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# How Do Children Combine Pointing and Language in the Earliest Stages of Development? A Case Study of Russian and Chintang

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## Abstract

Learning to establish joint reference is one of the main milestones of communicative and linguistic development. Pointing is one of the first entry points into this process, since gestures often precede verbal communication (Iverson & Goldin-Meadow, 2005). During early development, as well as in later language use, pointing and linguistic utterances interact in many ways, complementing each other's information. However, little is known about the development of this relationship during language acquisition. In this paper, we focus on the development of the co-occurrence of finger pointing and its accompanying utterances in infants growing up in two different cultures: Russia and Chintang (Sino-Tibetan, Eastern Nepal). We show that despite the differences in environment, the development of finger pointing and accompanying language use show substantial similarities. During the early phases of development, a larger proportion of points is not accompanied by language. As the children's linguistic abilities develop, children first use language to specify what is being pointed at, and later elaborate on some aspect of the referent.

**Keywords:** language development; gestural development; pointing; finger points; cross-linguistic, cross-cultural; longitudinal corpus study

## Introduction

Language and pointing are both universal features and central components of human societies (see Kita, 2003). One of the first steps by an infant in communicating with their environment is established by pointing (Bates, 1976), as both the production and interpretation of pointing require the development of the same communicative abilities that are later used for successful linguistic communication. There is ample evidence that early points occur around the same age cross-culturally, with the the same functions, mainly imperative and declarative (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Butterworth, 2003; Butterworth & Morissette, 1996; Callaghan et al., 2011; Carpenter, Nagell, & Tomasello, 1998; Fenson et al., 1994; Lieven & Stoll, 2013; Liszkowski, Brown, Callaghan, Takada, & de Vos, 2012; Ohama, 1984). Pointing alone, however, is often under-specified without additional linguistic information. Adult language users generally accompany their points with language and some research has been done on the interaction between language and gesture (Greenfield & Smith, 1976; Enfield, 2009). A substantial body of research has been dedicated to the ties between

gestural and linguistic development, showing that gestures are firmly integrated into and predictive of verbal development (Capirci, Contaldo, Caselli, & Volterra, 2005; Iverson & Goldin-Meadow, 2005). There are also many studies on the development of iconic gestures and their role in linguistic development (e.g. Namy, Campbell, & Tomasello, 2004; Özçalışkan & Goldin-Meadow, 2011). So far, however, there is little research on the role of language or even pre-linguistic vocalizations accompanying indexing points in first language learners. Even less is known about the development of speech and pointing in understudied communities. In other words, we know very little about the information conveyed in the language used by infants while pointing, i.e. the types of speech acts they perform and the information they want to share.

In this paper, we examine the relationship between pointing and the accompanying vocalizations and utterances in two very different cultural settings. We analyze the way these two domains are combined in the two languages to address the question of whether the relationship between pointing and language is independent of culture. Even though the specific systems of language and pointing differ greatly among cultures (Wilkins, 2003), the development of this interplay is a potential candidate for a universal of human communication.

For this small case study, we narrowed our focus on the development of utterances and vocalizations accompanying *finger points* only. Finger points are proposed as the most commonly and probably most frequently used type of pointing used by young children across cultures (Butterworth, 2003). Even in cultures, where other pointing gestures dominate, children tend to start out by using finger points (Haviland, 2003). While the gesture of extending the index finger that precedes conscious pointing and the intentional index finger pointing itself seem to be some of the earliest produced gestures during development (Butterworth, 2003; Masataka, 2003), the specific use of these gestures can vary from culture to culture (Wilkins, 2003).

To understand how children behave in their naturalistic environment, we rely on observational longitudinal data of children recorded in their home context. This allows us to evaluate the behavior of the people around them as well as the chil-

dren themselves. As a first step in addressing the question of whether there are universal tendencies with regard to the language co-occurring with points across cultures, we present a case study tracking the development of the relationship between language and finger pointing in 1 to 4-year-old children from two cultures, Russia and Chintang (Eastern Nepal), in naturalistic longitudinal recordings.

We chose these two diverse cultural contexts because pointing is an integral part of the style of communication between parents and children and this allows us to test whether pointing and language are used in a similar way independent of the socio-cultural environment and whether child surrounding input and the children's production are closely linked. In *WEIRD*<sup>1</sup> cultures like Russia, linguistic instruction plays a more important role than in the less child-centered environment of rural subsistence farmers and, thus, the pointing style is also expected to differ. Even though index finger pointing is ubiquitous in the world's societies, it might still be subject to specific cultural reinforcement that would result in a different path of development (Masataka, 2003).

First, we compare the proportion of finger points in both cultures in surrounding speakers' production as well as in that of the target children. Second, we examine the development of accompanying utterances to understand how often pointing occurs without accompanying utterances and whether this changes with development as well whether this differs from the production in the ambient language. In a last step, we take a more detailed look at the structure and content of the utterances that accompany finger pointing in both languages.

## Data

### Corpora and data selection

Our data consists of recordings from two corpora from the ACQDIV Database (Moran, Schikowski, Pajović, Hysi, & Stoll, 2016), Russian (Stoll & Meyer, Unpublished) and Chintang, a Sino-Tibetan language spoken in Eastern Nepal (Stoll et al., 2015). The two settings were chosen for their substantial differences in life-style and cultural attitudes towards linguistic instruction. The Russian corpus is a longitudinal naturalistic corpus of four children between the ages of 1;2 and 4;8 who live in small apartments in St. Petersburg where several people shared one room. Most interactions are dyadic and interaction partners are a small group of relatives, siblings, and friends. The children were recorded weekly for one hour at the home of the children. No observer was present during the recordings and the recordings were done with a fisheye lens, which maximized the recordings of interactions.

The Chintang corpus is a longitudinal naturalistic corpus of six children learning Chintang between the ages of 0;6 and 4;5. Chintang is both the name of the village as well as the language spoken by the people who live there. The climate is warm and most life happens outside. People in this

village live in scattered houses surrounded by rice paddies and families live from subsistence farming. Children spend most of their time outdoors in large groups of siblings and friends. They are surrounded by differing numbers of adults and seldom find themselves in dyadic interactions. Thus, the range of ages and relationship roles of the surrounding speakers in Chintang is much wider and more varied than in Russian, where the set of surrounding speakers is more limited. Recordings were done by a recording assistant from the community supervising the camera (with a fisheye lens) which was placed several meters away from the interactions to minimize the observer effect.

Our sample was chosen to cover as broad an age range as possible. An hour of recording per child was sampled from two children in three age groups: 1-2 year olds, 2-3 year olds, and 3-4 year olds. The sampled recordings were taken at the ages of 1;2, 1;6, and 1;11, 2;2, 2;6, and 2;11, and 3;2, 3;6, and 3;11. The resulting sample includes 6 hours per age group and language, resulting in a total of 36 hours across all recordings.

Pointing behavior strongly depends on contextual factors, such as activity, location, and number and age of surrounding speakers. In using naturalistic corpora, it is impossible to control for many variables. However, it is also important to use data as close to a naturalistic setting as possible to be able to understand how communicative pointing and language develop and are used in everyday interactions. The cultures do not only differ in terms of their main loci of interaction but also in their daily activities involving children. In the Russian setting, as is known from many other Western/Indo-European corpora of a similar size, many recorded interactions include prolonged dyadic interactions with multiple books and toys, which are unlikely to occur in the same manner for the same amount of time in non-recorded everyday settings (e.g. an entire hour of just playing with different toys without doing any other tasks in between). Particularly interactions with picture books involve a very specific ritual of gestures as well as a higher density of pointing. In our Russian sample, 10 out of 18 recordings included multiple interactions with picture books. The time spent looking at books ranged between 9 and 90% of the particular recording<sup>2</sup>. On average, the Russian recordings include 20% of picture book related situations. To avoid distorting the data on naturalistic pointing, and to create more comparable samples, book-related points were excluded from the Russian data.

### Annotation

The sampled videos were annotated by linguistics students in ELAN, where they could watch the videos and read the transcribed speech. In a first step, instances of pointing were identified in the videos and classified as belonging to one of

<sup>1</sup>Russia shares fundamental socio-economic features with the countries that contribute to *WEIRD* (Western, Educated, Industrialized, Rich, and Democratic) research outcomes.

<sup>2</sup>There is only one recording with an extreme (90%) amount of picture book content; this is the recording of *Russian Child 3* at the age of 2;11. The decision not to include book points affected the child surrounding speakers in this recording most; only one of their points was not related to book content.

the following categories: finger point, hand point, head point, object point, or other. These annotations do not constitute an attempt at interpreting the gestural meaning of any pointing but simply record the physical motion of pointing with a particular body part. In a second step, the points were annotated as being accompanied by: a linguistic utterance, a vocalization/pre-linguistic babbling, or no sound at all. In a third step, the accompanying verbal utterances were coded for their i) sentence type (declarative, interrogative, imperative, unclear, no utterance), ii) content of utterance (identification, comment, direction of attention, unclear, no utterance), and iii) intention (statement, command, question, unclear, no utterance). While *sentence type* refers to the structural properties of the sentence itself, *intention* classifies the speech act carried out by the utterance.

As for content of the utterance, *identification* refers to a speaker pointing out a referent and simply naming it, e.g. “dog”. *Comment* refers to when a speaker says something more about the referent than simply pointing it out, e.g. “That’s a cute dog”. Finally, *directing attention* occurs when no specific referent is named, e.g. *Here, there*. This latter category includes many vocalizations that are used to grab an interlocutor’s attention. Where intention or speech act couldn’t be established, from video and linguistic context, they were classified as unclear.

For both Chintang and Russian, a second annotator coded 10% of the data in order to test the robustness of the annotations by computing inter-rater reliabilities. The matches were at 89.1% and 89.7% for Russian and Chintang respectively. The Cohen’s Kappa statistics were 0.836 for Russian and 0.848 for Chintang data, which indicates a high level of agreement between coders.

## Results

### Proportion of finger points

As can be seen in Table 1 the two cultures differ in the overall amount of pointing employed by surrounding speakers during the recordings. Interestingly enough, the raw number of finger points is strikingly similar across both settings. However, it is important to keep in mind that 20% of the Russian data pertaining to picture book reading was removed from the sample. Leaving those data points in would have likely resulted in more finger points in the Russian recordings, since book reading involves a lot of finger pointing. In terms of proportion of finger points out of all points, on the other hand, the numbers are quite different. In Russian adults, finger pointing makes up a much larger proportion of points than in Chintang adults. Finger points make up 65% of Russian speakers’ and only 35% of Chintang speakers’ pointing. In Chintang, other points, such as head points and object points contribute a larger portion to the overall pointing behavior, while they are much less frequently used by Russian adults in interactions with infants. In the children’s production, on the other hand, we see that Russian children use more pointing overall. In terms of overall proportions of finger points, both Russian

and Chintang children follow the patterns observed in their surrounding speakers closely.

Table 1: Raw numbers of finger points in comparison to other points in Chintang and Russian recordings produced by surrounding speakers and the target children.

	Surrounding speakers		Target children	
	Chintang	Russian	Chintang	Russian
Finger points	460	428	119	543
Other points	1021	229	219	170

In terms of the development over time, which is illustrated in Figure 1, we tested whether surrounding speakers and adults differ in their use of finger points across age groups. We used Fisher’s exact test to determine whether there is a significant difference between the use of finger points in comparison to all other points in age group 1 (target children between 1;2 and 1;11) and the older groups as well as between group 2 and group 3. The pointing of both children and surrounding speakers differs significantly between group 1 recordings and the older children’s recordings, while the recordings of group 2 and 3 are not significantly different in terms of their proportion of finger pointing.

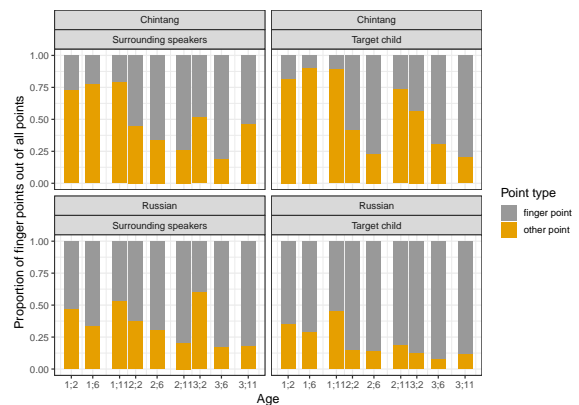


Figure 1: Proportion of finger points out of all points in target children’s and surrounding speaker’s production.

### Points and accompanying utterances

First we look at the development with respect to the proportion of finger points that are or are not accompanied by verbal utterances or other vocalizations (e.g. “eh!” or “ah!”).

Table 2: Raw numbers of points that occur with or without a vocalization or verbal utterance.

	Surrounding speakers		Target children	
	Chintang	Russian	Chintang	Russian
With utterance	444	417	105	462
No utterance	16	11	14	81

Table 2 shows that the numbers are, once more, very close for the surrounding speakers in Chintang and Russian. They do not differ statistically in terms of the amount of points they use without an accompanying utterance. In Chintang, fewer than 4% and in Russian fewer than 3% of points are unaccompanied by an utterance or vocalization. For the overall numbers, there is no statistically significant difference between the Chintang and the Russian target children, who use silent points more than adults; in 12% (Chintang) and 15% (Russian) of the cases. However, in the children's data, there are differences between age groups, which is represented in Figure 2. In Chintang, only age group 2 differs significantly from the other two groups, while in Russian, group 1 and 2 do not differ significantly, but there is a significant difference between groups 1 and 2 and group 3. While some development might be read into these results, the data used for this case study might be too sparse and susceptible to contextual influence that might strongly skew the outcomes.

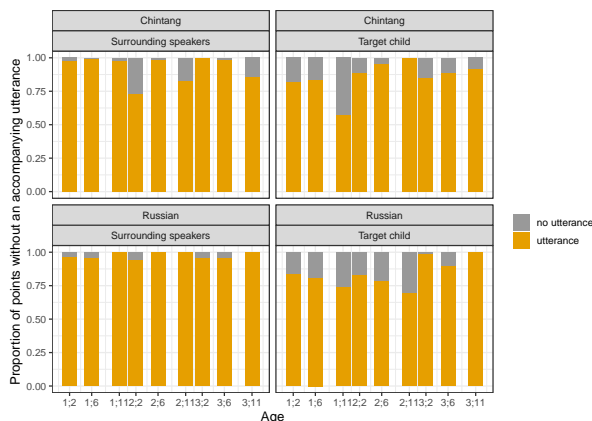


Figure 2: Proportion of finger points that are or are not accompanied by vocalizations or utterances in the target children's and surrounding speaker's production in different age groups.

Finally, Figure 3 shows the distribution of points accompanied by a verbal utterance, a vocalization, or silence for each individual child in the sample. Each row represents an age group within the individual language and juxtaposes each target child with their ambient language. While it is apparent that, as children advance through their language learning process, they use fewer and fewer points without an accompanying utterance, and, thus, become more like their surrounding speakers, it is also apparent that individual differences, especially at the earliest stages are quite pronounced. Target children 3 and 4 in both languages display very different patterns despite being in the same age group.

### Content of the accompanying utterances

While the previous section illustrated the development in terms of usage of utterances and vocalizations co-occurring with points, this section summarizes the content and structure

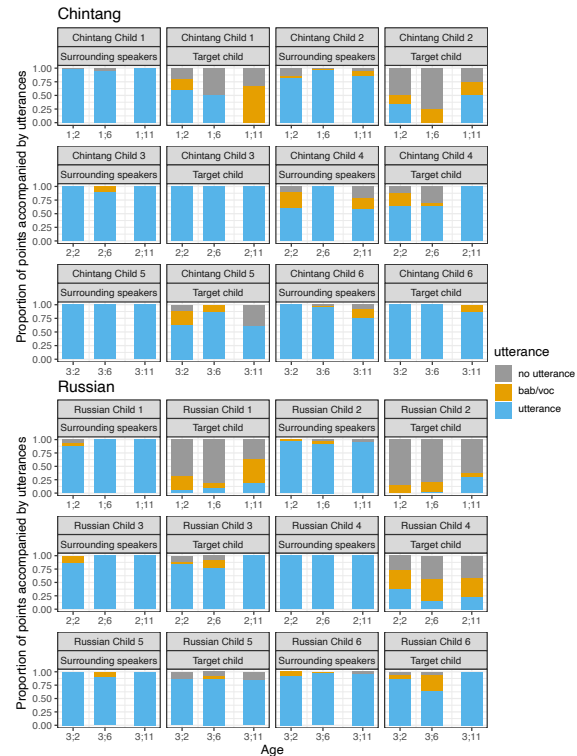


Figure 3: Proportion of finger points accompanied by vocalizations, utterances, or silence in the target children's and surrounding speaker's production.

of these utterances and shows the diversification and changes over time.

**Type of sentence** Figure 4 shows that in our sample, Chintang children begin to develop the use of imperative sentences later than Russian children. It also shows the greater prevalence of the use of declaratives and interrogatives by Russian surrounding speakers.

In the older groups, the two and three-year-olds, there is a diversification of the sentence types used with points. This might be a co-development of the increased and increasingly flexible production as the children become more proficient language users.

**Information content** The observation from the previous section is also apparent predominantly in the sample of the Russian children in terms of the information content they convey while pointing, see Figure 5. While the youngest group of the Russian target children uses finger points and accompanying vocalizations primarily to draw their interlocutor's attention, older children increasingly point while making an additional comment about the referent they are pointing out. Russian surrounding speakers hardly change the composition of the information content they convey while pointing throughout the sampled recording sessions. There is a tendency towards a reduction of simple identifications by surrounding speakers as the target child develops, which, again, reflects

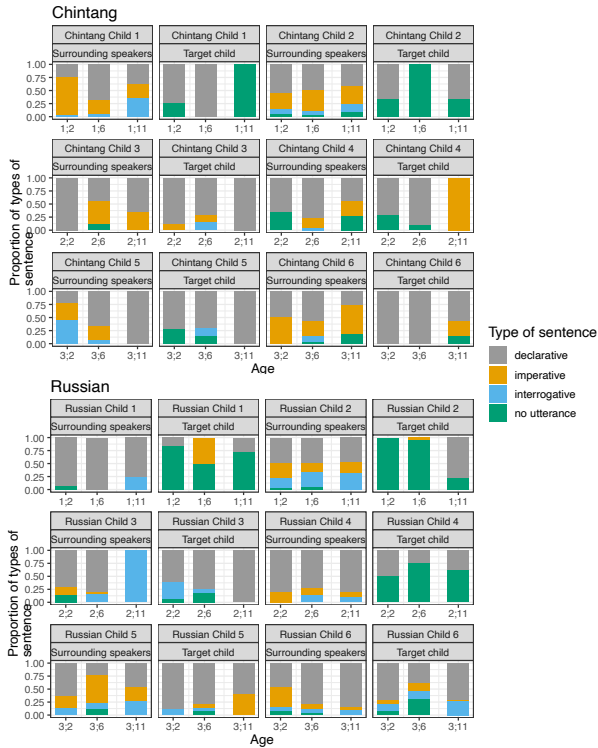


Figure 4: Distribution of the types of sentences accompanying finger points in surrounding speakers and target children.

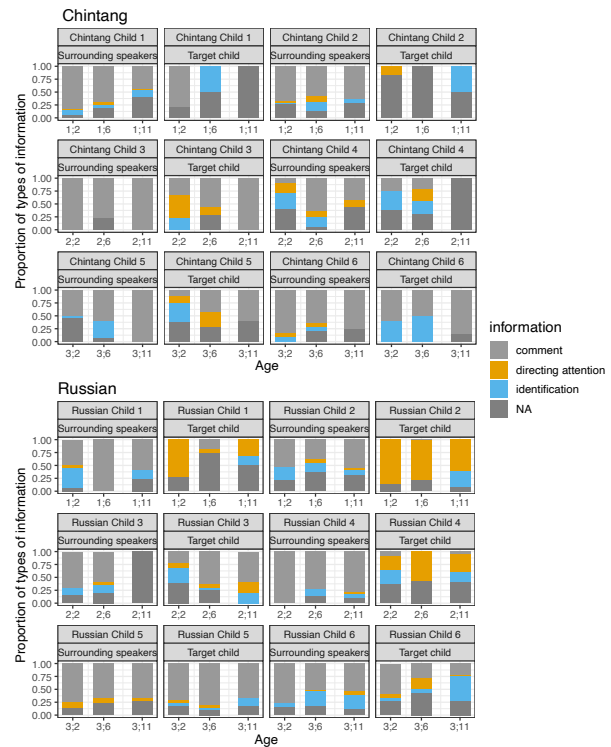


Figure 5: Distribution of the types of information conveyed in point-accompanying utterances.

the way adults might talk to a child. As the child becomes a more proficient user of language, in both production and perception, the interactions become more complex.

**Expression of intentions** Figure 6 shows how the expression of particular intentions develops over time. As children become more proficient in their use of language, their use of point accompanying speech acts becomes more like that of their surrounding speakers. This is particularly apparent in the oldest Russian children who mirror the distribution of their surrounding speakers well. In both Russian and Chintang, imperative utterances accompanying points are used by adults more than by children. Thus adults use verbal imperatives and accompany them by points for clarification. Across both languages and age groups (excluding the youngest children’s production), the most commonly used utterances that occur with finger points are statements. This means that points and language are used in symbiosis, each adding information to the other.

### Discussion

This case study contributes to understanding the role of language in communicative pointing during children’s earliest stages of language development. We have illustrated that it is not necessarily true, especially in the case of young children, that points are generally accompanied by language. While the percentage of unaccompanied points is fairly small in adults,

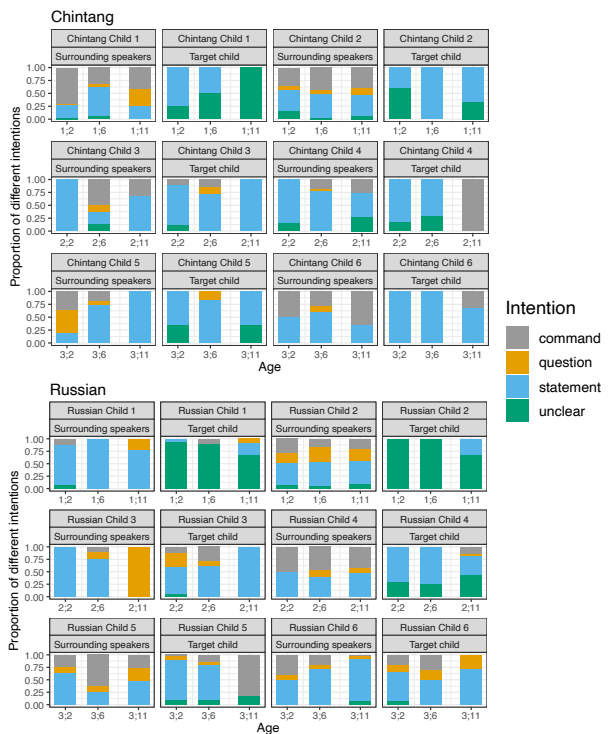


Figure 6: Distribution of the types of intention conveyed in point-accompanying utterances.

children have a higher rate of utterance-free points. This is especially true during the earliest stages of linguistic development. It is the case in both cultures studied here and is a likely candidate for a universal developmental pattern, since children must first build up their verbal inventories to be able to refer to specific entities, whereas a point can refer to many things they cannot name yet. However, we have also observed that even during the early phases of linguistic development, many points are accompanied by babbling or other vocalizations. This points to the fact that even though the children might lack concrete lexical items to employ together with finger points, they already participate in the practice of jointly using vocal and gestural communication. Thus, earliest phases of communicative behavior will consist mostly of points combined with attention grabbing vocalizations to draw in their interlocutors.

Children in both cultures differ from their input but display cross-cultural similarities. This is due to the fact that both pointing and first linguistic utterances tend to occur in a similar time frame. Pointing comes before language and once the children start to talk they appear to initially use the same function as previously had been used for points i.e. drawing attention. As their language develops, they are able to specify what is being pointed at and also to elaborate on some aspect of the referent or the intention in pointing. Although there is some evidence for an analogous distinction between reference and predication in some non-human species, this is the subject of considerable debate. In any case, language clearly allows for a qualitative leap in the specificity of communication and our data suggests that this may be a fundamental feature of early human development.

Despite the very different environments of these two cultures, it seems that the use of finger pointing and its interaction with language has considerable similarities. Adults in both cultures combine finger pointing and language in a highly similar way, even though their overall gestural behavior and their attitudes towards linguistic instruction vary considerably. Both in Chintang and in Russian, surrounding speakers accompany fewer points with a purely attention directing expression. In both cultures, this is much more prevalent in children. This is due to the fact that in adults pointing is used together with the name of the referent and a description or request related to it. This might be the result of a conscious or subconscious effort to aide the children in learning more about the linguistic representations of the world around them.

Differences reflecting cultural variation in child-directed discourse and linguistic attitudes can still be observed, however. The higher use of point-accompanying declaratives and interrogatives in Russian surrounding speakers might reflect the typical linguistic attitudes of Russian parents, who use pointing to encourage or guide their children's speech. Therefore, many points co-occur with questions about or descriptions of the referent they are pointing to. In a future step, we will analyze the content of the speech accompanying pointing

gestures further to gain a more meaningful insight into the development of the relationship between linguistic abilities and pointing behavior.

Currently, there is a large body of work on pre-verbal pointing, and some work on the earliest stages of combinations of points and language. This paper provides a first insight into the specific content and form of the utterances used with points. We plan to extend this research both in terms of different types of points as well as the number and diversity of languages and cultural settings. This includes an evaluation of each community's individual pointing behavior and the content and sentence types used together with the points in adult speech and an analysis of the development of these relations in children. This will then hopefully allow us to make more general claims about the interaction of pointing and their accompanying utterances.

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