Pointing gestures, vocalizations and gaze: two case studies

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POINTING GESTURES, VOCALIZATIONS AND GAZE: TWO CASE STUDIES

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Abstract. Conventional symbolic gestures like pointing appear at the end of children's first year. Gesture-word combinations can be observed in their second year and could serve as a transition towards two-word speech. However before gestures are combined with words, they are complemented by gaze and vocalizations. These combinations might already carry pragmatic, social and semantic functions. We explore the issue of pointing/vocalization/gaze combinations with data taken from two longitudinal follow-ups of French-speaking children aged 8 to 23 months. Our analyses show that gaze alone, or prosody alone, do not seem to have a discriminating role in differentiating the traditional functions of pointing (proto-imperative versus proto-declarative). Prosody in gesture/vocal combinations seemed to be an earlier, more discriminating feature than gaze in indicating children's positioning to their interlocutor and their use of differentiated social-pragmatic functions. Our results show that no feature alone can help interpret "pointing events" but that fine-grained correlations between pointing gestures, prosody, gaze, nature and position of the target, position of the participants, interpretation of the adult could help distinguish between the different functions of "pointing events".

Introduction

Just like language, pointing seems to be specific to the human race. It is a uniquely human gesture, if we consider the cognitive and symbolic operations involved rather than the gestural form alone, which can be produced by chimpanzees in certain trained conditions (Butterworth 2003; Tomasello 1999, 2003).

The pointing gesture has received particular attention in the field of language acquisition and is seen as a bridge between gesture and language as well as between words and their referents. The "founding fathers" of the study of child development and language had great intuitions about the importance of gestures and their relation to language. Darwin (1877) stresses the importance of observing the transition from uncontrolled body movements to intentional gestures in his notes on his son. Romanes (1889)

compares human and animal gestures, makes fine observations on the qualitative differences and mentions the gestural language of the deaf as a sign of the universality of symbolic gestures. Stern (1914) considers pointing in particular as a precursor of intentional marking.

For Werner & Kaplan (1963), pointing represents children's ability to discriminate between external objects and their own person. Communicational pointing then becomes the basis for referential behaviour and reciprocity established in common activities between children and their parents (Bruner 1975).

Several questions are still under discussion and claims have been recurrently made in the literature:

1) *The (dis)continuity between gesture and language*. Does linguistic representation emerge from non-linguistic representation (Werner and Kaplan 1963)? Are later verbal deictics in natural continuity with early pointing (Clark 1978)? The transition from pre-linguistic to linguistic communication has been addressed in studies of the (dis)continuity between gestures and signs in children's acquisition of signed languages. While discontinuity between the pointing gesture and points used as personal pronouns was illustrated in American Sign Language (Petitto 1986), the same phenomenon was not noted in Italian Sign Language (Pizzutto and Capobianco 2005), nor in recordings of children using French Sign Language (Morgenstern 1997). In the development of spoken language in hearing children, pointing seems to allow access to verbal naming and predict lexical development (Bates *et al* 1979). It may also have a crucial role in the transition from one to two-word speech and facilitate children's entry into syntax (Greenfield & Smith 1976), as cross-modal gesture-word combinations precede and announce utterances made of two or more vocal elements (Goldin-Butcher and Goldin-Meadow 2000; Goldin-Meadow and Butcher 2003; Volterra *et al* 2005). Pointing therefore allows children to operate a segmentation, to extract an element of the world that surrounds them, and to insert it in a proto-syntactic structure formed of two elements combining gesture and word.

2) *The role of gaze*. Children are said to look at adults when pointing in order to check on shared attention, which is generally considered as a reliable indication of the communicative value of pointing (Franco and Butterworth 1996). Pointing is both social – it enables children to establish joint attention with a partner (Schaffer 1977) – and referential – the designated object stands out from its environment (Bruner 1983; Cabrejo-Parra 1992), thus paving the way to symbolic activity and to language.

Pre-linguistic pointing could therefore be one of children's first symbolizing devices in the triadic behaviours, which appear at the end of the first year when children participate in joint attentional frames with others (Tomasello 1995, 1999).

3) *The origin of pointing is in question*. Pointing may develop out of prehension (Wundt 1912; Werner and Kaplan 1963). According to this hypothesis, unsuccessful grasping movements are interpreted by the adult as a gesture of request addressed to others (Vygotsky 1988). Alternatively, pointing may emerge from index-finger extension used to touch, press, or feel objects and explore the surrounding world (Masataka 2003). In both cases, the extended finger and arm establish a link between the child and the object.

4) *The function of pointing*. Many authors (Bates 1976; Marcos 1998) classically distinguish

- proto-imperative pointing: children point to a desirable object or place which the adult can help them to obtain or to reach (it may be replaced by reaching or grasping gestures);

- proto-assertive (also called proto-declarative) pointing: children point in order to share attention on some interesting or surprising object or event.

A third category, called informative, was recently evidenced experimentally: babies as young as 12-month-olds were found to point to inform another person of the location of an object s/he was looking for (Liszkowski *et al* 2006). The authors therefore present a social view in which infant pointing is seen as dependent on human skills and motivations for cooperation and shared intentionality (e.g., joint intentions and attention with others), which both serve as a platform for pre-linguistic communication.

A fourth, alternative account is proposed by Southgate et al. (2007), according to which infant pointing is neither declarative, imperative, nor informative but interrogative; rather than being motivated by the drive to share or help, it may serve a cultural learning mechanism by which infants can obtain information from adults.

Our issue in this paper is whether it is actually possible to differentiate several functions of pointing and if so, according to what parameters. Is the status of the object for the participants in the situation a distinctive feature discriminating the categories of pointing gestures described above? Is visual checking – as a means to establish joint reference – another differentiating aspect to take into account? Can we identify different types

of pointing gestures depending on joint attention and discursive focalisation? The purpose of this study is to examine and categorize the discriminatory features of young children's pointing gestures in context. Our aim is to find if there is a formal distinction between young children's pointing gestures according to their function in interaction.

Data and Method

We chose to work on two sets of longitudinal spontaneous data[1]. The children are a girl (Madeleine) and a boy (Théophile), from age 0;7 to 1;10 and 1;11 respectively. The two children are from middle-class two-parent families. One lives in Paris and the other in a suburb nearby. The children have been videotaped in their homes once a month for an hour, over a period of 15 months. (The filming is still in progress and will continue until they are 7 years old).

We are fully aware that our data would be considered as very "poor" according to some standards (Tomasello and Stahl 2004). But on the one hand these standards are particularly recommended in the study of very rare phenomena, which is not the case for pointing. On the other hand, each recording in our data therefore carries its share of surprises. We re-discover the children each time and our attention can thus be attracted by salient phenomena, changes, moods, which would not be the case if we made daily or even weekly observations. Each change functions as a "catastrophe" (Thom 1977), just like the objects the children point at and discriminate from the rest of the world.

A coding grid describing all pointing gestures, with specific annotations for gaze and vocalisations was designed. The three authors made fine analyses of each "pointing event" in context, using only the video at first. All the pointing gestures and gazes were then coded in the transcriptions as well. We consider coding and "transcription as theory" (Ochs 1979) or at least as a representation and practice of our theoretical approach and are very attentive to the features we distinguish in our coding system. We used the CHAT system and the CLAN tools (MacWhinney 1995) and made an intensive use of important secondary tiers: %gaze, %point (followed by the function we assigned to the pointing according to context), %qual (quality of the voice), %pos (interactional positioning, either monologal or dialogal), %pro (prosody), and of course %pho (vocal or verbal production transcribed in IPA). We made extensive

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use of the CLAN function, which allowed us to go from the transcription to the linked video.

Number of pointing gestures

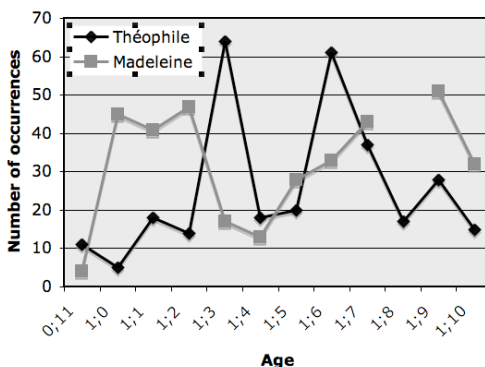The first piece of information that could be of interest is the number of pointing gestures per session.

Figure 1. Number of pointing gestures per age

We only coded intentional points with an extension of the right or left index finger as pointing gestures. As figure 1 shows, pointing gestures seem to emerge quite suddenly at the very end of the first year in our data: this is consistent with previous findings in both natural and experimental studies (Bates, Camaioni and Volterra 1975; Franco and Butterworth 1996; Guidetti 2003).

However, both Madeleine and Théophile already displayed arm extensions towards objects and people at 9 months old. The pointing gesture strictly speaking seemed to spring from the ability to use the thumb and index finger to pick up crumbs on the floor, press buttons, push toys, or scratch surfaces with their index finger, which was very much used by these children at 10 months old. This ability was then transferred and used with a communicative intent. This intent was already present in the two children's reaching gestures directed towards others with extended arm but without the index configuration, which should not be mistaken with their "monologal" attempts to reach unattainable objects with grasping movements.

Both mothers also extensively used pointing gestures directed to their children from the beginning of the data. Madeleine and Théophile could have therefore reassigned their fine motor ability for arm and finger

extension into a symbolizing device found in the input. The children's cognitive and motor development associated with a strong drive to imitate and take up forms in the input might be combined in the use of the pointing gesture as we see in other conventional gestures and routines such as waving hands to mean "bye bye," or "the itsy bitsy spider" game. These types of gestures preceded or were simultaneous to pointing (according to the motor dexterity they implied) in both children. As soon as the children take up these gestures, their adult partners position themselves as interlocutors and assign meanings to them, verbalize their interpretations, respond and therefore trigger the possibility for the child to take up that meaning again in a similar context. Children seize forms in context, be they gestures or words, they take over their meanings and set them again in movement as they use them in the dynamics of interaction.

Figure 1 also shows an overall increase with peaks that correspond to specific contexts and activities, such as book-reading or games involving pointing gestures: e.g. at 1;03, Théophile points in turn towards his mother and father to make them perform several actions for several minutes in a row. Pointing is therefore very much linked to context, to the person who is participating in the exchange, to the nature of the target and to specific situations.

Gaze

Visual checking has generally been considered as evidence that pointing is a referential gesture aimed at sharing attention with a social partner to some external event or object (Bates, Camaioni and Volterra 1975 ; Bates 1976). Such triadic behaviour – resulting in a referential triangle of child, adult and object – shows that the child has reached a new level of social understanding (Tomasello 2003) and intentional communication.

In our data, however, instances of pointing gestures where the children gazed exclusively at the target of the pointing without any visual alternation were predominant over the whole period of filming. Figures 2 and 3 illustrate the proportion of points accompanied by visual checking for Théophile (fig. 2) and Madeleine (fig. 3), compared with the overall number of points in each session between the ages of 9 months and 22 or 23 months.
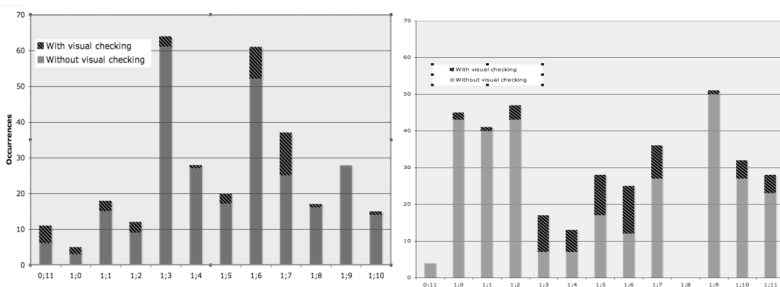
Figure 2 and 3. Number of pointing gestures with and without visual checking
(Théophile left, Madeleine right)

In our data, visual checking occurs with less than half the total amount of points (the highest figure is 50% for Madeleine at 1;06; it is always less for Théophile), which seems to contradict traditional claims in the literature[2]. This may in fact be due to conditions of data collection. Indeed, many studies underlining the importance of visual checking when pointing were conducted experimentally, i.e. with unusual objects in unfamiliar settings where the mother may have been a reassuring presence (Franco and Butterworth 1996). On the contrary, children who are filmed at home are often engaged in routine activities with adults providing a familiar frame. This may be particularly true when both child and adult are looking at a book or a screen side by side. Visual monitoring may not feel be as necessary then to check or ensure joint attention. Another hypothesis is that visual checking may not be the only way for the child to get the adult's attention.
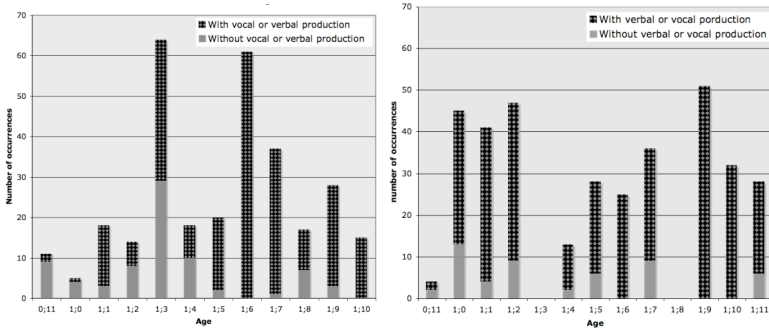
Vocal and verbal productions

From watching the videos, we noticed that pointing frequently occurred along with vocal and verbal productions and we therefore included that feature in our coding grid.

The following figures show the proportion of pointing gestures accompanied by vocal or verbal production for Théophile (fig. 4) and for Madeleine (fig. 5). Vocalizing while pointing is the rule in our data after the age of 15 months for Théophile and 12 months for Madeleine, and it may well serve the aim of getting the adult's attention when joint attention is not already established.

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[2] However, Leavens & Hopkins, 1999, have found that pointing, with visual monitoring might be more frequent in apes in captivity – who only use pointing with a requestive function unless they have had a special training involving language abilities- than in infants.

Figure 4 and 5. Number of pointing gestures with and without vocalizations
(Théophile left, Madeleine right)

In our data, vocal and verbal productions were mostly simultaneous with pointing and either duplicated or complemented it (Butcher and Goldin-Meadow 2000; Goldin-Meadow and Butcher 2003; Guidetti 2003) with increasing variety as time went by. The first vocalizations accompanying pointing were whimpering and shrill shouts, followed by nasal (e.g. *[m:m:m:]*) or vocalic (e.g. *[a:]*) sounds. By the end of the first year, babbling sequences (e.g. *[wada:waga:]*: Madeleine 1;00) and a range of verbal elements were also produced. These included demonstratives (*ça*, 'that') and localisers (*là*, 'there': Madeleine 1;00), whose meaning is equivalent to that of pointing, then denominations complementing the points (e.g. *[sisis]*, 'music' while pointing at the stereo, Madeleine 1;05; *[wawa]* while pointing at an animal in a book, Théophile 1;09). A few occurrences of bimodal combinations involved distinct semantic contents in the gesture and the word, and can be analyzed as comments on a topicalized object (Madeleine 1;07 points at the doll that was washed the day before and says *[vave]*, 'wash(ed)').

Apart from the semantic content of verbal productions accompanying pointing, another feature was taken into account: variations in the prosody of the children's vocal and verbal productions. Prosodic patterns might be the first stable element to code for semantic and pragmatic functions in vocal language acquisition (Crystal 1986; Dore 1975; Konopczynski 1991; Papousek and Papousek 1981). If pointing gestures can take on different functions, prosody might be a decisive element in characterizing co-occurring vocal or verbal productions.

Prosodic features of co-occurring vocalizations

Let us consider two events taken from our corpus. Madeleine (1;00) is eating yoghurt and at some point, her mother stops giving her spoonfuls. The child then points to the yoghurt while vocalizing. If we follow the traditional distinction, this can be coded as proto-imperative ('give me more yoghurt'). An analysis conducted with Praat shows that the prosodic contour of this vocalization is a rise. Later during the same meal, Madeleine suddenly turns around on her highchair and points at her bunny behind her on the floor. This can be coded as proto-declarative ('Look! My bunny is on the floor.'). Here, the prosodic contour of her vocalisation is a fall.

In order to find out if this was consistent, we coded each pointing event in Madeleine's data as either proto-imperative or proto-declarative or undecided depending on the situation, the mother's reaction and the nature of the object. Informative pointing was coded at first as being proto-declarative and then more finely specified as being localisations of objects in space in response to adults' questions such as "Where are your ears?" (Madeleine 1;05). We did not distinguish an interrogative function of pointing and considered it as a sub-class of the proto-imperative function: the child could either make a request for the object itself or be asking the adult *about* the object (request for labelling for example). These two situations seemed clearly different from the children's own comments on objects (proto-declarative).

Figure 6 presents the quantitative results of our categorization according to the proto-declarative and proto-imperative functions of pointing.
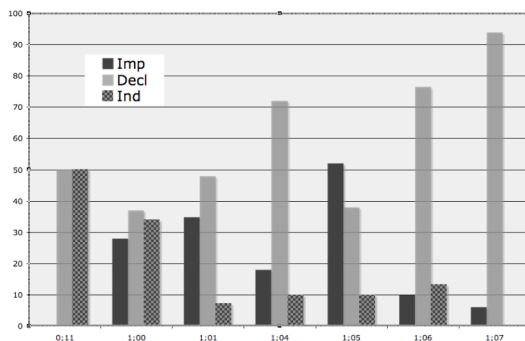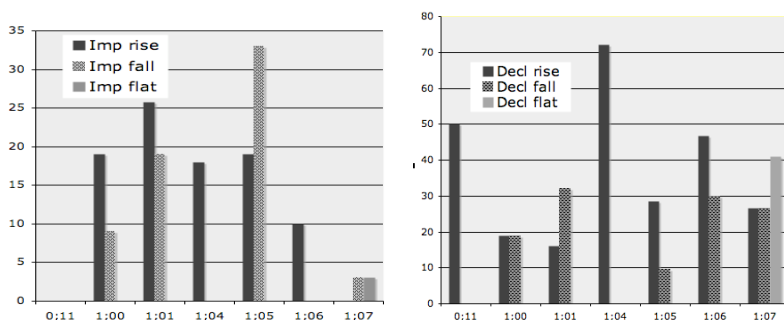

Figure 6. Typology of Madeleine's pointing gestures

Interestingly, declarative pointing (i.e. comments on the objects pointed at) occurs more frequently overall than pointing to request for an

object or action. Moreover, the latter tends to decrease as Madeleine increasingly uses identifiable verbal forms. The prime function of pointing for Madeleine is therefore the declarative function. She uses pointing to share comments on the target objects more than to make requests about them.

We then coded for prosody all Madeleine's "pointing events" [pointing gestures +/- vocalizations +/- gaze] between 0;11 and 1;07 (See figures 7 and 8). Thanks to the Praat software, we distinguished prosodic rises, prosodic falls and flat prosody. The results of our analyses are shown in the following figures.

Figures 7 and 8. Madeleine's pointing gestures with vocalizations coded as proto-imperative (left) and proto-declarative (right)

As we can see, the prosodic feature is not sufficient to distinguish proto-imperative and proto-declarative pointing. No consistent pattern emerges for either rise or fall. For both functions, there are more rises than falls. Furthermore, flat curves appear at 1;07, when Madeleine's vocalisations are often verbal productions with semantic meaning at the morpho-syntactic level. She might not need contrastive prosody as much at that stage. For example at 1;07, after having said *laver*, 'wash', Madeleine points at a stain on her doll's head while saying *bébé*, 'baby', and gives the doll to her mother. The prosody is flat here and the pointing event consisting of saying *bébé* and showing the stain, then giving the doll to her mother, could be considered as proto-imperative.

Discriminating features?

Our question about a formal difference between various pointing events corresponding to various functions in interaction remained unanswered after these analyses. Instead of assigning functions to the pointing events in the first place, another way of looking at the data was

then to analyze all rising and falling tones in the vocal productions simultaneous to pointing gestures in order to see if we could find out what kind of semantic or pragmatic features they were marking. We closely examined all the possible correlations between prosody and the different features we had coded: positioning of the object and of the interlocutor, nature of the object, focalisation, dialogic versus monologic pointing, gaze, new versus given information, the child as initiator or as giving a response, the adult's interpretation and our own interpretation of the pointing event.

Our first results show that the correlations are not clear-cut and that fine-grained analyses need to be conducted. However, some interesting elements seem to come out in this first attempt at discriminating the functions of pointing gestures.

Our first conclusion concerns the *position of the target*: whether the object pointed at is within reach or out of reach of the child, prosody is not discriminating. Even though the child may need the adult to give her the object, she does not systematically use a rising tone to obtain it.

As far as *the position of the adult* is concerned, the rising tone seems to be used to attract attention since it is systematic when the adult is not in view (absent, behind or with her back to the child). When the child and the adult are side by side or face to face, there are as many rising as falling tones in the vocal productions accompanying pointing gestures. The rising tone seems to be used to attract attention, but it is not its only function. Two layers of attention sharing might be superposed: 1) attention to the situation in general; 2) attention to the specific features of the situation the child wants to share. Therefore, the position of the adult is not a sufficient parameter to explain the child's use of prosody. However we can observe that pointing without any vocalization at all only occurs when the child and the adult are face to face.

Since attention sharing seems to be an important feature of "pointing events," we now turn to another related factor: *attentional focalisation*. When attention is not shared, the child has a tendency to use a rising intonation, but when attention is shared, there are as many rising as falling tones. Therefore, rising intonation is not only used to create attention focus; it seems to be polysemous. If the child does not have the adult's attention, she will use rising intonation, but if she does have the adult's attention, she may attribute a finer function to her rising tones: it may serve to discriminate topic (theme) and comment (rheme). For example, the child uses the rising tone at 1;07 when she says *clé* 'key' and a falling tone when she adds *pas là* 'not here' after a pause, as she points at the key hole.

Another feature we looked at was *the adult's interpretation of the pointing event*. A majority of pointing events interpreted as requests have

a rising intonation. A majority of pointing events interpreted as assertions have a falling intonation. But in both cases, this feature is not systematic.

There seems to be a hierarchy of different levels of shared attention and a relation to the use of various features: pointing, gaze, prosody, positioning of the participants and of the object and nature of the target object.

If we combine attention focalisation, prosody and gaze, we notice that *when attention is already shared* we often find a falling tone and gaze on the adult or a rising tone and gaze on the object. *When attention is not shared*, we often find a rising intonation and gaze on the adult. Gaze and prosody seem to be complementary as far as attention focalisation is concerned. Finer analyses would be required in order to find how these two features combine and if one of them is hierarchically more important than the other.

Since no single feature, in particular not prosody alone, is discriminating enough, what could be the bases for the adult's interpretation of the child's pointing gestures? *The nature of the object* seems to be one of the first clues for adults. For example, when the child points at a plane in the sky, the adult will think that she is not asking for it but is making a comment, which is not the case when the target is a cookie on the table which can be grabbed and eaten. *The position of the object* also seems to be decisive, since almost all pointing gestures interpreted as requests concern objects that are out of the child's reach. We must also add that our interpretation of our data analysis is not always the same as that of the participating adult at the time of recording. For example, when Madeleine says *cuillère là* 'spoon here' as she shows a coffee spoon on the table at 1;07, her mother gives it to her but the child does not take it: according to us she only wanted to comment on the localisation of the spoon. There is a rising intonation on *cuillère* (theme) and a falling intonation on *là* (rheme).

The correlations between all the features we took into account are quite complex and further analyses of their interacting influence on a larger corpus are required. However, our modest findings do point to the necessity to take all the relevant parameters into consideration when analysing pointing events and not to focus on a single feature.

Conclusions

Children's neurological maturation enables them to master their bodily movements and transform them into gestures thanks to finer motor skills. These gestures are assigned meaning by their interlocutors. At the same time, the children develop cognitive prerequisites that allow them to understand and use conventional symbolic gestures. The pointing gesture

therefore emerges out of motor and cognitive prerequisites, out of the capacity to symbolize and interact with others. It is of course closely linked to the adult gestural input that seems to support the child gesture production. Pointing is used as a socio-pragmatic tool in dialogue and should not be studied in isolation: it is accompanied by a number of features. Complementary gaze, facial expressions, vocalisations as well as the target of the pointing, its position and that of the participants, the interlocutor's reaction and behaviour must be taken into account. We could not find clear-cut oppositions in the use of prosody in the vocal and verbal productions which are part of the "pointing event," but a close examination of the correlations between gaze, prosody and pointing seems to be necessary in order to make subtle distinctions between the various functions of pointing.

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