *Persons* engagement has a positive correlation with vocabulary scores at 1;5 (rs[14]= 0.641, p<.05), and with vocabulary scores at 2;1 (rs[14]= 0.564, p<.05).

6.3.3.2 Urban Site

Table 6.7 presents the significant correlation results between the proportion of urban infants' partner interactions distributed by engagement levels and expressive vocabulary size. The results show no significant correlations between vocabulary scores at each collection period, and any type of interaction with *Siblings*, *Adults* or *Mothers*.

Table 6.7. Spearman's RHO correlations between expressive vocabulary scores and the proportion of time urban infants interact with communication partners based upon a 24-level categorization. Correlations are run between proportions at each collection period with vocabulary scores from the same and any subsequent collection period. $^{+}$p<.10; *p<.05; **p<.01

Partner	Correlation	Engagement Level	Spearman's RHO
Peer	1;1 – 1;5	Persons	-.639*
		Coordinated-JA	-.582*
	1;1 – 2;1	Persons	-.541*
Multiple+ Mother	1;1 – 1;1	Passive-JA	-.672**
Multiple	1;1 – 1;1	Shared-JA	+.593*
	1;1 – 2;1	Coordinated-JA	+.566*
	1;5 – 2;1	Coordinated-JA	+.613*

In terms of engagement with *Peers*, there are three significant correlations. First, the proportion of time infants spend interacting with *Peers* in *Persons* engagement at 1;1 has a negative correlation with vocabulary scores at 1;5 (rs[14]= -0.639, p<.05), and also with vocabulary scores at 2;1 (rs[14]= -0.541, p<.05). In addition, the proportion of time spent also with *Peers* in *Coordinated-JA* engagement at 1;1 has a negative correlation with vocabulary scores at 1;5 (rs[14]= -0.582, p<.05). Next, results show that the proportion of time infants interact with *Multiple+Mother* groups at 1;1 in *Passive-JA* engagement has a negative correlation with vocabulary scores also at 1;1 (rs[14]= -0.672, p<.01).

Finally, in regard to engagement with *Multiple* partner groups, there are three significant correlations. First, the proportion of time that infants interact with *Multiple* partners at 1;1 in *Shared-JA* has a positive correlation with vocabulary scores at 1;1 (rs[14]= 0.593, p<.05). Also, the proportion of time infants interact with *Multiple* partners at 1;1 and 1;5 in *Coordinated-JA* engagements have positive correlations with vocabulary scores as 2;1 (respectively: rs[14]= 0.566, p<.05; rs[14]= 0.613, p<.05).

6.3.4 Discussion

Data concerning correlations between the proportions of time spent with different communication partners and vocabulary development statistically shows that the urban and rural Mozambican communities are following different styles of language socialization. In Section 6.3.4.1, I will briefly discuss the results of the 2-level and 6-level correlation analyses for both the rural and urban sites. Since the 24-level analysis provides the most informative and fine-grained details of relations between engagement and vocabulary development, this discussion gives preference to the results based off of this analysis in Section 6.3.3. Results regarding the rural area are discussed first in Section 6.3.4.2, and followed directly in Section 6.3.4.3 by a discussion of the urban results. Both of these discussions will also individually relate back to the discussion of correlation results of solely engagement levels presented in Chapter 5. In order to best understand the interaction between the correlation results presented in this chapter, a general discussion follows in Section 6.4

6.3.4.1 Two-level and Six-level Analyses

In the rural area, there were no significant results in the two-level analyses between either the proportions of time spent engaged with mothers or all other partners at any collection period and any vocabulary scores. As the distribution at 1;5 shows that other partners have begun to overtake mothers in terms of the proportions of engagement, the lack of significant relation between any engagements with either mothers or all other partners could suggest that infants are adjusting to the change in their social network. In the six-level analysis of the rural area, there is one significant negative correlation between the proportion of engagement spent with *Multiple* partners at 1;1 and vocabulary at 1;1. Apart from that, there are interesting patterns in most of the six communication partner categories. In regard to engagements with infants' mothers, results show that all engagement proportions with *Mothers* have a positive relation to vocabulary scores, but *Multiple+Mother* engagements always show a negative relation

to vocabulary scores. The combination of these categories in the two-level analysis does not allow this differentiation to be noticed.

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In the urban area, the results show a significant positive relation between the proportions of engagement with all other partners at 1;1 and vocabulary scores at 1;5. In fact, the relation between the proportions of time spent engaged with other partners at all collection periods and all vocabulary scores show positive relations. This is an interesting pattern, and somewhat unexpected, since one might assume that engagement with mothers would have significant positive relations to vocabulary development. However, in the interviews, mothers in the urban area responded more often than rural mothers did that the community played a role in educating infants (see Table 6.1), thus the fact that the proportion of time spent with all other partners has a significant positive relation to urban vocabulary scores seems appropriate. Moreover, if the urban area does adhere to a more child-centered caregiving practice, then this significant relation to vocabulary could represent a distribution of that practice amongst various communication partners.

In the six-level analysis of the urban area, there is one significant correlation result, and two nearly significant results. In terms of engagement with *Peers*, there was a significant negative relation between engagements at 1;1 and vocabulary scores at 1;5, as well as a similarly almost significant relation to vocabulary scores at 2;1. Since *Peers* are also developing their own communication skills, and there could be some competition for resources, these significant negative correlations in the urban area seem appropriate. In regard to engagement with *Multiple* partners, results show that the relation between the proportion of engagement at 1;1 and vocabulary scores at 1;1 has nearly a significant positive relationship. This is entirely the opposite from what was found in the rural area. At this level of analysis, I cannot be sure why engagements with these partners have different relationships with vocabulary scores, and will return to this in the 24-level analysis discussion.

Also, in the urban area, engagement with *Multiple+Mother* always shows a positive relation to vocabulary scores. This pattern is in complete opposition to the rural area results, which showed negative relations to vocabulary for all collection period analyses. In the two-level analysis this was not apparent since this group category was combined with *Mothers* as individual partners. While not significant, this dissimilarity could relate to different forms of infant socialization practices, since the proportion of *Multiple+Mother* in the rural area is always rather infrequent, whereas in the urban area it is the second most frequent communication partner category at both 1;1 and 1;5. It could be the case that because urban infants spend almost as much time interacting with groups including their mother as they do interacting with her individually, that such engagement would be more beneficial than detrimental. This requires further analysis in the 24-level correlation results, and will be followed up further in the general discussion in Section 6.4.

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Already we can see that extending the categorization of communication partners is more informative than collapsing all partner types into two categories. As there are no significant relations with engagements with mothers in either the rural or urban community in the two-level analysis, it could be that the combination of individual and group engagements with mothers (i.e., *Mothers* and *Multiple+Mother* categories) affected the results. In addition, as we saw in both Chapters 4 and 5, the combinations of different engagement level categories in different types of analyses provide less informative results. Therefore, it could be the case, in both the two-level and six-level analyses, that too many aspects are being collapsed together, which can cancel each other out (cf. the combination of *Persons* and *Objects* engagement in Childers et al., 2007, see Section 5.3.2.1). Given these differences, the 24-level analysis is both necessary and preferred.

6.3.4.2 Rural 24-level Analysis

In regard to the rural area, it appears that when rural infants are involved in engagement where their attention has to moderate multiple social dynamics and object-oriented engagement, then these interactions negatively relate to vocabulary development. This conclusion is based on four primary observations concerning the patterns of correlations (cf. Table 6.6). First, all of the significant negative correlations between different partners and vocabulary development involve *joint attention* engagement. Second, the results show that all significant correlations between engagement with *Mothers* and vocabulary are positive correlations. The only joint engagements with *Mothers* that do not show a significant correlation with vocabulary scores are *Coordinated-JA* engagements. Third, *Persons* engagement with *Multiple* partners has the only other positive correlation with vocabulary, whereas all remaining significant correlations with *Multiple* partners are negative correlates. Fourth, all significant correlations with *Multiple+Mother* group engagements are negative correlates.

Based upon these results, there seems to be a pattern between positive and negative correlations based upon how much an infant interacts with a given partner category, and also how complex an interaction is. All positive relations to vocabulary involve joint attention engagement with *Mothers*, as well as *Persons* engagement with *Multiple* partners. Since *Mother* engagements are paired interactions, involving no other partners, there are no further human distractors present within the interaction. Also, as *Mother* engagements are the most frequent, the addition of objects to a dyadic engagement should be fairly regular. Thus, joint attention engagements appear not to suffer from distractions if these interactions only involve the *Mother* as the other partner. In such scenarios, infants may not have to regulate their attention to *Mothers* as much as they would with a communication partner they interact with less often. This seems to also be the case in *Persons* engagements with *Multiple* partners, where social directives are more straightforward or involve shared play activities, but

distractions are minimal since no targets are included. Moreover, this would also help explain why *Shared-JA* interactions with *Mothers* have a positive relation to vocabulary scores. Even though these interactions involve a mismatch of goals, they could potentially offer beneficial learning scenarios for an infant if they are followed-up by engagements designed to clarify goals. This could be especially true if these engagements involve their *Mother* and her goals, which might be easily understandable since *Mothers* are the most frequent interactants with infants at this age.

When these two different dynamics – the inclusion of either the infant's mother or external targets within *Multiple* partner engagements – begin to merge, there are negative correlations with vocabulary scores. In fact, all negative correlations with vocabulary scores involve joint attention and engagements with less frequent partners, be those individuals (i.e., *Adults*) or groups (i.e., *Multiple* and *Multiple+Mother*). In regard to the negative relation between *Coordinated-JA* with *Adults* and vocabulary scores, it could be the case that such interactions are not beneficial if the *Adult* partner's goals are in opposition to that of the infant. For example, Strassman (2011) was able to show that in the Dogon culture of Mali, infants living in households where their grandmother was also present were twice as likely to *not* survive infancy because of the inter-generational competition for resources. Since rural Mozambican households generally involve multiple generations, a respect for the elderly as head of the family, and grandmothers (who are categorized as *Adults*) are often used as secondary caregivers, this correlation could represent something similar to the effect found in the Dogon community (Strassman, 2011). In regard to the negative correlations of joint attention observed around multiparty interactions, it seems to be the case that joint attention may be too difficult for rural infants when it happens concurrently with multiple factors vying for or against an infant's attention and goals, as this would have a detrimental relation to vocabulary development. The interesting question is: why does this happen? It may be the case that rural children have more difficulties in these types of engagement either because of developmental issues (due to lower SES), or due to less familiarity with object stimulation. This requires further

comparison with the urban area, so this question will be discussed in more detail in Section 6.4.

In regard to the correlation results in Section 5.2, the preceding analysis also provides further information regarding interaction dynamics as well as additional consistency of correlations. The correlation between the proportion of time infants spend in *Persons* engagement at 1;1 and vocabulary scores at 2;1 is mostly due to the correlation of these engagements with *Mothers*. It seems the proportion of time rural infants spend in *Persons* engagement spent with *Mothers* at 1;1 shows the best relation to later vocabulary scores. Furthermore, the preceding analysis shows that rural *Coordinated-JA* engagement across development involving *Adults*, *Multiple+Mother*, or *Multiple* communication partners all have negative correlations. Based upon the Section 5.2 results, it seems that *Coordinated-JA* engagement at 1;1 with *Multiple+Mother* group interactions carries the strongest effect, which occurs less than all other communication partner categories except *Peers* (see Appendix 8). This supports the previous findings, and shows that it is not *Coordinated-JA* engagement with infants' most frequent communication partners, but instead with their less frequent interaction partners, that have negative correlations with word learning. Such an implication leads me to believe that in the rural area it is the stability associated directly with the most frequent communication partner (i.e., *Mothers*) that allows for the best word leaning, and this occurs during *Persons* engagement, not with *Coordinated-JA*. One could assume that object naming may not be a regular interaction technique in the rural community, which the parental responses in Table 6.2 appear to confirm. In addition, as discussed previously, Vogt and Mastin (2013a) find little speech occurring in rural interactions, which would certainly not foster word learning.

6.3.4.3 Urban 24-level Results

Turning now to the urban area correlation results using the 24-level analysis, there are three distinct points to make. First, all positive significant correlations with vocabulary involve *joint attention* engagement with *Multiple* partners. An interaction with *Multiple*

partners allows an infant access to many more communication partners and types of engagement from which to learn vocabulary. This would be especially true if the urban area follows a more child-centered approach to caregiving, which would suggest more object naming within interactions (Greenfield, 2009), thus in turn suggesting that these engagements would be rich in child-directed speech. Furthermore, as these interactions with *Multiple* partners involve targets, the possibility of word learning again greatly increases. However, this is in direct contrast with the results obtained in the rural area, and will be discussed comparatively in Section 6.4.

Second, all significant correlations with *Peer* engagement are negative correlates. I am led to assume that engagement with urban *Peers* are detrimental possibly due to the fact that *Peers* are also developing their skills as a communication partner. This could also involve conflicting goals between infants and *Peers*, such as the competition for resources (Strassman, 2011), which might have negative relations to the outcome, and thus the benefit, of an interaction (Gaffan et al., 2009; Harkness, 1977; Mundy et al., 2007; Tomasello & Todd, 1983). As *Peers* are also becoming competent language users, it makes sense that engagement with them would offer little if any potential for word learning, especially those interactions where a target object is present but not referred to due to lack of linguistic knowledge.

Third, *Passive-JA* engagement with *Multiple+Mother* groups have a negative correlation with vocabulary. In such engagement, an infant's attention is only focused on the target as introduced by a partner(s), and the infant does not attend to either the mother or any other partner present in the group interaction. A negative relation with vocabulary development could occur when an infant's attention is being redirected by multiple people at the same time toward a target, thus the infant may be unsure of who is interacting with whom, causing it to be a difficult situation to learn from. In contrast to this, engagements with *Multiple* partners show that there are significant positive correlations with *Shared-JA* and *Coordinated-JA*. The differences in these relations between joint attention interactions and vocabulary development would then either be based upon the presence of mothers in the group interaction, or based upon the

dynamics of attention between partners. As *Passive-JA* lacks a coordination of eye-gaze or the demonstration of corresponding behavior, it may be the case that the inclusion of this in the other levels of joint attention is more beneficial to word learning.

In regard to the engagement level correlation results in Section 5.2, this partner analysis provides some support in consistency of correlations, but also offers some discrepancies. Turning first to the Section 5.2 correlation results concerning the proportion of *Coordinated-JA* engagement at 1;1 and vocabulary scores at 2;1, there is a consistency of correlations – it is the amount of *Coordinated-JA* with *Multiple* partners that fosters a positive correlation with vocabulary scores. Now, in regard to the positive correlation between the proportion of *Persons* engagement at 1;1 and vocabulary scores at 1;5, this result is no longer found in the communication partner analysis. Instead the only significant correlation that comes close is that of *Persons* engagement with *Peers* at 1;1 and vocabulary at 1;5, but this correlation is negative rather than positive. This issue is possibly due to a large difference in the proportions under analysis – the amount of time urban infants spend interacting in *Persons* interaction and the amount of time that infants interact with *Others-Total* are both much larger proportions of time than that of *Persons* engagement with only *Peers* (see Appendix 8). This differentiation of large and small proportions may explain the inconsistency of the positive/negative relation of *Persons* engagement and vocabulary scores – more time spent interacting suggests more opportunities for word learning, whereas less time spent in engagement may not allow for proper learning.

6.4 General Discussion

Ethnographic data was able to greatly further the analysis of communication partner distributions and caregiving styles in Mozambique. This information covered beliefs on infant's developmental milestones, general child rearing, and language socialization – such as the greater prevalence of urban mothers participating in object naming tasks, or that rural mothers believe personhood sets in later in infancy than their urban

counterparts. Responses from mothers in Table 6.2 were able to show how both communities shared some similarities in child-rearing beliefs that are generally considered standard in non-industrial communities, such as the high occurrence of sibling caregiving (Brown, 2011; Greenfield, 2009; Keller et al., 2005; Schieffelin & Ochs, 1986; Zukow-Goldring, 2002). More specifically, though, were the dissimilarities in responses from mothers, which adds further support to these communities representing different prototypical learning environments (Keller, 2012). Urban mothers responded more often than rural mothers did that object-stimulation and cultural practices in social interactions were important aspects of language socialization (Table 6.2), which are both common characteristics that non-industrial urban communities share with industrial cultures and non-industrial cultures respectively (Keller, 2012). In addition to linguistic development, rural and urban mothers continually differed in responses concerning aspects of social and nutritional development (Table 6.1). The fact that rural mothers have a much different view of infants as individuals, not considering them as people until after the age of 1;0, is possibly one of the most important characteristic differences in parenting beliefs. If infants in the rural and urban non-industrial communities are not treated as equal or competent communication partners in a similar fashion, it seems logical that they would not develop vocabulary in the same style nor along the same time scale.

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In the rural area, the proportional distribution of partner engagement abruptly changes after 1;1 with a drastic decrease in *Mother* engagement, and corresponding increase of *Sibling* engagement. This, in combination with the correlation results presented in Table 6.6, seems to justify the claim that rural caregiving systems are less child-centered than urban communities, and instead adhere to a more situation-centered style of caregiving. The engagements with partners that held negative correlations with vocabulary in the rural area were all outside of the mother-infant pair. This could suggest that the amount of time spent with other interaction partners is not beneficial for word learning either due to infants' lack of experience interacting

with these partners, due to conflicting interests between infants and others for resources, or because these other engagements involve multiple partners and/or targets, which make interactions more complicated for infants to follow. Also, results suggest that the relation between rural infants' engagements' potential for vocabulary development transpires in time spent in *Persons* engagement, and also engagement with those communication partners who are the most frequent interactants at 1;1 – *Mothers.* Such *Persons* engagement, often manifested as motor stimulation (Vogt et al., 2013), would not contain any conflicts of interest in resources, as well as no unfamiliar target objects. As there is much less speech in infant interactions in the rural area compared to the urban area (Vogt & Mastin, 2013a), and prototypical rural non-industrial environments' infant socialization is focused on social responsibility through action autonomy, the role that *Persons* engagement plays seem rather appropriate.

Turning to the urban non-industrial area, the data suggests that Mozambican urban *Mothers* implement a language socialization process that is at times similar to those described in studies of child language acquisition in industrial societies – where the community is child-centered and caregivers act as supervisors, supporting infant socialization within the family and community (Lieven, 1994; Schieffelin & Ochs, 1986). In regard to the distribution of engagement with different communication partners, the most important result shown is that urban *Mothers* are continually the most frequent individual interactant with infants throughout all collection periods. This alludes to a very stable relationship between mothers and infants, which would certainly be beneficial to both social and linguistic development. In addition, the second most frequent proportion of engagement at both 1;1 and 1;5 was with *Multiple+Mother* group engagement. As both of the partner categories that involve mothers are the most frequent over early development, this suggests the urban area caregiving system involves heavy amounts of moderation and supervision by *Mothers*. This would certainly entail a more child-centered approach to caregiving (Schieffelin & Ochs, 1986). The correlation results from the 24-level analysis certainly seem to uphold this claim.

Results in Table 6.7 showed that for urban infants, *triadic joint engagement* with *Multiple* partners had positive correlations with vocabulary development. The amount of time spent in *Multiple* partner engagement could relate to word-learning if the caregiving system is child-centered, implying that the goals and actions of the infant are the central focus of the group (Schieffelin & Ochs, 1986), making it relatively simple for the infant to follow and learn from. Or it could be the case that these interactions offer more variable learning possibilities than engagement with *Mothers* because there are more partners present in these interactions, causing the context to be much more variable, and the amount of linguistic input to be higher solely based upon the greater number of people. This might suggest that because the proportions of time urban infants interact with *Mothers* is stable over development, these types of engagement are possibly standardized, which may not result in learning many new vocabulary words. To justify this claim requires further research into the types of engagement and daily routines that are happening in the video data, as well as a deeper analysis of the context of speech occurring when infants and mothers are engaged together.

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When comparing the correlation results from the two non-industrial communities, there are three points of interest. First, positive correlations with vocabulary in the rural site still consistently relate to *Persons* engagement in both an analysis by engagement levels as well as by communication partners. However, in the urban area significant engagement level correlations with *Persons* engagement are lost in the communication partner analysis, and only significant relations between *Coordinated-JA* and vocabulary are still present in the results. This could suggest that in the urban area it is more the *style* of engagement with all types of partners that relates to vocabulary scores, rather than the amount of time interacting with an *individual partner*. If this is in fact the case, then this adds further support to the claim that the urban area is more child-centered than the rural area. This is an important differentiation to make here because *Persons* engagement has been understudied in previous research as an

engagement that may relate to vocabulary development, and is apparently rather significant in non-industrial communities, if not also within industrial communities.

Second, significant correlations with *Multiple+Mother* groups in both sites were negative in the 24-level analysis, and included all forms of *triadic joint engagement* across sites. As discussed previously, it may be that this type of partner interaction is too cognitively complex because it involves too many distractors for infants – having to share their mother's attention, the inclusion of other less frequent communication partners, and the inclusion of a target creating a triadic engagement. As noted in Section 6.3.4.1 and earlier, this may be because urban mothers are implementing a process of infant socialization in which they play more of a supervisory capacity, which would account for why *Multiple+Mother* engagement is second only to engagement with *Mothers* in the urban area, but is almost the least frequent partner engagement in the rural area. Since mothers may be enacting a supervisory role, their attention may be focused more on the behavior of other communication partners, rather than the infant, which may disturb the infant's coordination of attention.

Third, positive correlations with vocabulary in the rural site revolve around engagement with *Mothers*, whereas positive correlations in the urban site relate to *Multiple* partner *Persons* engagement. Why would this difference exist? In terms of the rural area, it is expected from the characteristics of different prototypical learning environments that there would be less object stimulation (Greenfield, 2009; Keller, 2012), which was supported by mothers' small number of responses regarding object stimulation in the semi-structured interviews (see Table 6.2).

Given the age range studied, and the observed shift in caregiving at 1;5, engagement with mothers up to 1;1 are most likely stable and standard aspect of rural infants' social networks. Since mothers are the most frequent engagement partner at 1;1, it seems that engagements involving the infant and mother as a pair, and also with a target object, are not difficult for rural infants, showing positive relationships to vocabulary development. All other joint attention engagement outside of the mother-

infant pair shows significant negative correlations. As multiparty joint attention engagements show negative correlations, but multiparty *Persons* engagement show positive correlations, the addition of targets to rural infants' engagement in multiparty interactions seems to be a plausible explanation for the negative relations with vocabulary development. Based upon a lifestyle of subsistence farming in the rural area, and generally lower SES than the urban area (e.g., less parental education and longer periods of breastfeeding), it may also be that infants experience less healthy physical and cognitive development. This in turn may cause rural infants more difficulty dividing their attention across multiple factors in complex interactions, than would occur in standardized interactions.

Vogt and Mastin (2013a) have shown that the amount of child-directed speech and gestures in the rural community were significantly less than in the urban community, and the gestures that did occur were predominantly based around motor stimulation (Vogt et al., 2013). This suggests that engagement in the rural area involved more silent interactions, which would certainly make it more difficult for word learning if there is only minimal language exposure. Moreover, it would be much harder for infants to navigate joint attention in group interactions if these involved mostly gestures and limited amounts of speech. However, navigating attention would be less difficult in multiparty interactions without an external target object, and the majority of gestures revolved around physical movement and play. In addition, given the general configuration of rural households, multiparty interactions were usually made up of other *Peers* and *Siblings*. This could also suggest that there may have been intra-group competition for resources during joint attention engagements (Strassman, 2011), which could also cause a negative impact on word learning. If this is the case, then one might expect that negative relations between engagement with *Multiple+Mother* groups and vocabulary would not occur because mothers would be able to supervise the allocation of resources. However, if infants are socialized in a process similar to social responsibility through action autonomy (cf. Keller, 2012), and mothers are not enacting a child-centered viewpoint, then a negative relation involving

Multiple+Mother groups might occur. This is precisely what the results show: a negative relation between rural *Multiple+Mother Passive-JA* engagement and vocabulary scores. Moreover, as it seems to be that rural caregiving is under flux between 1;1 and 1;5, proportions of engagement at 1;1 may not be the best representation of rural caregiving practices and social network structures. If this is true, then *Multiple+Mother Passive-JA* engagement may be negative relations to vocabulary development if these represent engagements designed to aid in the transfer of caregiving. Yet, the possibility still remains that this negative relation is not based upon the caregiving structure of the rural community at all. As discussed in Section 6.4, *Passive-JA* engagement with *Multiple+Mother* does not involve any overt checking of other partner's eye-gaze by the infant. In such cases, the lack of gaze checking lessens the probability of aligned attention, and thus in turn lessens the likelihood of understanding a communication partner's intent. Given that engagement with *Multiple+Mother* involves more than one possible partner, this latter explanation is also a likely explanation.

In the urban area, on the other hand, different types of joint attention in multiparty engagement were the only correlations to show positive relations with vocabulary scores. As these positive results are in direct opposition to those of the rural community, it seems plausible that urban infants are experiencing a different form of socialization. Based upon mothers' responses in Table 6.2, and what one would expect based upon differences in non-industrial prototypical learning environments (Keller, 2012), results suggest that object stimulation is a more prevalent socialization *technique* in urban non-industrial infants' caregiving. In addition, in Table 6.1, mothers' responses to interviews show further differences in socialization *beliefs*. Urban mothers considered infants to have reached personhood by an earlier age, that social interactions were one of the most important aspects of caregiving, and that the community played a role in infant education. It may be the case that the urban community takes on a greater role in infant socialization than occurs in the rural area, and this may occur earlier in life. This claim seems to hold true based upon the

distribution of multiparty interactions (i.e., *Multiple* and *Multiple+Mother*) in Table 6.3, which have higher proportions in the urban area for all collection periods except for *Multiple* engagement at 2;1. Thus, urban infants would be more accustomed to multiparty interactions, especially if these are with communication partners they regularly interact with, which would mean that including targets may not affect infants' attention negatively as it does in the rural environment. Given the fact that urban infants are weaned earlier than their rural counterparts suggests a supplementary diet, which would imply better health and higher-SES (to purchase additional food), as well as a lesser likelihood of infants having to compete with other individuals for resources (e.g., targets) during engagement. This combination of factors suggests urban infants are better capable of managing attention to multiple factors in complex types of engagement. Furthermore, as we know that urban infants are exposed to significantly more speech and gestures overall (Vogt & Mastin, 2013a), these are most likely rich aspects of multiparty interactions, which would certainly be beneficial for word learning. Thus, the positive correlations of joint attention engagement with *Multiple* partners suggest a more child-centered version of infant socialization.

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In summation, naturalistic field observation studies of child language acquisition are able to show that socialization processes not only differ between cultures, but also across communities. Furthermore, the results show that engagements with various individuals and groups of partners have significant positive and negative correlations to vocabulary development, which augment learning based upon the socialization process of that community. Also, these correlations from different communication partners are able to show whether or not a community, not an entire culture, implements a child-centered or situation-centered approach to language socialization. Based upon the results presented in this chapter, I am able to conclude that language socialization not only differs between industrial and non-industrial cultures, but that the process of linguistic socialization can differ within an individual non-industrial culture based upon the characteristics of prototypical learning environments.

CONCLUSIONS AND FUTURE RESEARCH

This dissertation aims to provide an exploratory analysis of the relation between infant engagement and vocabulary development in rural and urban non-industrial communities in Mozambique. Not only is this country under-represented in the literature, but also a comparable analysis between urban and rural communities in a non-industrial culture is uncommon within the fields of language acquisition and child development (see Section 2.2). At this point in time, the results presented in the preceding chapters are part of a continuum, and do not represent the final understanding of infant engagement, socialization and language acquisition from a perspective that encompasses all prototypical learning environments. However, in regard to different prototypical non-industrial communities (Greenfield, 2009; Keller, 2012), the analyses undertaken were able to provide valuable results regarding the four exploratory research questions presented in Section 1.2, which will each be addressed in turn in the following pages.

7.1 Reanalyzing Engagement Levels

The first objective for this exploratory analysis was to review the methods and literature available on infant engagement and early language acquisition analysis. In Section 2.1, an important distinction was made between different types of research methodologies in order to provide a clear understanding of how certain methods may affect research participants and thus provide somewhat biased results. I argued that while the majority of preceding studies on infant engagement labeled themselves as *naturalistic* observation, they were in fact more suited for the category of *semi-structured* observation methods (Eisenbeiss, 2009), because the instructions and materials provided to parents in these previous studies constricted the environment and possible engagement in such a way that they were no longer fully natural. It became more apparent in Section 2.2, that while simulated play and object-stimulation methods in semi-structured observation are certainly able to provide data on infant engagement and language acquisition, these scenarios produce a disproportional

amount of triadic joint engagement (e.g., *Passive-JA* and *Coordinated-JA*). By creating an environment that is biased towards large proportions of engagements that involve attention towards objects, observations could easily misrepresent what is a normal learning situation for an infant, and this in turn could either misrepresent an entire culture or result in a poor application of research methods to foreign cultures. For these reasons, the CASA MILA project attempted to retrieve data that was truly naturalistic in form – where parents received no instructions that would alter their current household interactions, no novel or foreign toys were provided, and there were no restrictions in terms of which family members were present during filming or interacted with the participating infant.

Since this study was taking a different approach than previous studies in observing infant engagement, it was necessary to review the engagement categorization used in previous studies and investigate whether this categorization would be fully adequate for analyzing naturalistic observations. Bakeman and Adamson (1984) introduced the first continuum of infant engagement levels, which research since has either replicated in part or manipulated into a less-extensive classification, neither route providing a comprehensive analysis of infant engagement itself. In addition, other studies (e.g., Carpenter et al., 1998; Childers et al., 2007) were downplaying the relation between different forms of solitary engagement (i.e., *Unengaged, Onlooking, Objects* & *Observing*), as well as any affect that communication partners aside from an infant's mother might have on development. A critique of how infant engagement can be classified was apparently missing from the literature. This allowed me to raise my first exploratory research question:

> **What engagement levels would emerge by analyzing engagement via the basic universal components of infant interactions?**

To address this question, in Section 2.3 I provided a theoretical analysis of the universal components of interactions, which include infants, communication partners, targets, mutual interaction goals, and the alignment of attention between infants and

partners in goal-oriented engagement. Specifically, the role of aligned goals in engagement has been touched on in some studies (Clark & Marshall, 1981; Liebal & Carpenter, 2011; Tomasello, 2005), but to my knowledge it has not been applied to infant engagement in as direct a way as handled herein. This analysis created five distinct components that could be applied to any type of cultural interaction involving an infant as one of the designated communication partners. In Section 2.3.2, I provided a full component-based analysis of infant engagement and how different combinations of interaction components resulted in either viable or invalid interaction scenarios.

Of those combinations that were considered possible engagement levels, presented in Table 2.3, there were two combinations that did not apply directly to Bakeman and Adamson's (1984) existing classification of engagement levels, because there were discrepancies with the definitions provided by Bakeman and Adamson (1984). It was therefore decided that these two new combinations represent distinct types of infant engagement. One of these categories, *Observing*, represents a goal-oriented version of watching other communication partners, different from *Onlooking*. The other category, *Shared-JA*, represents an interaction where mutual interaction goals in triadic joint engagement were not aligned and fully realized, which separated this category from *Coordinated-JA* engagement. Both of these categories have not been fully realized in previous engagement level classifications due to the minimized role that goal oriented behavior has been given. Recent research, though, has certainly laid an extensive foundation for this (Carpenter & Liebal, 2011; Clark, 1996; Tomasello et al., 2005), and inspired the application of goals as an individual component of engagement. By implementing a component-based analysis allowed me to address this first exploratory question and create an expanded version of categorizing infant engagement, which furthered the original classification of Bakeman and Adamson (1984) while also accounting for all interaction types analyzed in related studies.

Engagement level distribution results, in Section 4.1, showed that not only were both new categories present, but there were significant differences between rural and urban proportions of each engagement category at different collection periods. In the

correlation analysis in Section 5.2, of either novel category, only *Observing* engagement showed up in the significant results as having a positive relation with vocabulary scores in the rural area. As these two categories were separated from others based upon aspects of goal-oriented behavior, it may be that observations of younger ages and vocabulary scores of older ages would be necessary to show if there are other significant relations with vocabulary. However, it appears to be that even if these categories do not show many significant correlations, the use of an extensive categorization of engagement within a correlation analysis yields more informative results than other classifications used in the literature.

In Section 5.3, I applied the engagement classifications used in previous studies' correlation analyses to our naturalistic observation data in order to assess how results may be affected by less extensive categorizations. Results showed that collapsing different existing engagement categories together could cancel out significant results if these have opposite relations to vocabulary development. In addition, using a full spectrum classification (e.g., including solitary engagement and joint engagement) provided valuable results on intra-cultural differences across communities that would not have been noticed if only specific engagement levels were analyzed. With such correlation results spanning solitary and joint engagement levels, I advocated that a full-spectrum analysis of engagement was more informative than removing or ignoring categories.

7.2 Infants' Naturalistic Engagements in Different Cultural Settings

Given the prevalence of research on Western, industrial infants' language acquisition and engagement, it was necessary to address cross-cultural differences in infant socializations, caregiving practices and parental sociodemographics. Section 2.4 reviewed research covering infant cognitive and linguistic development in many different types of industrial and non-industrial cultures, and it became readily clear that caregiving and socialization practices differ greatly both across and also within

cultures. Through the work of Abels et al. (2005), Greenfield (2009), and Keller (2012), the issue of cross-cultural understanding has been made clearer through their accumulative efforts. Their work has resulted in the organization of three prototypical learning environments – industrial urban middle-class, non-industrial urban, and non-industrial rural communities – each of which have their own specific, though not entirely mutually exclusive, cultural sociodemographics and characteristics of infant socialization. The CASA MILA project investigates these three different cultural representations, and this dissertation focuses on both of the non-industrial prototypical cultural learning environments. To explore infant engagement in a non-industrial culture, longitudinal naturalistic observation data of infants was collected in urban and rural Mozambique communities, starting from the age of 1;1 and ending at the age of 2;1.

With the categorization of engagement based upon the universal components of infant interactions, which includes two understudied forms of goal-oriented behavior, we are ready to investigate the second research question:

> **What is the proportional distribution and development of infants' engagement levels in spontaneous, natural interactions in rural and urban non-industrial communities?**

This question was raised to assess how much time infants spend in various types of engagement in representative naturalistic observations of extended family environments in non-industrial communities. To investigate this question, Chapter 4 analyzed the mean proportion of time that infants engaged in eight types of solitary and joint engagement (see Section 2.3) in both the rural and urban non-industrial communities. While the distributions of engagement levels at each collection period – 1;1, 1;5, and 2;1 – are comparable across sites, there are significant differences in the proportion of time spent in specific engagement levels. In the rural area, infants spent a significantly greater proportion of time in levels of solitary engagement, specifically *Unengaged* at 1;1 and *Observing* at 1;1 and 1;5. Urban infants, on the other hand, spent

a significantly greater proportion of time in *Passive-JA* engagement at 1;1, and *Shared-JA* engagement at both 1;5 and 2;1.

These differences can be explained based upon the differences between rural and urban prototypical learning environments, where infants in rural environments are treated less as communication partners and more as observers than their urban counterparts (Greenfield, 2009; Keller, 2012). This difference is also similar to the differentiation made by Schieffelin and Ochs (1986) between cultures that apply a form of infant socialization that is situation-centered (e.g., rural observing) compared to one that is child-centered (e.g., urban joint engagement). This division in infant socialization seems to be even more applicable to these non-industrial communities when we look at the developmental changes in engagement level proportions across the three collection periods. Specifically, the results show that over development none of the proportions of engagement levels significantly change in the rural area. This caused me to question if other dynamics of rural infant engagement were changing over development or if engagement was regulated across types. In the urban area, however, three engagement level proportions significantly change by 2;1 – *Onlooking* and *Passive-JA* both significantly decrease, and *Observing* significantly increases. These changes in the urban area suggested a shift between infants being passive and co-dependent interactants to more independent interactants, focused on goal-oriented behavior.

In addition to this distribution analysis, in Section 4.2, I also provided an exploratory comparison between the results from Bakeman and Adamson's (1984) industrial analysis using semi-structured methods, from Childers et al.'s (2007) non-industrial Nigerian study replicating the same semi-structured methods, and from our own naturalistic observation of non-industrial communities. By first comparing previous studies that differed in culture but not methodology, and then comparing our data with Childers et al. (2007), which differed by methodology but not culture, allowed me to show how semi-structured methods most likely affected how individuals interacted with infant subjects. This comparison indicates that the use of

semi-structured observation methods affects the type of data retrieved from both industrial and non-industrial societies, but affected data differently based upon the socialization practices of said cultures.

Specifically, it seems that the proportion of dyadic and triadic engagement are reversed. Naturalistic observation shows greater proportions of *Persons* engagement, and smaller proportions of *Passive-JA*, due to effects of parental instructions to simulate play in semi-structured interviews. Data of non-industrial communities show higher levels of *Coordinated-JA* than industrial infants exhibit early in development, which is most likely due to different effects of infant socialization. There are differences in the proportions of *Objects* and *Coordinated-JA* engagement, which are considered due to cultural differences between Bakeman and Adamson (1984) and Childers et al. (2007). Those differences in proportions that are due to methodological differences between our data and that of Childers et al. (2007), are the proportions of *Persons* and *Passive-JA* engagement. The variations in these four categories are also present when comparing our data with that of Bakeman and Adamson (1984), allowing me to extrapolate which differences are based around culture, which are based around methods, and which may have an accumulated affect of both.

7.3 Relating Engagement Levels to Vocabulary Development

Now that there are results regarding the proportional distribution of infant engagement levels – where rural infants spend significantly more time in forms of solitary engagement, urban infants spend significantly more time in forms of triadic joint engagement – we are ready to turn to the third research question.

> **Do engagement levels' proportions from naturalistic observation data at infants' ages of 1;1, 1;5 and 2;1 have any significant relations to these infants' vocabulary scores?**

While the proportional distribution data was able to shed some light on the amount of time spent in types of engagement and possible socialization, an analysis between these proportions and infants' vocabulary development is able to provide more informative results as to how these engagements may relate to infants' vocabulary development. Chapter 5 explored this question by applying a correlation analysis between the proportions of engagement at each collection period with infants' expressive MBCDI vocabulary scores at concurrent and subsequent collection periods. I first analyzed the results from the parental MBCDI used to measure expressive vocabulary size at the different data collection points. The results showed that urban infants had significantly larger expressive vocabulary scores at each collection period when compared to their rural counterparts. This difference in vocabulary size was most likely due to varying sociodemographics: parents with higher education levels tend to produce more child-directed speech and object stimulation (Abels et al., 2005; Greenfield, 2009; Hart & Risley, 1995); as well as non-subsistence based lifestyles, which probably relate to better levels of health and parental investment, and in turn better cognitive development (Greenfield, 2009).

In regard to correlation results of solitary engagement levels, there were differences between the two communities. In the rural area, results showed that there was a significant positive relation between the proportion of time spent *Observing* at 2;1 and vocabulary scores at the same age. As prototypical rural learning environments are more situation-centered, and children often learn from example and mimicry rather than interaction (Hoff, 2006; Keller, 2012; Schieffelin & Ochs, 1986), which entails more observing of behavior, then this result supports the differentiation of prototypical environments. In the urban community, results instead showed significant negative correlations between vocabulary scores and both *Onlooking* and *Objects* engagement levels at different collection periods. As *Objects* engagement does not include another interactive partner from whom an infant could experience a word-learning interaction, this negative relation to vocabulary was suitable. In terms of *Onlooking* engagement, another individual is present, but is not involved with the

infant or with a target, which means that *Onlooking* is not sufficiently optimized for word learning. Note, by the way, that this result further reinforces the differentiation of *Observing* from *Onlooking* as its own unique category of engagement.

Turning to the joint engagement levels, the only shared significant correlation was the positive relation between *Persons* engagement and later vocabulary scores. Due to the fact that prototypical non-industrial learning environments generally participate in less object-stimulation and more in socially oriented interactions than urban industrial prototypical environments (Keller, 2012), the positive relation between vocabulary and *Persons* engagement appear appropriate. Such a relation between *Persons* engagement and vocabulary development has, to my knowledge, not been reported in previous studies, yet could play an important role in how non-joint engagement can impact vocabulary development. This engagement category most likely has such a positive relationship with non-industrial vocabulary development because infants in both rural and urban non-industrial communities are socialized with emphasis on different forms of autonomy. This push for individualism, especially in communities that differ in levels of child-centeredness (Schieffelin & Ochs, 1986), would most likely involve greater proportions of dyadic joint engagement in order to navigate social network hierarchies and social responsibility, especially if engagement involving object stimulation is less likely to occur.

Moreover, Vogt et al. (2013), when analyzing the gestures associated with *Persons* engagement, found that these engagements manifest themselves differently across both communities: In the rural area these gestures mostly focus around motor stimulation, whereas in the urban community these involved predominantly ritualized play gestures. In line with Keller (2012), this suggests that the infants in the rural community are more frequently engaged in interactions that stimulate the development of action autonomy, whereas the urban infants more often engage in playful interactions that may be better suited to learning social responsibilities and cognitive development.

The correlation analysis further shows that *Coordinated-JA* has a positive relation with vocabulary in the urban community, but a contrasting negative correlation in the rural community. This is surprising, because previous research has placed emphasis on the positive role that *Coordinated-JA* has on word learning and development. Through different levels of analysis, it became clearer that this difference in correlation results is most likely based on an accumulation of five different factors. First, non-industrial urban communities share some aspects of infant socialization with industrial communities, such as object naming interactions, which occur much less in rural non-industrial socialization (Keller, 2012). Second, the urban community has a slightly higher SES, based upon parental education and employment, which could entail a more child-centered version of infant socialization than in the non-industrial rural area (Schieffelin & Ochs, 1986). Third, a related analysis found that the amounts of speech, gestures and co-speech gestures in the non-industrial rural community were significantly less than their urban counterparts, suggesting more silent *Coordinated-JA* engagement (Vogt & Mastin, 2013a). Fourth, based upon the change in rural infants' social networks to what looked like sibling caregiving at 1;5 (see Section 6.2), either the proportions of engagement measured at 1;1 or the vocabulary measured at 1;5 may not be appropriate representations for analysis due to the rural infants' changing network dynamics. Fifth, joint attention engagement with various partners in the rural area showed negative relations with vocabulary development, whereas these interactions with mothers did not (see Section 6.3), which suggested that the addition of targets within engagement was detrimental to rural infants if the other partner was not the most frequent interactant, an infant's mother, whom infants are already accustomed to interacting with in various ways. Thus, while this result clashes with previous correlation studies (Carpenter et al., 1998; Childers et al., 2007), it is not necessarily inappropriate given the cultural and methodological differences between these studies and our own.

7.4 Engagement Within the Infants' Social Networks

Now that we have results in regard to the correlation between engagement level proportions and infants' vocabulary development – where *Persons* engagement showed positive correlations to vocabulary scores in both communities, and forms of solitary engagement, as well as *Coordinated-JA* engagement, showed conflicting correlations across communities – it is possible to raise the fourth research question.

> **How do the different levels of joint engagement with different communication partners relate to vocabulary development?**

This research question was raised to address whether or not the dynamics of engagement with various communication partners from the extended families were comparable in the different communities. To address this question, I looked at the roles of different communication partners and their use of engagements with infants in increasingly more fine-grained level of detail. First, ethnographic data from Section 6.1, which was collected through questionnaires in face-to-face interviews from each collection period as well as a semi-structured interview at the close of the study, added further support to the conclusions drawn regarding the relation between infant social networks and vocabulary development. In regard to engagement outside of those with the primary caregiver, mothers in both communities responded during the interviews that interactions with siblings were important for linguistic and cognitive development; yet, rural mothers took this one step further, and half of rural mothers also stated that siblings were the secondary caregivers of infants, which was not a regular response in the urban community. These similarities and differences are represented well in the proportional distribution results, which implied a transfer to a sibling caregiving system in the rural community. This could have been based upon the fact that mothers in the rural and urban areas had a very different idea of when an infant was considered to possess personhood, which in turn would suggest when parents believe it is worthwhile to invest in an infant's linguistic and social

development, rather than solely their nutritional development during the first year of life. In the rural area, the majority of mothers believed personhood set in after infants' surpassed 1;0 years, whereas in the urban area mothers considered this to occur either at birth or by 0;6 months of age. This different belief about personhood could explain the significantly smaller amounts of child-directed speech and gestures in the rural community (Vogt et al., 2013), which would in turn relate to the rural infants' significantly smaller vocabulary scores. In regard to these three noteworthy ethnographic points, and the fact that all other responses were similar across communities, it appeared that parental interviews provided data to support Keller's (2012) proposal that urban and rural non-industrial communities represent different prototypical learning environments that still partially share common traditional beliefs about infant socialization and caregiving.

In Section 6.2.1, I looked into the proportional distribution of joint engagement with partners based upon a division between engagements including an infant's mother versus engagement with all other possible communication partners. From this two-level analysis, it appeared that a shift in caregiving was occurring in the rural area, and by the age of 1;5 rural infants spent more time with other communication partners than interacting with their mother. In the urban area, this did not occur, and mothers remained continuously the most frequent communication partners, compared to other communication partners, until 2;1, where the mean proportions of these two categories neared equal proportions. However, there were no significant differences within sites based upon collection period, nor across sites; only the decrease of rural infants overall engagement with mothers neared significance. Most likely, this was due to the fact that this was a coarse-grain analysis, combining many categories of communication partners, which therefore did not allow me to draw any substantial conclusions. In order to determine if these shifts in engagement levels proportions were based upon engagement with specific individual secondary caregivers or by small increases of engagement with various types of communication partners or groups, a more fine-grained analysis was needed.

In Section 6.2.2, I applied a six-level categorization of communication partners that distinguished mothers individually, as well as mothers in groups, groups without mothers, and three other individual partner categories based upon age groups (i.e., peers, siblings and adults). Based upon these divisions, it became apparent that the rural and urban infants experienced different proportions of engagement with partners in their social networks. In the rural area, distributional results showed that mothers had most likely transferred primary care to (possibly multiple) sibling caregivers when infants were between 1;1 and 1;5, due to the drastic decrease in *Mothers* engagement and parallel increase in *Siblings* engagement. I considered this to be a 'shift' in caregiving as the only other increase between 1;1 and 1;5 was that of *Multiple+Mother* group engagement, suggesting that mothers supervise some interactions with other communication partner (e.g., peers, siblings, or adults) during the transition, and the proportion of time with *Siblings* only continued to increase by 2;1 to equal that of *Mothers*. It could be possible that the 'supervision' in *Multiple+Mother* engagement is simply a group interaction in which the mother and another communication partner both participate, and in these circumstances the mother supervises - or trains - the other communication partner. Whether that is actually the case, could be discovered by further analyzing these interactions and coding whether the group consists of the infant's mother with one other partner or the infant's mother within a group of partners. If this is indeed the case, then negative correlations between *Multiple+Mother* joint attention engagement and vocabulary scores are quite possibly due to the changing dynamics of rural infants social networks and caregiving systems.

Turning to the proportional distribution of urban communication partners, results showed that the proportion of time infants spent interacting with their mothers individually was continuously stable over all three collection periods. The decrease in engagement that occurred with mothers in the two-level analysis was due to the fact that *Multiple+Mother* engagement, which was the second largest proportional partner category at 1;1 and 1;5, significantly decreased at 2;1. This decrease is accompanied in

parallel by an increase in *Siblings* engagement between 1;1 and 2;1, as well as an increase in *Peers* engagement between 1;5 and 2;1. This shift suggested that urban caregivers followed a more child-centered version of infant socialization than their rural counterparts. As mothers, both individually and within groups, were the most frequent communication partner that urban infants interacted with at 1;1 and 1;5, this suggested that caregivers had been more available to infants, and also supervised their interactions with other communication partners by including themselves within the group dynamics. This seemed to change at 2;1, where *Multiple+Mother* engagements decrease, and unsupervised engagement with younger communication partners increased in parallel, which suggested that urban mothers were allowing infants to navigate their social network more on their own.

While these proportional distribution analyses showed how rural and urban infants' social networks are partitioned differently, these results did not shed light on the relation that these social network constructions may have with vocabulary development and language learning. Therefore, an exploratory correlation analysis was necessary, which was carried out through three successively more detailed categorizations of communication partner engagement. The same two-level and six-level partner categorizations from the distribution analysis were implemented in this correlation analysis. The third categorization was a 24-level analysis, which separated the proportion of time spent with each of the six partner categories by each of the four types of joint engagement. Since this analysis is an exploration of non-industrial infants' social networks, and the 24-level analysis is an informative representation of communication partner engagement, my discussion focuses on results of this analysis.

In the rural community, results indicate that when rural infants were involved in interactions where their attention had to manage multiple social dynamics in triadic joint engagement, then these interactions related negatively to vocabulary scores. This indication was based upon the pattern of significant positive and negative relations observed in the results. The only interactions with significant positive relations to vocabulary were *Persons*, *Shared-JA* and *Passive-JA* engagements with infants' *Mothers*,

and *Persons* engagement with *Multiple* partners. Interactions that had significant negative relations involved triadic joint engagement with *Adults*, *Multiple+Mother*, and *Multiple* communication partners. The difference between positive and negative relations to vocabulary seems to be based around if interactions involved too many distractors, or if the partners involved were not frequent communication partners. As mothers engaged infants most (see Figure 6.3), their style of engagement is well established within the pair, so the addition of targets to any engagement would not be overly taxing in terms of cognitive requirements. However, when joint attention engagement occurs with less frequent partners (i.e., *Adults*, *Multiple+Mother*, and *Multiple*) it seems to be the case that there are too many unfamiliar factors and engagement dynamics for an infant to maneuver, causing negative relations with vocabulary development. Thus, the more familiar a communication partner is, then the more likely it will be that engagements involving targets will be beneficial to word learning (e.g., joint attention with *Mothers*); and the less familiar a communication partner is, then the more likely that engagements involving targets will not be beneficial to word learning (e.g., joint attention with *Adults* or *Multiple*).

These patterns further support the idea that socialization in the rural area is not very child-centered, but rather situation-centered. The positive correlation with *Persons* engagement found in the engagement level analysis from Section 5.2 was shown in Section 6.3 to be based upon the proportion of that interaction with *Mothers,* which occurred more than all other possible partner categories (see Appendix 8). Furthermore, the predominant gestures occurring in *Persons* engagement were found to involve motoric stimulation (Vogt et al., 2013). This suggests that a large proportion of interactions with mothers revolved around directing a child's movement, adjusting their already occurring actions, or conducting daily routines (e.g., bathing, clothing, grooming). If this is the case, this style of engagement does not relate to the attention or goals of the infant, but instead to those of the mother, and possibly also those of the community in general. Moreover, the negative correlation with *Coordinated-JA* found in the engagement level analysis of Section 5.2 was based off of an accumulation of the

proportion of this interaction with different and infrequent communication partners. As various communication partner categories excluding the mothers all showed similar negative relations with joint attention this seems to confirm a situation-centered socialization in the rural community. If this is the case, then different communication partners interacted similarly with rural infants – in a manner that did not cater to the attention and goals of the infant. Evidently, a deeper analysis of rural infants' triadic joint engagement with non-caregivers is necessary, which complementary research in the CASA MILA project has begun to address in terms of the amount and types of speech and gestures occurring in joint engagement (Vogt & Mastin, 2013a; Vogt et al., 2013).

In the urban community, a different pattern of correlations was found that is in line with a more child-centered approach to socialization. The majority of urban interactions that showed negative relations with vocabulary learning involved *Peer* communication partners. Since peers are also developing their own linguistic and social skills, it seems reasonable that the proportion of engagement with such communication partners would not relate well to word-learning and vocabulary scores. In addition, if peers are also exposed to child-centered socialization, which seems to be the case, then when urban infants interact with peers there could easily have been a conflict of interest if each individual is used to interacting with a partner that caters to their own focus of attention.

Furthermore, positive correlations were found between vocabulary scores and triadic joint engagement with groups of *Multiple* partners, which is in direct opposition to the rural results. It could be inferred that urban engagement with *Multiple* partners carried more weight in regard to word learning. Since the proportion of time infants spent interacting with mothers was stable over development, these multiparty engagements could represent the most varied types of joint engagement, which would allow for greater exposure to new words. Even if multiparty engagement did not happen very often, it has been established that the urban area uses a rather child-centered approach to caregiving, which would also apply in multiparty interactions. As

multiparty communication and object stimulation are more common in the urban area, and children tend to be healthier than in rural community (thus providing better conditions for controlling and dividing attention), multiparty *Coordinated-JA* can yield positive correlations to vocabulary. The question still remains as to why we do not see positive correlations between engagement with mothers and vocabulary, as in the rural community, and this is a question that future analysis and research should consider.

7.5 Limitations

The research and results presented in this dissertation were all part of an exploratory study of infant engagement in an under-represented culture, which entails certain limitations in regard to the data collected, the individuals studied, and aspects of data analysis. Specifically, there are five limitations that need to be addressed, but this does not imply that these are the only limitations of the study.

The first limitation that should be addressed is the sample size presented, both regarding the number of participants observed and the amount of data collected. In a more ideal analysis, it would have been preferred to have at least three times as many participating families per site, which would allow for other types of statistical analysis, specifically multiple regression (Green, 1991). In addition, dense data collection across a longer time span of infant development (Lieven & Behrens, 2011) would help clarify and support findings regarding engagement level differences and correlations across sites. However, due to the complex nature of manually coding naturalistic observation, a larger sample size is far more time consuming to process. This is a limitation that exists in most studies of child language acquisition. The sample size of participants presented is greater than that of Childers et al. (2007) and the same as that of Bakeman and Adamson (1984), and the amount of data recorded per participant is double and triple the amount of both studies respectively. This was in itself the reason to take an exploratory approach, yet future research should collect still larger data sets.

The second limitation to address involves the adaptation of the MacArthur-Bates Communicative Development Inventory. Despite all efforts to minimize any issues with the measurement of infant vocabularies, the MBCDI still has its own limitations. Since we are unable to verify known vocabulary with an infant directly, and are unable to catalogue every moment of an infant's life, any measurement of vocabulary will by default involve some approximation as well as human error. As this type of parental checklist was originally designed for American English-speaking infants of middle-class urban families, the parents completing these checklists are both educated and literate. Adapting the MBCDI into an interview for non-industrial communities, that are highly illiterate and have little education, led to its own complications. For example, with the word *laugh*, mothers at times responded that their child knew *how to* laugh, rather than if their child knew the *word* 'laugh'. In the end, we had to remove items, such as 'laugh', from the adapted MBCDI that created confusion and resulted in inappropriate responses. Overall, parental checklists have been shown to result in both over- and underestimation of vocabulary by parents (Houston-Price et al., 2007; Law & Roy, 2008). One might expect that observation would provide a more accurate measurement of vocabulary, but such a method is only able to represent a small selection of possible speech contexts (Pine et al., 1996; Tardif et al., 1999; Tomasello & Mervis, 1994). Furthermore, it has been shown that recorded observation of participants, as compared to observation field notes, results in less speech (Schneidman & Goldin -Meadow, 2012). Thus, while there are limitations with the adaptation and administration of MBCDI parental checklists, a more appropriate and universal method is unavailable as of yet.

The third limitation relates to different language barriers between Vogt and myself, our local Mozambican research assistants, and the families that participated in the study. Even though both Vogt and myself learned Portuguese and Changana through language immersion, classes and private tutors, the fact remains that we are neither fluent nor native speakers of these Mozambican languages. This is explicitly why we relied upon our local assistants for many translations and explanations in local

languages. Such a language barrier certainly could have added to the limitation of the MBCDI adaptation, but is more obvious in terms of parental interviews about caregiving, as well as the analysis of the observational data. Without clear proficiency in the local languages, interviews involved at least three levels of translation – designed in English/Dutch and translated into Portuguese by researchers, discussed in Portuguese between researchers and local assistants, translated by local research assistants into the parents' mother-tongue (as necessary), and finally reported back through the same process in reverse. This could have resulted in some aspects of either questions or responses being lost in translation. In terms of data analysis, speech that occurred during a specific type of engagement can usually be rather definitive in terms of how that engagement should be classified. While transcriptions and translations of speech from the observation data was completed by local research assistants under supervision by either Vogt or myself, clarifications that may have been needed during later analysis were not possible. Clarifying language issues such as this have to be done in person, due to ethical constraints on data dispersal, and additional field work in Mozambique after data collection was not possible.

A fourth limitation, and related to the last, is the unfamiliarity that both Vogt and myself have with the culture(s) of Mozambique. While Vogt lived in Mozambique for one and a half years, and completed a pilot study there (Vogt, 2009), prior to this project, and I have completed other extensive field work studies of traditional cultures in other sub-Saharan countries, neither of us are natives of these traditional cultures. Thus, we have carried out the research with our own Western-influenced customs and cultures. The ethnographic data presented in Section 6.1 is only a small representation of Mozambican culture from two distinct communities. Given how informative such information was in the different discussions of Chapter 6, it is highly probably that additional sociodemographics and cultural beliefs affect Mozambican infants' socialization and caregiving in various ways. As Lieven (1994) points out, the culture and ethnography of a given community under study are vital to understanding aspects of language use and acquisition.

The fifth limitation to discuss relates to the fact that observation data was coded manually over an extensive time period. While Vogt and myself applied the same definitions to our coding practices, this does not imply that data coding is 100% identical. Sometimes specific interactions had to be discussed at length before agreement was reached as to what code would be most applicable. As this suggests, the early stages of data coding involved some adjustments and editing of material already coded, as well as further specifications of definitions. A finalized set of coding definitions was presented in Section 3.4.1.2, which was applied to all data presented in this dissertation. It is necessary to note, that because manual coding was a time-consuming process, coding observation data took place between and after collection periods, which was almost a two-year process. Due to this lengthy process, it is possible that any individual coding such data could stray from or adjust their coding strategy ever so slightly, which would affect future coding decisions. Even though the inter-rater reliability scores for our coding of observation data was acceptable, these issues are still important to raise awareness for future studies. The creation and application of accurate automated coding technology would help alleviate this limitation.

7.6 Final Remarks

To conclude, this dissertation was able to make multiple contributions to the fields of child development, language acquisition and developmental psychology. First, I was able to provide an extended version of infant engagement categorization, which was based on the universal components of human interactions, and was able to account for a more extensive spectrum of engagement that occurs in natural observation. Second, lengthy amounts of video data from both an urban and rural community of an understudied non-industrial country were collected over three collection periods between infants' ages of 1;1 and 2;1. Third, an adapted version of the MBCDI was created, tested and normed for three languages – Changana, Ronga & Mozambican

Portuguese. Fourth, I provided *both* an analysis of the proportional distribution of infants' engagement levels as well as the correlations between these proportions and expressive vocabulary scores across collection periods. Fifth, I provided descriptive comparisons with previous research studies in regard to the culture studied, the method of observation used, as well as the type of engagement level classification implemented. Sixth, a novel analysis of rural and urban non-industrial infants' social networks was provided through ethnographic data and multiple levels of increasingly diverse communication partner classifications – both to analyze the proportional distribution of infants' joint engagement with different partners, as well as the correlations between these proportional analyses and infants' MBCDI expressive vocabulary scores.

Future research focusing on the relations between joint engagement, infant socialization, and language acquisition, should return to the process of collecting data from purely naturalistic observations. Elicitation techniques and semi-structured observation methods are only able to provide representations of infants' interaction abilities and linguistic skills, and can easily skew both the data retrieved as well as the cultural assumptions drawn from such data. By relying on longitudinal data collections of naturalistic observations, I have been able to show that methods used in research of infant development and language acquisition need to rely upon more standardized versions of data collection and analysis, as well as construct more cross-culturally appropriate comparisons in order to address the full spectrum of infant engagement in all prototypical learning environments. In this dissertation, I have applied research methods that are able to remove/lessen biases in data collection, and have provided novel, preliminary steps towards a standardized classification and analysis of both infants' engagement and their social networks.

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In this dissertation, I was able to show that infant engagement in rural and urban Mozambique appears to follow and adhere to the characteristics and socialization styles of prototypical learning environments, as proffered by Greenfield (2009) and

Keller (2012). By applying different correlation analyses based upon the proportion of time infants spend in different engagement, and with whom they are engaged, I was able to show that *Persons* engagement appears to be more beneficial than joint attention is for vocabulary development. While this was truer of the rural environment, the role of *Persons* engagement in the urban area was also accompanied by positive relations from *Coordinated-JA*. This furthered the notion from Keller (2012) that urban non-industrial environment somewhat represent a middle ground between the non-industrial rural and industrial urban prototypical learning environments. The role that *Persons* engagement plays in these communities is important because it sheds new light on the relationship between different levels of infant engagement and vocabulary development. In addition, by applying various analyses of communication partners within infants' social networks, I was able to show how communal ideas regarding caregiving can manifest through different forms of dyadic and triadic engagement with different communication partners. By doing so, it became apparent that engagement outside of the mother-infant pair has significant relations with vocabulary development, which have not been previously exposed in research on infant development. Such results could help in the development of novel research programs for the study of language acquisition, as well as possible improvement of parental education programs in non-industrial cultures. Future research on the topic of infant engagement and language acquisition should continue to take into account what we know from semi-structured observation and elicitation studies, but more importantly, continue to explore the rich dynamics of infants' polyadic environments within and across different prototypical learning environments.

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[Untitled illustration of Africa highlighting Mozambique.]. Retrieved March 5, 2013 from *http://harambeeusa.org/projects/past-projects/mozambique/*. Copyright © 2010 by Harambee USA Foundation.

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APPENDICES

APPENDIX 1: PARENTAL QUESTIONNAIRE FOR AGE 1;1

Data:	**No:**

Informação do pai

Língua materna	
Fala português	Bom / Mais ou menos / Pouco / Nada
Nível de educação	nenhuma / EP1 / EP2 / ESG1 / ESG2 / mais alto
Ocupação	

Informação da mãe

Língua materna	
Fala português	Bom / Mais ou menos / Pouco / Nada
Nível de educação	nenhuma / EP1 / EP2 / ESG1 / ESG2 / mais alto
Ocupação	

Informação da família

Número de crianças	
Número de pessoas na casa	
Primeira língua falada na casa	
Outras línguas falada na casa	

Informação da saúde

Tinha tido algumas problemas durante sua gravidez ou outros complicações de nascimento?	sim [ ] não [ ], em caso sim, explicar:

O nascimento de seu filho estive antes de expectação?	sim [ ] não [ ], em caso sim, explicar:
É possível que o seu filho tem problemas de ouvido?	sim [ ] não [ ], em caso sim, explicar:
É possível que o seu filho tem problemas visual?	sim [ ] não [ ], em caso sim, explicar:
O seu filho tinha tido doenças gravadas, ficava no hospital ou tem alguns desvantagens?	sim [ ] não [ ], em caso sim, explicar:

Informação de cuidador

Quem esta o primeiro cuidador de seu filho?	Mãe- Pai - Vovó - Tia - Irmão - Primo - Outro
Quem esta o outro cuidador de seu filho?	Mãe- Pai - Vovó - Tia - Irmão - Primo - Outro
Quando vai para a machamba, a bomba de água ou fazer compras, leva o seu filho consigo?	Sempre - pelo mais - às vezes - nunca

Outras questões

Numa base semanal, quantas vezes você está longe de casa?	Tudo semana - maior parte - às vezes - nunca
Numa base diária, quanto tempo você passa longe de casa?	Mais de meio dia - algumas horas - menos de 2 horas - nunca
Quando você saí da casa, leva o seu filho consigo?	Sempre - pelo mais - às vezes - nunca

O seu filho já fala?	Frequentemente - às vezes - nunca
Você tenta ensinar seu filho novas palavras?	Frequentemente - às vezes - nunca
O seu filho responde ao seu nome?	Sempre - pelo mais - às vezes - nunca
Você fala com seu filho durante a alimentação?	Sempre - pelo mais - às vezes - nunca
Você fala com seu filho durante tomado banho ou vestido?	Sempre - pelo mais - às vezes - nunca

Com quem o seu filho prefere brincar?	Consigo - outras - seu próprio
O seu filho brinca em seu próprio?	Frequentemente - às vezes - nunca
O seu filho brinca com outras crianças?	Frequentemente - às vezes - nunca
Você brinca come seu filho?	Frequentemente - às vezes - nunca
Quando o seu filho brinca com outras crianças, há normalmente só uma outra criança ou mais?	Sempre uma - pelo mais uma - pelo mais - sempre mais

O seu filho tenta de imitar a senhora?	Frequentemente - às vezes - nunca
O seu filho tenta de falar?	Frequentemente - às vezes - nunca
O seu filho canta ou tenta isso?	Frequentemente - às vezes - nunca
Você canta para seu filho?	Frequentemente - às vezes - nunca

Principalmente, você canta canções com palavras existentes ou só sons?	Palavras - sons - os dois

ENGLISH TRANSLATIONS

1. Father Language (Changana=0; Ronga=1; Portuguese=2; Macua=3; Jawa=4)

2. Father Portuguese Level (None=0; A Little=1; Somewhat=2; Good=3)

3. Father Education Level (none=0; EP1=1; EP2=2; ESG1=3; ESG2=4; More=5)

4. Mother Language (Changana=0; Ronga=1; Portuguese=2; Macua=3; Jawa=4)

5. Mother Portuguese Level (None=0; A Little=1; Somewhat=2; Good=3)

6. Mother Education Level (none=0; EP1=1; EP2=2; ESG1=3; ESG2=4; More=5)

7. Number Children in Family

8. Number of Persons in House

9. Primary Language in House (Changana=0; Ronga=1; Portuguese=2; Macua=3; Jawa=4)

10. Other Languages? (Changana=0; Ronga=1; Portuguese=2; Macua=3; Jawa=4)

11. Complications in birth? N/Y
12. Birth before 9 months? N/Y
13. Hearing problems? N/Y
14. Vision problems? N/Y
15. Hospitalization in 1st year? N/Y

16. Primary Caregiver (Other=0; Mom=1; Dad=2; Grandma=3; Aunt=4; Sibling=5; Cousin=6)

17. Secondary Caregiver (Other=0; Mom=1; Dad=2; Grandma=3; Aunt=4; Sibling=5; Cousin=6)

18. Child taken out with CG? (None=0; Some=1; Most=2; Always=3)

19. Per week, CG time away (None=0; Some=1; Most=2; All week=3)

20. Per day, CG time away (None=0; Less 2h=1; Few Hours=2; Most of Day=3)

21. Child Speaks? (None=0; Some=1; Frequent=2)

22. Teach new words? (None=0; Some=1; Frequent=2)

23. Child responds to name? (None=0; Some=1; Most=2; Always=3)

24. Talk during feeding? (None=0; Some=1; Most=2; Always=3)

25. Talk during bath/dress? (None=0; Some=1; Most=2; Always=3)

26. Prefers to play with? (Alone=0; Others=1; Caregiver=2)

27. Plays alone? (None=0; Some=1; Frequent=2)

28. Plays with others? (None=0; Some=1; Frequent=2)

29. CG plays with child? (None=0; Some=1; Frequent=2)

30. Plays 1-1 or Many-1? (Always alone=0; Sometimes Alone=1; Sometimes Group=2;
Always Group=3)

31. Child tries to imitate CG? (None=0; Some=1; Frequent=2)

32. Child tries to speak? (None=0; Some=1; Frequent=2)

33. Child tries to sing? (None=0; Some=1; Frequent=2)

34. CG sings to child? (None=0; Some=1; Frequent=2)

35. Sing with words? Sounds? (Sounds=0; Words=1; Both=2)

APPENDIX 2: PARENTAL QUESTIONNAIRE FOR AGE 1;5

Data:	**No:**

Mudanças

Tem mudanças na família?	sim [ ] não [ ], em caso sim, explicar:

Informação da casa

Vocês têm televisão ou rádio na casa?	sim [ ] não [ ]
Em caso sim: Quanto tempo por dia o seu filho asiste-a ou ouve-o?	

Informação da saúde desde ultima visita

É possível que o seu filho tem problemas de ouvido?	sim [ ] não [ ], em caso sim, explicar:
É possível que o seu filho tem problemas visual?	sim [ ] não [ ], em caso sim, explicar:
O seu filho tinha tido doenças gravadas, ficava no hospital ou tem alguns desvantagens?	sim [ ] não [ ], em caso sim, explicar:
O seu filho toma medicamento?	sim [ ] não [ ], em caso sim, explicar:

Durante a vida do seu filho, você tinha tido doenças gravadas que causou hospitalização ou que preveniu de cuidar de seu filho por um período prolongado de tempo? [Quando, quanto tempo, por quê e quem cuidado pelo filho?]	sim [ ] não [ ], em caso sim, explicar:
Você toma medicamento?	sim [ ] não [ ], em caso sim, explicar:

Informação de alimentação

Normalmente, qual são as refeições do seu filho:

Matabicho:	Massa/arroz/pão - caril/vegetais/fruta - carne/frango/peixe/ovo - leite - outro - nunca
Almoço:	Massa/arroz/pão - caril/vegetais/fruta - carne/frango/peixe/ovo - leite - outro - nunca
Jantar:	Massa/arroz/pão - caril/vegetais/fruta - carne/frango/peixe/ovo - leite - outro - nunca
Quantas vezes por dia você amamenta o seu filho?	
Que tipo de 'snacks' o seu filho toma com frequência?	bolachas - doces - fruta - zumo - outro - só às vezes - nunca toma snacks

Outras questões

Você tenta de ensinar o seu filho novas palavras?	Frequentemente - às vezes - nunca
Você indica ou mostra pelos objetos ou atividades quando ensina o seu filho novas palavras?	Frequentemente - às vezes - nunca
O seu filho pergunta-lhe sobre as palavras dos objetos?	Frequentemente - às vezes - nunca

Quando seu filho faz um erro na produção de uma palavra ou uma frase, você corrigi-la (por exemplo por meio de repetir a palavra ou frase corretamente)?	Frequentemente - às vezes - nunca
As crianças às vezes fazem erros bem como, por exemplo, utilizar a palavra 'cão' por indicar uma cabra. Será que o seu filho faz isso também?	Frequentemente - às vezes - nunca
Você acha que o seu filho tem um desenvolvimento da linguagem normal?	Normal - avançado - atrazado - não sei
Se sua família há crianças mais velhas quem vão para escola, falam português na casa? (Por exemplo entre eles?)	Frequentemente - às vezes - nunca

ENGLISH TRANSLATIONS:

1. Changes to family? (0=None; 1=Move; 2=Decrease; 3=Increase)

2. Television or Radio? N/Y

3. Time spent with media? (1=1hr, Little; 2=2hr, Few, Sometimes; 3=3hr, Morning/Evening; 4=4hr, Frequent, All day)

4. Hearing problems? N/Y
5. Vision problems? N/Y
6. Hospitalization 13-18 months? N/Y
7. Child takes medicine? N/Y
8. CG hospitalization? N/Y
9. CG takes medicine? N/Y

10. BREAKFAST (Grain=1; Fruit/Veg=2; Meat=3; Milk=4; Other=5; None=0)
11. LUNCH (Grain=1; Fruit/Veg=2; Meat=3; Milk=4; Other=5; None=0)
12. DINNER (Grain=1; Fruit/Veg=2; Meat=3; Milk=4; Other=5; None=0)
13. BREASTFEEDING (0=None; 1=Rare; 2=Few, Some; 3=Meals; 4=Almost all day; 5= All day)

14. SNACKS/SWEETS (Biscuits=1; Sweets=2; Fruit=3; Juice=4; Other=5; Only Sometimes=6; None=0)

15. CG teaches new words? (None=0; Some=1; Frequent=2)

16. CG shows object/activity to teach? (None=0; Some=1; Frequent=2)

17. Child asks for object names? (None=0; Some=1; Frequent=2)

18. CG corrects production errors? (None=0; Some=1; Frequent=2)

19. Child generalizes words? (None=0; Some=1; Frequent=2)

20. Child has normal language development? (Remedial=1; Normal=2; Advanced=3; Don't Know=0)

21. Siblings speak Portuguese at home? (None=0; Some=1; Frequent=2)

APPENDIX 3: PARENTAL QUESTIONNAIRE FOR AGE 2;1

Data:	**No:**

Mudanças

Tem mudanças na família?	sim [ ] não [ ], em caso sim, explicar:

Informação da família

Ordem de nascimento da mãe	
Irmãos da mãe que mais velhos: masculino e feminino	
Irmãos da criança que mais velhos: masculino e feminino	

Informação da casa

Vocês têm televisão ou rádio na casa?	sim [ ] não [ ]
Em caso sim: Quanto tempo por dia o seu filho asiste-a ou ouve-o?	

Informação da saúde desde ultima visita

É possível que o seu filho tem problemas de ouvido?	sim [ ] não [ ], em caso sim, explicar:
É possível que o seu filho tem problemas visual?	sim [ ] não [ ], em caso sim, explicar:

O seu filho tinha tido doenças gravadas, ficava no hospital ou tem alguns desvantagens?	sim [ ] não [ ], em caso sim, explicar:
O seu filho toma medicamento?	sim [ ] não [ ], em caso sim, explicar:
Durante a vida do seu filho, você tinha tido doenças gravadas que causou hospitalização ou que preveniu de cuidar de seu filho por um período prolongado de tempo? [Quando, quanto tempo, por quê e quem cuidado pelo filho?]	sim [ ] não [ ], em caso sim, explicar:
Você toma medicamento?	sim [ ] não [ ], em caso sim, explicar:

Outras questões

Você tenta de ensinar o seu filho novas palavras?	Frequentemente - às vezes - nunca
Você indica ou mostra pelos objetos ou atividades quando ensina o seu filho novas palavras?	Frequentemente - às vezes - nunca
O seu filho pergunta-lhe sobre as palavras dos objetos?	Frequentemente - às vezes - nunca

Quando seu filho faz um erro na produção de uma palavra ou uma frase, você corrigi-la (por exemplo por meio de repetir a palavra ou frase corretamente)?	Frequentemente - às vezes - nunca

É sua criança tímida?	Muito / Só com estranhos / Raramente / Nunca
Seu bebê interagir com todos os membros da família ou apenas alguns? Quantas pessoas?	tudos [ ] alguns [ ] Quantas? [ ]
Seu bebê interage com outros membros da comunidade?	sim [ ] não [ ]
Se sim, com quem?	Crianças / Filhos / Adultos
Você acha que o seu filho tem um desenvolvimento da linguagem normal?	Normal - avançado - atrazado - não sei
Se sua família há crianças mais velhas quem vão para escola, falam português na casa? (Por exemplo entre eles?)	Frequentemente - às vezes - nunca

ENGLISH TRANSLATIONS:

1. Changes to family? (0=None; 1=Move; 2=Decrease; 3=Increase)

2. Mother Birth Order
3. Mother's Older Siblings: Female
4. Mother's Older Siblings: Male

5. Infant's Older Siblings: Female
6. Infant's Older Siblings: Male

7. Television or Radio? N/Y
8. Time spent with media? (1=1hr, Little; 2=2hr, Few, Sometimes; 3=3hr, Morning/Evening; 4=4hr, Frequent, All day)

9. Hearing problems? N/Y
10. Vision problems? N/Y
11. Hospitalization 13-18 months? N/Y
12. Child takes medicine? N/Y
13. CG hospitalization? N/Y
14. CG takes medicine? N/Y

15. CG teaches new words? (None=0; Some=1; Frequent=2)
16. CG shows object/activity to teach? (None=0; Some=1; Frequent=2)

17. Child asks for object names? (None=0; Some=1; Frequent=2)
18. CG corrects production errors? (None=0; Some=1; Frequent=2)

19. Child shyness (None=0; Rarely=1; With strangers=2; Frequent=3)
20. Child plays with everyone at home? (No=0; Yes=1)
21. How many household members does the child play with?

22. Child plays with non-family members in community? (No=0; Yes=1)
23. With whom do they play? (Infants=0; Children=1; Adults=2; Infants+Children=3; Infants+Adults=4; Children+Adults=5; All=6)

24. Child has normal language development? (Remedial=1; Normal=2; Advanced=3; Don't Know=0)
25. Siblings speak Portuguese at home? (None=0; Some=1; Frequent=2)

APPENDIX 4: CDI NORMING STUDY (Dr. Paul Vogt – Primary Author)

To assess validity of the responses given by the caregivers of the study, we compared these responses with those obtained from the norming study. Since we have more confidence in mothers' reporting of expressive vocabulary than receptive vocabulary, we only analyze expressive vocabulary. Following Fenson et al. (1994), we carried out a logistic regression using growth fitting to relate *age* with the scores of expressive language for both communities and for both the norming study and the observation study (Figure A4-1). For both communities and both data sets, *age* is a strong predictor for expressive vocabulary ($p<.0001$; Table A4-1).

Table A4-1. Results from the logistic regression using growth fitting for the rural norms, rural main, urban norms and urban main studies.

	β	β SE	t-value	Pr(>|t|)
Rural norms				
Intercept	4.4313	0.2496	17.75	<2e-16
Age	0.0053	0.0004	13.99	<2e-16
Residual standard error: 13.16 on 376 degrees of freedom				
Rural main				
Intercept	5.3553	0.8820	6.072	3.75e-07
Age	0.0068	0.0012	5.484	2.50e-06
Residual standard error: 16.44 on 40 degrees of freedom				
Urban norms				
Intercept	4.3312	0.3386	12.79	<2e-16
Age	0.0061	0.0005	11.64	<2e-16
Residual standard error: 19.62 on 258 degrees of freedom				
Urban main				
Intercept	5.0548	0.6861	7.368	5.80e-09
Age	0.0076	0.0011	7.152	1.15e-08
Residual standard error: 18.1 on 40 degrees of freedom				

To verify whether the expressive vocabulary of the main subjects develop according to what was obtained in the norming study, a logistic regression was performed on the combined data sets with *data-set* as an additional predictor (Table A4-2). This analysis yields a strong significant effect for *age* in both communities ($p<.001$). A significant effect for *data-set* was found for the rural community ($t(1,416)=-2.13$; $p=.034$) with interaction ($t(1,416)=2.20$; $p=.0282$). The urban data did not show a significant effect for *data-set* ($t(1,298)=-0.94$; $p=.349$) nor for the interaction ($t(1,298)=1.24$; $p=.218$).

Although the rural data from the main subjects yield a significant effect with interaction compared to the norming data, we accept this effect, as the two regression curves are highly similar, and the effect may be related with their participation in the study. From Figure A4-1, we can see that in the first period (~ 365-450 days) the scores for both communities tend to be below the regression line, at the end of the study (~ 725-800 days) the scores appear above the regression line.

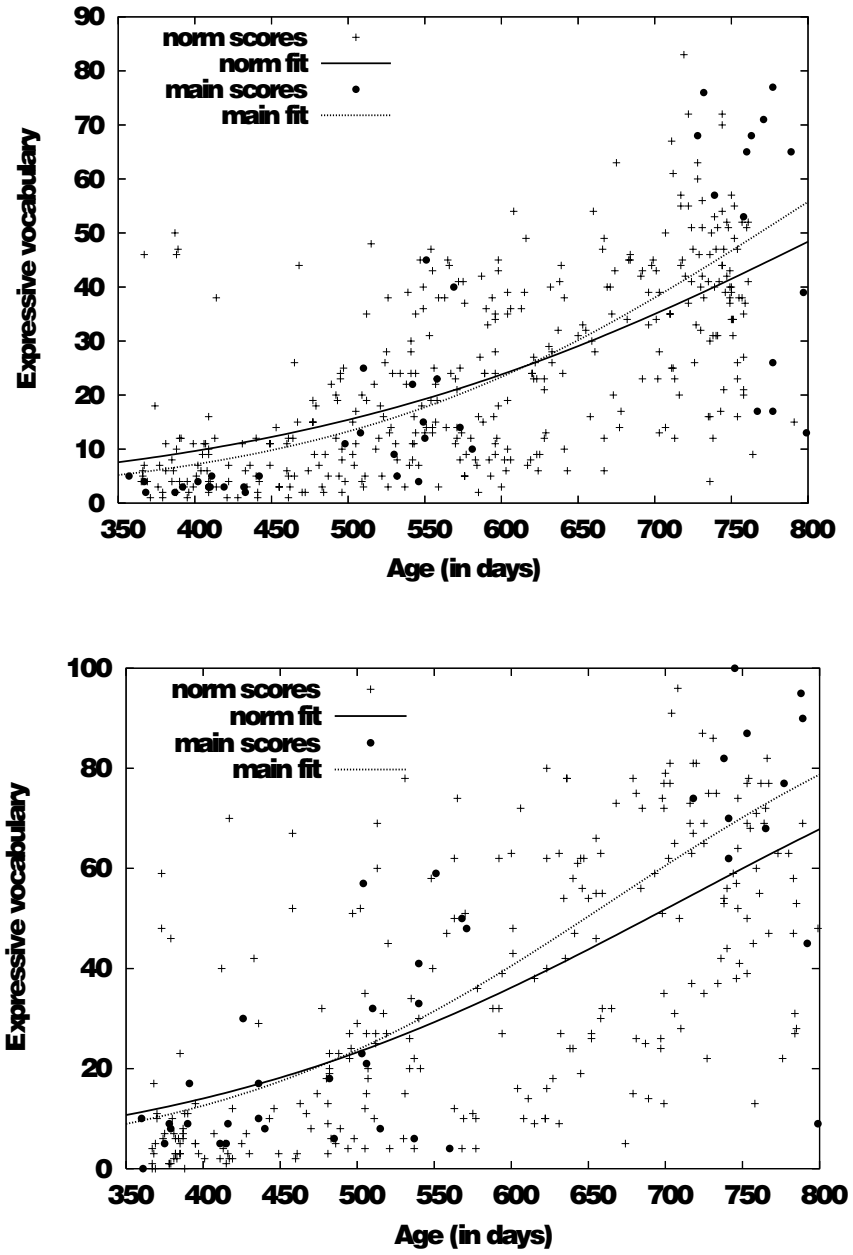

Figure A4-1: The scatterplots containing the scores on expressive vocabulary from the norming and main studies as a function of infants' age for the rural (top) and urban (bottom) communities. The lines show the fitted logistic regression curves for the two data sets per community.

Table A4-2. Logistic regression analysis with age and dataset as predictors for expressive vocabulary in both communities on both the norming and main data sets.

Predictor	**β**	**SE β**	**t-value**		***p***	**Odds ratio**
Rural						
Constant	-4.4871	0.2316	-19.38		<.001	NA
Age	0.0053	0.0004	14.64		<.001	1.0054
Set (0 = norms; 1 = main)	-1.4395	0.6768	-2.13		.0340	0.2370
Interaction	0.0022	0.0010	2.20		.0282	1.0022
Test			χ^2	*df*		
Wald test			281.2	3	.0	
Goodness-of-fit			31.50	3	<.001	
Urban			t-value			
Constant	-4.4926	0.3053	-14.72		<.001	NA
Age	0.0063	0.0005	12.93		<.001	1.0063
Set (0 = norms; 1 = main)	-0.6808	0.7255	-0.94		.349	0.5062
Interaction	0.0014	0.0012	1.24		.218	1.0014
Test			χ^2	*df*		
Wald test			221.2	3	.0	
Goodness-of-fit			44.99	3	<.001	

To validate whether these differences are significant, we grouped the infants of the norming study in age groups of 2 consecutive months (i.e., 1;0–1;1, 1;2–1;3, ..., 2;1–2;2) to have comparative groups with the infants of the observation study. We then carried out a series of t-tests to compare responses of the infants of the observation study with the responses of the norming study in the corresponding age groups. The results indicate that for the rural community, the main respondents are significantly below the norming population at infants' average age of 1;1 (t(52.64)=-3.82; p<.001), similar to each other at age 1;5 (t(18.1)=0.41; p=.688) and almost significantly higher at 2;1 (t(15.1)=1.97; p=.0679). For the urban community, the main respondents are similar to the norming study at ages 1;1 and 1;5 (t(54.5)=0.16; p=.876 and t(17.6)=1.02; p=.321 resp.), but significantly higher at 2;1 (t(18.2)=2.54; p=.020). Note, however, that the scores from the norming study appear to have a few outliers, especially for ages below 450 days and possibly beyond 700 days.

Thus, it appears that both communities have higher responses at 2;1, whether due to over-exaggeration of responses by caregivers, or due to learning effects from participation within the study, the effect is unclear. Given that the overall tendencies for both communities are fairly similar, I am confident that that the measures for vocabulary development are acceptable.

APPENDIX 5: SEMI-STRUCTURED CAREGIVER INTERVIEW

1: A coisa mais importante durante a criação dos filhos é:

Contato com o corpo	para massagem / para exercer / para abraçar
Brincar	Com mãe / com outros / com tudo / sozinho
	apenas com objetos / com apenas as pessoas / com pessoas e objetos
Alimentação	variadas [ ] constante [ ]
	Amamentar até quando? [ ]
Outro	Explique aqui:

2: Questões para responder

É uma criança um membro integral de uma comunidade no nascimento?	sim [ ] não [ ]
Se não, então quando?	

3 & 4:

Como é que um cuidador ensinar uma criança?
Como é que uma criança aprende (idioma)?

5 & 6:

Qual é o propósito da mãe na criação dos filhos?
Qual é o propósito da comunidade?

ENGLISH TRANSLATIONS:

QUESTION 1:

In your opinion, which of the following is the most important aspect of child caregiving:

a) Body Contact
b) Social Interaction
c) Nutrition
d) Other

- If 'body contact' then which of the following aspects is most important:

    a) Massage muscles
    b) Exercising limbs and mobility
    c) Hugging and affection

- If 'play-time' then which of the following play partners is most important:

    a) With mom
    b) With others (not mom)
    c) With everyone
    d) Alone

- If 'nutrition' then is it more important to have a varied diet or a standard diet of the same food?

- If 'other' then please explain further.

QUESTION 2:

In your opinion, do you consider an infant to be a person – an integral member of your community – from birth? (e.g., Do you consider it worthwhile to talk with an infant before they can speak? Does an infant have any role within the community itself? Do you consider them as a fully embodied person?)

If no, then please explain further why not? And at what age does that occur?

QUESTION 3:

In your opinion, how does a caregiver go about teaching a child new things? Can you give some examples? (e.g., How do you teach a child someone's name? How do you correct your child when they say something inappropriately? How do you teach them a song or a game?)

QUESTION 4:

In your opinion, how does a child go about learning (a language)? (e.g., How do you think your child learns from you? From other family members? From the community? How do they recognize the meaning of words? When are you sure that your child knows the meaning of a word and aren't just repeating it? Why does it take children as long as it does to learn language?)

QUESTION 5:

In your opinion, what specifically are a mother's responsibilities to her children in regard to childcare and development?

QUESTION 6:

In your opinion, what specifically are the community's responsibilities in regard to childcare and child development?

APPENDIX 6: MIG EXPERIMENT RESULTS & DISCUSSION

This appendix presents an evaluation experiment designed to test the component-based categorization of engagement presented in Section 2.3.3. In this experiment, participants were asked to view video fragments of different types of engagement from a non-industrial and a Western culture, and to decide on a 5-point Likert scale whether or not they agreed that a mutual interaction goal was present between the infant and other interactants in the video clip. Two different cultures were chosen to investigate whether there was any effect of a participant understanding their own culture better than an unknown one. Rather than testing all components present in infant interactions, it was decided to test only for the presence of the mutual interaction goal component. This was done because goals rely upon the presence of the other interaction components (Tomasello, 1995; Tomasello et al., 2005), thus testing the other interaction components by default. In this manner, subjects were not overburdened with additional cognitively demanding questions, and were still able to reliably test the categorization technique.

The main goal was to assure that the different possible combinations of interaction components that represent engagements, as presented in Table 2.3, were each identifiable to novice coders. Thus, overall, this experiment could test more than one possible representation of each engagement level. For example, *Passive-JA* has different possible combinations, those with and those without mutual interaction goals; it was important to assess an example of each type of *Passive-JA*. This experiment can then provide an additional form of inter-rater agreement concerning how engagement level categorization has been completed in this dissertation.

The secondary goal of the experiment was to determine how novice coders would treat goal related and non-goal related visual attention of infants (i.e. *Observing* vs. *Onlooking*) and similarly for goal related and non-goal related triadic interactions (i.e. *Shared-JA* and *Coordinated-JA*). The first type of goal-oriented behavior relates to the infant as a bystander, while the second relates to the infant as an interactant, thus

representing different types of goal-oriented involvement. I expect that mean Likert scores will show slightly less agreement for *Observing* than *Onlooking*, as well as less agreement for *Shared-JA* than *Coordinated-JA*. Since participants were trained on the application of a mutual interaction goal, this is still something that they are perfecting during the experiment, but the presence of individual goals or goal-oriented behavior is something participants' have inherently learned over their own development. Thus, since *Observing* involves monitoring goal-oriented behavior and *Onlooking* does not, I expect some participants to feel that less strongly about the lack of a mutual interactions goal in *Observing* interactions. On the other hand, as *Shared-JA* and *Coordinated-JA* both involve goal-oriented behavior, but differ in the alignment of goals, I would expect participants to feel more strongly about goals being present in *Shared-JA* rather than judging the alignment.

Participants

I report data from two groups: 86 Dutch speaking participants, recruited from Tilburg University and personal social networks of CASA MILA researchers; and a second control group of 6 trained participants, representing researchers trained in coding the different engagement levels. This control group consisted of four Tilburg University students who worked as research assistants on the CASA MILA project, Vogt, and myself. Table A6-1 presents data from these participants.

Table A6-1. Demographics of experiment participants.

PARTICIPANTS	*Novice N1 = 84*[7]	*Expert N2 = 6*
Age		
17-25	40	4
25-40	25	1
40-72	19	1
Gender		
Male	14	3
Female	16	3
Parent		
Yes	23	0
No	61	6
Education		
High School	2	0
MBO (Vocational)	11	0
HBO (Secondary Vocational)	17	0
BA / WO	38	3
MA	7	2
PhD	9	1

Materials

As mentioned in Section 1.3, the CASA MILA project also collected data from an industrial urban population, which was completed in the Netherlands. Twelve middle-class, educated Dutch families volunteered for the project, and all families were exposed to the same research methods and process presented in Section 3.1.4. Data was collected longitudinally when infants were approximately the same ages as the Mozambican infants. Only observations from 1;1 were chosen for the experiment because this was the only collection period from the Dutch data that had been analyzed for engagement levels at the time of this experiment. Video clips were taken from this coded data, and CASA MILA coders (a Bachelor's assistant, Vogt, and myself) verified engagement level labeling. From the collected observation data, examples of all eight

[7] Two participants were removed from the data due to outlying responses (see Section 3.2.4), and are therefore not reported on further.

engagement levels at 1;1 were sought out from both the Mozambique and the Netherlands participant families. All selected video interactions fulfilled the following criteria:

- Less than 15 seconds in length.
- Involved no preceding contextual information.
- All communication partners were within the field of video footage for the entire interaction.
- There was no question as to who the relevant actors were.

Vogt, myself, and one Dutch research assistant, independently categorized each segment and agreed on the engagement level, as well as whether or not a mutual interaction goal was present within the interaction.

Procedure

The experiment was administered through the Qualtrics[8] online research platform. All participant instructions and necessary subtitling were provided in Dutch. Before beginning the experiment, the experimenter told each participant that:

1) The purpose of the experiment involved intuitions regarding the presence or absence of mutual goals in infant interactions.
2) The written instructions explained what a mutual interaction goal was in detail, gave examples both containing and lacking a mutual interaction goal, and that these instructions were available throughout the experiment if needed.
3) There would be a brief training session (e.g., 2-5 minutes), in which participants and experimenters discuss the participant's decision-making process.

[8] *http://www.qualtrics.com/*

4) They should ask any additional questions for clarification before starting the actual experiment blocks.

Participants then read through the concepts, definitions, examples, and response procedures. Any questions or clarifications were addressed at this time by the experimenters. First, there was a brief training session involving three video clips representing solitary, dyadic and triadic joint engagement interactions (*Unengaged*, *Persons*, and *Coordinated-JA*). With each training video, participants were asked if they agreed that a mutual interaction goal was present between the infant and any communication partner. Participants responded along a 5-point Likert scale of agreement: Strongly Disagree, Disagree, Not Sure / Neutral, Agree, and Strongly Agree. Participants were urged to agree or disagree, and to only apply Neutral responses when they were absolutely unsure.

After each training video, the participant and experimenter discussed the response given. If participants did not answer as expected, they were asked why they had chosen that response, and if that decision followed the given instructions. If they did not understand the conflict, the instructions were reviewed again. Participants then proceeded with the experiment on their own, without further supervision. This consisted of eight video segments from the Netherlands and eight from Mozambique – which allowed for almost all representations of engagement levels (see Table 2.3) to be present in the experiment. The participants were shown the 16 videos in a randomized order, and provided a response to the same Likert scale of agreement as in the training session for each video clip. The experiment lasted approximately 30 minutes.

Data Analysis

Before completing statistical analyses, I explored the results for outliers, and found only two participants in the novice group that were outliers, and removed them from the sample, resulting in the 84 novice participants presented. Before analyzing responses to the interaction stimuli, the Likert scale responses had to be recoded in

such a way that the data was comparatively analyzable. This was applied because mutual interaction goals are only present in five of the sixteen stimulus videos. Thus, for these five stimuli where a mutual interaction goal was considered to be present, responses were inverted so that all responses were in accordance with the same scale of responses. In this way, the lower the Likert scale response score, the better that participant's score is in alignment with the expected response. Shapiro-Wilk tests showed that novice participants' responses were normally distributed (p=.307), as were those responses from the expert group (p=.355).

It was also necessary to test the reliability of the participants' answers. To assess this, I compared participant responses to the most controlled stimulus example, *Unengaged* interactions, for each cultural representation. This engagement was considered the most standard because it always involves the infant alone, where no other objects or communication partners are attended to, which thus never contains a mutual interaction goal. A Wilcoxon Signed-Rank test was applied as the data is based upon Likert scale responses, and shows that there is no significant difference between participant responses for Mozambican and Dutch examples of *Unengaged* (Z=-1.155; p=.248).

Results

Likert responses have been evaluated separately for the Mozambican and Dutch data by a repeated measure Anova with engagement levels as within factors, and expertise (novice; expert) as between factors9. Pairwise comparisons within engagement levels were made using the Bonferroni correction. Table A6-2 presents the mean Likert response scores for all novice participants.

[9] For both sites, Mauchly's Test of Sphericity showed a significant result. In that case, the Huynh-Feldt correction should be applied to the degrees of freedom. While doing so, none of the results showed any difference with the test assuming sphericity, both in terms of levels of significance and effect size. Therefore it has been decided for ease of presentation to report the results of the non-corrected test only.

Table A6-2. Mean Likert response scores (scores range from 1 to 5; standard deviations between parentheses) from novice participants.

	Unengaged	Onlooking	Objects	Observing	Persons	Passive-JA	Shared-JA	Coordinated-JA
NL	1.03	1.06	1.88	1.52	1.63	1.69	2.48	1.35
	(.058)	(.092)	(.236)	(.192)	(.199)	(.193)	(.295)	(.157)
MOZ	1.04	1.55	1.13	1.10	1.22	2.49	2.69	2.89
	(.057)	(.185)	(.135)	(.118)	(.142)	(.281)	(.266)	(.289)

Comparing novice and expert responses with a Mann-Whitney U test, in Table A6-3, found that all engagement level Likert responses from the novice group were not significantly different from the expert group. However, mean differences for two Mozambican stimuli were almost significantly higher in the novice group: *Coordinated-JA* (U=146; p=.077) and *Shared-JA* (U=137; p=.053).

Table A6-3. Mann-Whitney U test results comparing mean Likert responses of the novice and expert groups in each of the cultures represented. ($^{+}$p<.10)

	Unengaged	Onlooking	Objects	Observing	Persons	Passive-JA	Shared-JA	Coordinated-JA
NL								
Mann-Whitney U	240	231	201.5	226.5	247.5	250.5	235	237
Sig. (2-tail)	.587	.464	.363	.933	.626	.977	.776	.750
MOZ								
Mann-Whitney U	231	235.5	207	244	216	182.5	137	146
.Sig. (2-tail)	.464	.762	.261	.849	.324	.249	.053^{+}	.077^{+}

Response results comparing novices and experts for the Dutch data are presented in Figure A6-1 and those for the Mozambican data in Figure A6-2. Both novices and experts follow the same pattern of response scores for both the Netherlands and Mozambican data.

The Netherlands data displayed an effect of engagement level ($F(7,616)=6.26$, $p<.001$, $\eta^2_p=.066$), but there was no effect of expertise ($F(1,88)=.006$, $p=.939$). There was no interaction between engagement level and expertise ($F(7,616)=.264$, $p=.967$). Experts overall mean scores ($M=1.58$, $SE=.150$) were almost identical to those of novices ($M=1.57$, $SE=.04$). The results showed that the engagement levels were grouped into three clusters as noticed in Figure A6-1 – one group consisted of solitary engagements, another group consisted of only *Shared-JA*, and the third group consisted of all engagement types.

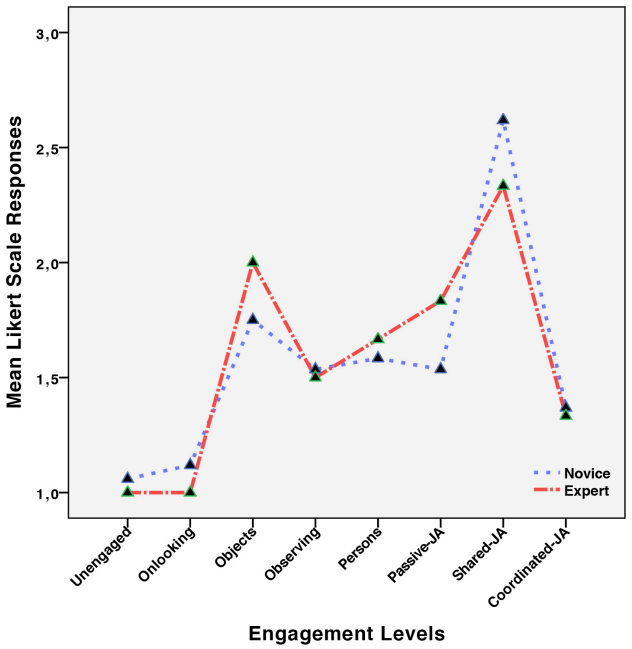

Figure A6-1: Mean Likert responses to Dutch stimulus evaluated by expertise (novel vs. expert coders).

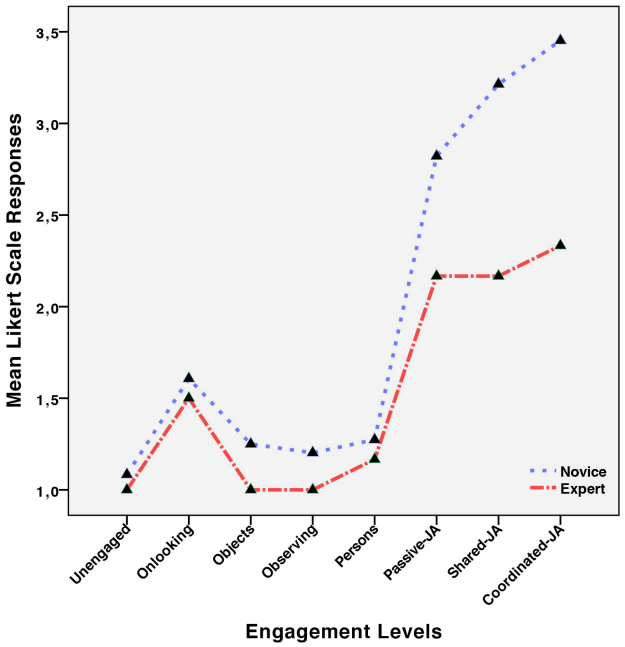

Figure A6-2: Mean Likert responses to Mozambican stimulus evaluated by expertise (novel vs. expert coders).

The Mozambican data displayed a larger effect of engagement level ($F(7,616)=15.80$, $p<.001$, $\eta^2_p=.152$) and also an effect of expertise ($F(1,88)=8.80$, $p<.05$, $\eta^2_p=.091$). There was no interaction between engagement level and expertise ($F(7,616)=1.19$, $p=.31$). Experts overall mean scores ($M=1.54$, $SE=.145$) were lower than those of novices ($M=1.99$, $SE=.039$). The results showed that the engagement levels were grouped into two distinct clusters as noticed in Figure A6-2 – one group consisted of all solitary and dyadic engagements, while the other group consists of all triadic joint engagement interactions.

Given the fact that there is a possible confound for cultural bias, a chi-square test of independence was performed to examine the relation between 'neutral' responses and all other responses. The relation between these variables was significant, χ^2 (2, $N=1344$) = 6.831, $p<.01$. Novice Dutch participants were more likely to choose the 'neutral' response for Mozambican stimuli than for Netherlands stimuli.

Conclusions

Comparing mean Likert response scores for novice participants based upon different cultural stimuli, in Table A6-2, shows that for both types of stimuli, novice coders' Likert responses increase, becoming less in alignment with our own coding judgments, as interactions increase in complexity. However, this pattern of increasing disagreement does not fit to each cultural representation in the same manner. Turning to Table A6-3, we can see that mean Likert responses for novice and expert coders are not significantly different for any of the Netherlands interaction examples. In fact, as is seen in Figure A6-1, novice and expert coders followed the exact same pattern of responses for judging mutual interaction goals in each of the eight infant engagement levels. On the other hand, when looking at the responses for Mozambican examples, we see in Table A6-3 that the novice and expert groups have a near significant difference in responses for more complex interactions. In addition, based upon Figure A6-2, we can see that again novice and expert coders followed the same pattern of responses to stimuli for all solitary and dyadic engagement, but as interaction complexity increased, novice scores became less and less like those of the expert group.

This difference in coding Mozambican stimuli versus that of the Netherlands might imply that participants are better able to judge engagement and goals within a culture they are very familiar with rather than a culture that they have no preconceived notions about. This uncertainty could be based upon judging whether or not a mutual interaction goal is present, but this uncertainty could be just as likely due to participants feeling too culturally uninformed to make an appropriate decision. This raises the question of whether individuals might be more *comfortable* making judgments about goals in cultures they are familiar with, but does not imply that individuals are not *able* to properly judge foreign interactions. It is quite possible that longer training sessions with Mozambican data would be able to correct for this difference.

In regard to the novel engagement level categories, the results follow the expectations set forth in Section 3.2. The mean Likert score of novice participants for

Observing in both cultural representations is higher than that of *Onlooking* (Table A6-2). This suggests that infant *Observing* does relate to more goal-oriented behavior than *Onlooking* does because some participants judged these interactions as containing a mutual interaction goal or being less sure that it did not contain such a goal. However, it could be that these participants did not fully understand the importance of mutuality in the interaction goal. Regardless, this difference implies that *Observing* contains more goal-oriented behavior than *Onlooking*. Turning to the other novel category, *Shared-JA*, the data shows much more drastic differences when compared to mean Likert responses of *Coordinated-JA* interactions. In regard to the Netherlands interactions, *Shared-JA* is the most debated engagement level out of the entire categorization; on the other hand, *Shared-JA* responses for the Mozambican examples are just as varied as those for the other two categories of triadic joint engagement. Based upon these differences, it is apparent that individuals vary as to whether they believe that this engagement contains a mutual interaction goal, but further testing would be necessary to fully understand why there is so much variation in regard to this engagement level. Since Shared-JA is defined as containing goals, but not achieving the coordination of these goals, these results at least provide preliminary support for separating *Shared-JA* from the category of *Coordinated-JA*.

Generally, this experiment provided results that support the use of the extended engagement level categorization and the implementation of a component-based approach that involves goal oriented behavior as a necessary component. However, there are two possible caveats that should be mentioned. First, those participants that made up the expert group all had exposure to the Mozambican data, and also had experience coding interactions based upon very fine-grained factors and requirements. Since the mean Likert scores from the two groups follow the same general pattern, though, I do not see this as a factor that contributed negatively to the results. Second, the definition of a mutual interaction goal has been designed and defined by researchers of a Western culture and applied to different prototypical learning environments of both Western and non-industrial communities. This is a fact that I

cannot refute and could relate to some differences between judging goals in different cultural examples of infant interactions. Nonetheless, the definition of a mutual interaction goal was inspired by the observation of non-industrial family interactions, as well as the Western theoretical discussions of shared experience, mutual knowledge and common ground (Bratman, 1992; Carpenter, 2009; Carpenter & Liebal, 2011; Chouinard & Clark, 2003; Clark & Marshall, 1981; Gilbert, 1989; Tomasello et al., 2005).

APPENDIX 7: MEAN OCCURRENCES OF ENGAGEMENT LEVELS

Table A7-1. Mean occurrences (with standard deviations) of each engagement level distributed by site (rural and urban) and collection period (1;1, 1;5, 2;1).

Engagement Levels	Rural Occurrences			Urban Occurrences		
	1;1	1;5	2;1	1;1	1;5	2;1
Unengaged	27.78 (8.89)	29.21 (10.98)	33.71 (8.87)	21.35 (9.48)	24.50 (9.65)	30.21 (10.19)
Onlooking	26.00 (12.73)	26.85 (12.95)	21.71 (9.82)	30.57 (11.84)	29.35 (10.47)	22.78 (7.19)
Objects	32.92 (15.13)	41.78 (16.20)	43.28 (15.71)	45.50 (16.26)	36.14 (16.99)	53.21 (8.80)
Observing	12.78 (7.65)	18.28 (9.23)	20.57 (9.38)	8.78 (6.29)	6.14 (3.15)	23.57 (13.22)
Persons	27.64 (9.17)	37.00 (14.27)	42.78 (11.59)	47.00 (14.86)	40.00 (10.89)	56.35 (19.89)
Passive-JA	5.14 (3.35)	6.07 (4.75)	2.28 (2.65)	10.35 (6.76)	5.28 (3.21)	2.07 (1.22)
Shared-JA	2.35 (1.04)	3.21 (2.33)	3.07 (2.18)	4.50 (4.53)	6.07 (4.21)	7.71 (4.43)
Coordinated-JA	14.78 (7.53)	20.21 (11.23)	23.92 (10.96)	20.35 (9.46)	23.14 (14.38)	30.35 (11.44)
Total Occurrences	151.85 (30.14)	185.64 (38.83)	193.21 (22.94)	193.28 (40.96)	176.64 (26.46)	227.28 (34.49)

APPENDIX 8: MEAN PROPORTIONAL DISTRIBUTIONS OF 24-LEVEL ANALYSIS OF PARTNERS PER ENGAGEMENT FOR ALL COLLECTION PERIODS

Table A8-1. Mean proportions (with standard deviations) of each partner category per engagement level distributed by site (rural and urban) and collection period (1;1, 1;5, 2;1).

Partner Type	Rural Vocabulary			Urban Vocabulary		
	1;1	1;5	2;1	1;1	1;5	2;1
Peer						
Persons	.017	.021	.024	.015	.012	.036
	(.024)	(.027)	(.033)	(.017)	(.016)	(.045)
Passive-JA	.004	.0004	.001	.003	.002	.0004
	(.009)	(.001)	(.001)	(.005)	(.004)	(.001)
Shared-JA	.003	.0002	.001	.005	.005	.012
	(.005)	(.001)	(.004)	(.007)	(.011)	(.019)
Coordinated-JA	.003	.019	.013	.019	.027	.030
	(.011)	(.035)	(.021)	(.027)	(.057)	(.040)
Sibling						
Persons	.040	.059	.086	.026	.036	.054
	(.048)	(.052)	(.098)	(.023)	(.047)	(.066)
Passive-JA	.002	.011	.001	.007	.004	.0002
	(.003)	(.017)	(.002)	(.007)	(.007)	(.001)
Shared-JA	.002	.004	.006	.006	.006	.005
	(.004)	(.008)	(.006)	(.010)	(.012)	(.006)
Coordinated-JA	.035	.053	.043	.019	.047	.033
	(.068)	(.058)	(.033)	(.020)	(.116)	(.034)
Adult						
Persons	.019	.015	.017	.039	.010	.025
	(.029)	(.021)	(.028)	(.039)	(.010)	(.031)
Passive-JA	.003	.001	.005	.004	.001	.001
	(.006)	(.001)	(.017)	(.008)	(.003)	(.002)
Shared-JA	.001	.005	.001	.004	.002	.004
	(.002)	(.015)	(.002)	(.005)	(.004)	(.008)
Coordinated-JA	.014	.014	.015	.011	.011	.013
	(.031)	(.034)	(.031)	(.020)	(.016)	(.013)

Mother						
Persons	.113	.090	.077	.129	.111	.112
	(.079)	(.073)	(.046)	(.108).	(.114)	(.090)
Passive-JA	.012	.008	.005	.028	.011	.004
	(.010)	(.007)	(.010)	(.027)	(.018)	(.004)
Shared-JA	.007	.007	.002	.006	.018	.014
	(.006)	(.009)	(.003)	(.011)	(.025)	(.016)
Coordinated-JA	.077	.040	.050	.056	.072	.074
	(.089)	(.035)	(.070)	(.035)	(.126)	(.074)
Multiple+Mother						
Persons	.019	.049	.013	.071	.080	.021
	(.029)	(.084)	(.023)	(.077)	(.078)	(.034)
Passive-JA	.002	--	--	.001	.001	--
	(.003)			(.002)	(.003)	
Shared-JA	.001	.002	.001	.004	.007	.003
	(.003)	(.003)	(.003)	(.009)	(.014)	(.006)
Coordinated-JA	.013	.023	.009	.030	.054	.005
	(.018)	(.053)	(.014)	(.073)	(.105)	(.007)
Multiple only						
Persons	.014	.018	.011	.019	.023	.007
	(.020)	(.020)	(.016)	(.023)	(.036)	(.012)
Passive-JA	.001	--	--	.002	--	--
	(.002)			(.007)		
Shared-JA	.001	.001	.002	.0003	.001	.002
	(.002)	(.001)	(.004)	(.001)	(.002)	(.005)
Coordinated-JA	.027	.014	.019	.028	.011	.007
	(.049)	(.017)	(.025)	(.040)	(.021)	(.009)

APPENDIX 9: SPEARMANS CORRELATION RESTULTS FOR 24-LEVEL ANALYSIS PROPORTIONS 1;1 AND VOCABULARY SCORES AT ALL COLLECTION PERIODS

Table A9-1. Spearman's correlation results (with p-values) between the proportions of each partner category per engagement level at 1;1 distributed by site (rural and urban) and vocabulary score at each collection period (1;1, 1;5, 2;1).

Partner Type	Rural Vocabulary			Urban Vocabulary		
	1;1	1;5	2;1	1;1	1;5	2;1
Peer						
Persons	-.202	.087	.441	-.083	**-.639**	**-.541**
	(.488)	(.768)	(.114)	(.779)	**(.014)**	**(.046)**
Passive-JA	-.256	.000	.384	-.113	*-.513*	-.336
	(.376)	(1.00)	(.175)	(.700)	*(.061)*	(.240)
Shared-JA	.049	.209	.348	-.093	-.367	-.341
	(.867)	(.473)	(.223)	(.751)	(.197)	(.233)
Coordinated-JA	-.187	.138	-.166	-.299	**-.582**	-.380
	(.523)	(.639)	(.571)	(.300)	**(.029)**	(.180)
Sibling						
Persons	.404	.038	*.481*	.209	.435	.139
	(.152)	(.899)	*(.082)*	(.473)	(.120)	(.636)
Passive-JA	-.030	-.049	*.463*	-.166	-.164	.074
	(.920)	(.869)	*(.096)*	(.570)	(.575)	(.801)
Shared-JA	.120	-.286	-.257	.071	.096	.073
	(.682)	(.321)	(.375)	(.809)	(.743)	(.805)
Coordinated-JA	-.228	-.373	-.002	.207	.081	.044
	(.434)	(.189)	(.994)	(.478)	(.783)	(.880)
Adult						
Persons	.180	-.056	-.223	-.253	*-.473*	.002
	(.539)	(.849)	(.443)	(.384)	*(.088)*	(.994)
Passive-JA	-.023	-.388	-.443	.329	-.074	.228
	(.937)	(.170)	(.112)	(.250)	(.801)	(.433)
Shared-JA	-.042	-.408	-.387	.169	-.395	.078
	(.887)	(.148)	(.171)	(.564)	(.162)	(.791)
Coordinated-JA	-.213	-.243	**-.594**	.342 (	-.175	.301
	(.465)	(.402)	**(.025)**	.231)	(.549)	(.296)

Mother						
Persons	.284	*.521*	**.816**	-.209	.293	-.002
	(.324)	*(.056)*	**(.000)**	(.473)	(.310)	(.994)
Passive-JA	-.315	-.106	-.292	-.185	-.048	-.288
	(.273)	(.719)	(.310)	(.527)	(.869)	(.318)
Shared-JA	.073	**.569**	.275	-.324	.013	-.285
	(.803)	**(.034)**	(.341)	(.258)	(.964)	(.323)
Coordinated-JA	-.092	.292	.071	-.147	.257	.297
	(.753)	(.311)	(.811)	(.616)	(.374)	(.302)
Multiple+Mother						
Persons	-.101	.080	.135	.192	.274	.194
	(.732)	(.786)	(.646)	(.512)	(.343)	(.507)
Passive-JA	-.248	-.388	-.371	**-.672**	-.184	.211
	(.393)	(.170)	(.191)	**(.009)**	(.530)	(.468)
Shared-JA	-.212	-.168	.141	.120	-.157	-.299
	(.466)	(.565)	(.630)	(.683)	(.592)	(.299)
Coordinated-JA	-.312	**-.752**	-.389	-.002	.360	.371
	(.277)	**(.002)**	(.169)	(.994)	(.206)	(.191)
Multiple only						
Persons	-.263	**.641 (.014)**	**.564**	*.474*	.026	.269
	(.365)		**(.036)**	*(.087)*	(.929)	(.352)
Passive-JA	**-.743**	-.217	-.199	*-.460*	-.153	.040
	(.002)	(.456)	(.494)	*(.098)*	(.600)	(.893)
Shared-JA	-.072	-.378	.207	**.593**	.375	.079
	(.806)	(.182)	(.477)	**(.025)**	(.186)	(.787)
Coordinated-JA	**-.688**	-.175	-.264	*.467*	.236	**.566**
	(.007)	(.549)	(.362)	*(.093)*	(.417)	**(.035)**

Summary

This dissertation aimed to explore the potential relations between infant engagement and vocabulary development in rural and urban communities in Mozambique. In Chapter 1, I presented four exploratory research questions: (RQ1) What engagement levels emerge by analyzing the basic universal components of infant interactions? (RQ2) What is the proportional distribution and development of infants' engagement levels in spontaneous, natural interactions in rural and urban non-industrial communities? (RQ3) Do engagement levels' proportions have any significant relations to these infants' vocabulary scores? (RQ4) How do the different levels of joint engagement with different communication partners relate to vocabulary development?

In Chapter 2, the literature review showed that since the first classification of infant engagement levels, research has either replicated this in part or manipulated it into a less-extensive classification, neither route providing a comprehensive analysis of infant engagement itself. A critique of how infant engagement is classified was apparently missing from the literature. To address RQ1, I provided a theoretical analysis of the universal components of interactions. Based upon this analysis, I extended the original classification of six engagement levels by individuating two engagement levels: *Observing* engagement and *Shared Joint Attention*.

Chapter 3 outlined, in extensive detail, the methods used for both data collection and data analysis over the course of research for this dissertation. To explore infant engagement in a non-industrial culture, longitudinal naturalistic observation data of infants was collected in urban and rural Mozambique communities, starting from the age of 1;1 and ending at the age of 2;1. It was necessary to collect data that was entirely unstructured, in order to analyze infant engagement that was representative of the most natural interactions possible.

To investigate RQ2, Chapter 4 analyzed the mean proportion of time that infants engaged in solitary and joint engagement. In the rural area, infants spent a significantly greater proportion of time in levels of solitary engagement. Urban infants, on the other

hand, spent a significantly greater proportion of time in levels of triadic joint engagement. These differences can be explained based upon the distinctions between learning environments, where rural infants are treated less as communication partners and more as observers when compared to their urban counterparts. This distinction is also similar to the differentiation between cultures that apply a form of infant socialization that is situation-centered (e.g., infants are engaged only after they begin speaking) compared to one that is child-centered (e.g., infants are engaged as potential communication partners from early infancy).

With these results regarding the proportional distribution of infant engagement levels, I was able to turn to RQ3. Chapter 5 applied a correlation analysis between the proportions of engagement at each collection period with infants' vocabulary scores at concurrent and subsequent collection periods. First, results showed that urban infants had a significantly larger vocabulary at each collection period when compared to their rural counterparts. Second, in regard to the correlation results, the only shared significant correlation was the positive relation between *Persons* engagement and later vocabulary. The correlation analysis further showed that *Coordinated-JA* had a positive relation with vocabulary in the urban community, but a contrasting negative correlation in the rural community. While this result clashed with previous studies, it was not entirely unexpected given the cultural and methodological differences between these studies and our own.

In Chapter 6, I addressed RQ4 and looked at the roles of different communication partners and their use of engagements with infants. First, I looked into the proportional distribution of joint engagement with various types of communication partners. Results showed rural mothers transferred primary care to sibling caregivers, whereas urban results showed that the proportion of time infants spent interacting with their mothers was continuously stable over all collection periods. Second, I provided a complex correlation analysis, which separated the proportion of time spent with each partner category by each of the four types of joint engagement. In the rural community, results indicate that the more familiar a rural communication partner is,

then the more likely it will be that engagements involving targets will be beneficial to word learning (e.g., joint attention with caregivers); and the less familiar a partner is, then the more likely that engagements involving targets will not be beneficial to word learning (e.g., joint attention with other adults or groups). In the urban community, the majority of interactions that showed negative relations with vocabulary involved infant communication partners. Positive correlations were found between vocabulary scores and triadic joint engagement with groups, which is in direct opposition to the rural results. Yet, the question still remains as to why we do not see positive correlations between engagement with mothers and vocabulary, as in the rural community, and this is a question that future analysis and research should consider.

In Chapter 7, I reviewed each of the four exploratory research questions in detail, relying on data from each of the different chapters to further address the practice of infant engagement and socialization in non-industrial Mozambican communities. I showed that infant engagement in rural and urban Mozambique appear to follow and adhere to the characteristics and socialization styles of prototypical learning environments. By applying correlation analyses, I was able to show that *Persons* engagement appears to be more beneficial than *Joint Attention* is for vocabulary development. The role that *Persons* engagement plays in these communities is important because it shed new light on the relationship between different levels of infant engagement and vocabulary development. Also, I showed how communal ideas regarding caregiving can manifest through different forms of dyadic and triadic engagement with different communication partners. By doing so, it became apparent that engagement outside of the mother-infant pair has significant relations with vocabulary development, which have not been previously exposed in research on infant development. Future research on the topic of infant engagement and language acquisition should continue to take into account what we know from semi-structured observation and elicitation studies, but more importantly, continue to explore the rich dynamics of infants' environments within and across different prototypical learning environments.

Curriculum Vitae

EDUCATION

Ph.D. 2013 **Cognitive Science & Linguistics.** *Tilburg University, Netherlands.*

Dissertation Topic: "Exploring Infant Engagement, Language Socialization and Vocabulary Development: A Study of Rural and Urban Communities in Mozambique." Supervisor: Paul Vogt. Promoter: Fons Maes.

M.Sc. 2008 **Evolution of Language & Cognition.** *University of Edinburgh, UK.*

Dissertation Topic: "Evolution of Memory Systems and the Emergence of Symbolic Language." Supervisor: Jim Hurford. Promoter: Simon Kirby.

M.A. 2006 **Sociolinguistics & Semantics.** *Michigan State University, USA.*

M.A. Exam/Thesis: "Issues Regarding the Color Terms of Khwe(dam)." Advisor: Marcin Morzycki. Committee: Christina Schmitt and Grover Hudson.

B.A. 2005 **Archaeological Anthropology & Linguistics.** *Dartmouth College, USA.*

PROFESSIONAL QUALIFICATIONS

- I have designed, conducted, and completed international research in Mozambique, Namibia, Netherlands, China, and the UK.
- My most recent work involved a lengthy cross-cultural field study of infant language development based upon the potential of various social interactions to effect vocabulary development.
- Previous experimental research includes intuition studies of human behavior, sociolinguistic studies of language biases and psychological studies involving both qualitative and quantitative data analysis.
- Outside of academia, I worked as a research associate to the Presidential Offices of the John Templeton Foundation conducting in-depth reviews of natural theology, legal governance, and international religious liberty.
- My communications skills have been finely honed by previous consulting work and projects undertaken at many prestigious education institutions around the world.
- My personal relations and flexibility are demonstrated by my international

employment, research responsibilities and breadth of studies. I have excellent time management, organization and analysis skills – both theoretical and practical.

RESEARCH EXPERIENCE

- CASA MILA Project, Tilburg University 2009-2013
- The John Templeton Foundation 2007-2009
- Namibia Field Research, MSU Summer Research Grant 2006
- Research Assistant, Michigan State University 2006
- Research Assistant, Dartmouth College 2004-2005

TEACHING EXPERIENCE

- Assistant Lecturer, *Classics – Academic English*, Tilburg University 2012-2013
- Undergraduate Teaching Assistant, *Honors Linguistics & Sociolinguistics*, University of Edinburgh 2008
- Undergraduate Teaching Assistant, *Optimality Theory*, Dartmouth College 2005
- TEFL Teacher & Program Administrator, *ACES*, China 2005

PUBLICATIONS/PRESENTATIONS

- Mastin, J.D., & Vogt, P. (under review-a). Analyzing infant engagement: Filling the gaps in research approaches. *Journal of Infant Behavior and Development.*
- Mastin, J.D., & Vogt, P. (under review-b). Correlations between infant engagement levels and vocabulary development: An observational study of Mozambican infants from 1;1 to 2;1. *Journal of Child Language.*
- Vogt, P., & Mastin, J.D. (2013a). Language socialization and infants' vocabulary development in rural and urban Mozambique. *Paper presented at the CogSci 2013 Conference.*
- Vogt, P., & Mastin, J.D. (2013b). Anchoring Social Symbol Grounding in Children's

Interactions. *Künstliche Intelligenz, 27*(2), 145-151.

- Mastin, J.D., Vogt, P., & Claessens, I.H.E. (2013). Analyzing infant attention, interaction and goals. *Poster presented at the CogSci 2013 Conference.*
- Vogt, P., Masson-Carro, I., & Mastin, J.D. (2013). Predicting vocabulary development from co-speech gestures: Duration or occurrence, that's the question. In: *Proceedings of TiGeR 2013: The combined meeting of the 10th international Gesture Workshop (GW) and the 3rd Gesture and Speech in Interaction (GESPIN) conference*.
- Mastin, J.D., & Vogt, P. (2012a). Joint engagement and vocabulary development: A cross-cultural, observational study of Mozambican infants from 13- to 25-months. *Presentation at the 5th international conference of Language, Culture & Mind.*
- Vogt, P., & Mastin, J.D. (2012). Co-speech gestures and early vocabulary development in rural and urban Mozambique. *Presentation at the 5th international conference of Language, Culture & Mind.*
- Mastin, J.D., & Vogt, P. (2012b). The affects of multi-partner environments on joint engagement. *Presentation at the conference proceedings of the European Human Behavior and Evolution Association.*
- Vogt, P., & Mastin, J.D. (2011a). The effect of using multimodal gesture on infants' vocabulary development in natural environments. *Poster presented at the 12th International Congress for the Study of Child Language (IASCL).*
- Mastin, J.D., & Vogt, P. (2011a). Joint attention and vocabulary development: A cross-cultural, observational study of Mozambican infants. *Student Award presentation and poster presented at the 12th International Congress for the Study of Child Language (IASCL).*
- Vogt, P., & Mastin, J.D. (2011b). Variation in frequencies of multimodal gesture usage and vocabulary development. *Poster presentation at the Adyloc CNRS Conference.*
- Mastin, J.D., & Vogt, P. (2011b). Joint attention and language acquisition: A cross-cultural, observational study of Mozambican infants. *Presentation at the Anela/Viot Juniorendag Workshop & Conference.*
- Mastin, J.D., & Vogt, P. (2010). Frequency distribution of multimodals in usage-based learning of word-meanings. *Presentation at the 4th international CogLing Days Workshop.*

- Mastin, J.D. (2008). Signaling as an evolutionary stable system: From animal

communication to human language. *Conference presentation at the Language Evolutionary Research Network.*

- Mastin, J.D. (2008). *Evolution of Memory Systems and the Emergence of Symbolic Language*. MSc Dissertation, Evolution of Language and Cognition, University of Edinburgh.
- Mastin, J.D. (2007). *Sir John's Writings on Core Themes: A Classification of Donor Intent*. The John Templeton Foundation Press.
- Mastin, J.D. (2006). *Linguistic Issues Regarding the Color Terms of Khwe(dam)*. MA Dissertation, Theoretical Linguistics, Michigan State University.

HONORS & AWARDS

- IASCL Conference Student Presentation Award Winner 2011
- MSU Summer College Research Abroad Grantee 2006

SKILLS

- Supervision/Management of teams between 5 and 20
- Management of multi-year research projects
- Supervision of undergraduate and master's students
- Statistical Analysis Programs: SPSS
- Praat & ELAN – recording and analysis proficiency

LANGUAGES

- Spanish, Portuguese—attained conversational fluency, reading and writing
- Khwedam, Changana, Ronga—conversational speaking, listening, reading, some writing, and grammatical knowledge.
- Mandarin, Dutch—attained conversational speaking
- French, Italian—some reading knowledge

Acknowledgements

Over the past decade I have packed my luggage well over a hundred times, jet setting around the world on various academic and life adventures. However, when my baggage arrived at Schiphol airport for the first time, little did I know what the coming four years held in store for me… and for a multitude of other people as well. While this dissertation may show my perseverance and skills as an academic, it is also a fine demonstration of the support, mentoring and inspiration that I have received. Now that the light at the end of the tunnel has been found, it is important to share the success of this accomplishment with those also deserving. Thus, I take the opportunity now to express my gratitude and heartfelt appreciation for their contributions. First, I must express my thanks to my two supervisors, Dr. Paul Vogt and Prof. Dr. Fons Maes. Their support over the years has been paramount during this research project.

Paul's camaraderie and personal attention have allowed me to become not only confident in my work, but also in myself as a professional and a researcher. Over the past four years he and I have probably spent more time together than do most post-graduates and supervisors. From sharing a desk over the first months, to 16-hour days in the Mozambican bush, to Skype calls across the world, to World Cup games, to jamming to African rhythms, and even to living on the same street on two different continents. Despite linguistic and cultural differences, Paul and I were both able to learn from each other, which has allowed the CASA MILA project to grow and thrive. I cannot thank him enough for believing in me and offering me the chance to work on this project at Tilburg University.

Fons has always been able to provide the most appropriate guidance when it comes to my research, and always with a smile. As I am prone to become stuck in minute theoretical aspects of my work, he was continually able to remind me of the "big picture" and not stray too far from my central topics. Fons' ability to play devil's advocate, and make me critically question my own theories, has further shaped both my academic mind and spirit. Most importantly, though, I must thank Fons for

listening. Whether during a random rant or an argument over theory, he always ensured that we both understood each, and moved forward together, as part of a team.

In addition to my supervisors, many colleagues and employees at TiU have been of great support to my research, as well as to me personally. Specifically, the statistical assistance and mentoring from both Prof. Dr. Carel van Wijk and Dr. Martijn Goudbeek provided me with more usable knowledge than any class I've previously taken. In addition, I must thank Prof. Dr. Emiel Krahmer for his support as a temporary supervisory during my time here, and also for always being available to discuss matters of work or life. Special thanks also goes to Dr. Afra Alishahi, Dr. Seza Dogrouz and Dr. Paula Roncaglia-Denissen, for all of their professional support and guidance during my transition from a post-graduate to a professional academic. Finally, I would not have been able to complete my work at TiU without the help of specific supporting staff: Els van Loon, Joke Hellemons, Eva Verschoor, Jacinta Buysse, and Lauraine de Lima. I tip my hat to these ladies for all the hard work they do for this institution, and for the amount of individual attention they provided me as I navigated the waters of Dutch academia.

While Paul and I have certainly done our fair share over the past four years, the work completed in the CASA MILA project could not have happened without the support of cultural organizations, volunteer families, our many field assistants, and our research assistants at TiU. Wona Sanana, a Mozambican grassroots NGO, and Associação Communitário Ambiente da Mafalala (ACAM), a suburb community center of the capital city, were both of paramount influence in the procurement of field sites and research participants. Special thanks to Gildo Milagre Mahluza and Flavio Liberato Fernandes, of Wona Sanana, for believing in the power of research, and the ability for grassroots campaigns to succeed. The procurement of volunteers for the project would not have been possible without these men. Moreover, the project itself would not be a success without the families that volunteered to participate. I have so much gratitude to the participants, and their communities, in both Mozambique and the Netherlands, for opening their homes and lives to us. Yet this work involved more than just Paul and

myself. Our local assistants in Mozambique – Miller Vicente Chivambo, Artemisa Pedro Chauke, Hipolito Alberto Zamdamela, Nilza Angelina Tembe, Sandra Jaime Chirindza, and Delfina João – as well as our research assistants in the Netherlands – Anne Kuis, Lienke van Hoek, Irene Claessens, Van Lee, Mohammad Hafiz , Yevgen Matusevych, Suzanne Aussems, Diede Schots, and Ingrid Masson-Carro – were all irreplaceable aides-de-camp, as well as close friends.

The last four years would not have been as enjoyable as they were, if not for the friendships I have built during this time. To my friends in the Netherlands – Lee, David, Bart, Nanne, Shos, Jette, Joolie, Jamie, Rogier, Joost (the Beast), Wouter, Suzanne, Rianne, and Ischa – thank you for your friendship and your support. To the friends I made in Mozambique – Torstein, Johannes, Hanne & Gullik, Chloé & Matt, Claudia & David, Suzan, Sally, Kelly, Mama Lafima, Delfina, Hussein, Ivan, Adrienne, Steve, April, Lisa, Mije, and Zach – I hope you know how much our time together meant to me, and that I will meet you all one day at Costa del Sol for some frango and Laurentina Preta! To my good friends in the USA – Pumpkin, Beebles, Domi, Ming, PJ, Glitterbox, Tyler, Ivo & Katie, and Sparklez – thank you for being there over all the years, continents, and changes; your continual support has meant the world to me, and always will.

While everyone I've known during my PhD has been of support in some way or another, I could never have accomplished this task without the love and encouragement of my parents, as well as my family of choice. My parents, Betty & Jon, taught me when I was little that I could do anything I set my mind to, and succeed at anything that I did not run away from. After 13 years, 5 degrees, 4 continents, and $172 in Skype credit… they finally have a doctor for a son! I can only hope that I can continue to make them proud. My family of choice, my dear Radical Faeries, have shown me just how special and unique my life is within this crazy and grand universe. I can only begin to thank them for providing me with a community and spaces to not only discover who I truly am, but to allow me to flourish and thrive. Blessed be!

Most importantly, I would like to express my deepest thanks and gratitude to my partner, the love of my life, Didier García. His patience, support, encouragement, and

love have been vital in surpassing all obstacles, whether these were emotional, physical or theoretical. The fact that he flew around the world to be with me in Mozambique, as well as the Netherlands, only begins to show how truly special our relationship is. Didier is, and will always be, my muse… my inspiration. I look forward to packing my luggage one last time, and returning home to his embrace. To my special boys – Steve and Jamie – I also thank them for their love and support over the past few years, and look forward to many an adventure together in the future.

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31. J. Douglas Mastin. *Exploring Infant Engagement. Language Socialization and Vocabulary. Development: A Study of Rural and Urban Communities in Mozambique.* Promotor: A.A. Maes. Co-promotor: P.A. Vogt. Tilburg, 11 October 2013.