Speakers' Use of Interactive Gestures as Markers of Common Ground

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Abstract. This study experimentally manipulates common ground (the knowledge, beliefs and assumptions interlocutors mutually share [6]) and measures the effect on speakers' use of interactive gestures to mark common ground. The data consist of narratives based on a video of which selected scenes were known to both speaker and addressee (common ground condition) or to only the speaker (no common ground condition). The analysis focuses on those interactive gestures that have been described in the literature as 'shared information gestures' [4]. The findings provide experimental evidence that certain interactive gestures are indeed linked to common ground. Further, they show that speakers seem to employ at least two different forms of shared knowledge gestures. This difference in form appears to be linked to speakers' use of gesture in the grounding process, as addressees provided feedback more frequently in response to one of the gesture types.

Keywords: common ground, interactive gestures, gestural markers, pointing, palm up open hand gesture.

1 Introduction

Much research in the field of gesture has focused on those speech-accompanying movements representing semantic information related to the content of speech. McNeill [1], [2] has termed these iconic and metaphoric gestures. Co-speech gestures that have received far less attention are those termed 'interactive gestures' [3], [4], [5]. In contrast to iconic and metaphoric gestures, interactive gestures do not represent any propositional information. Instead, they are closely tied to the social context in which they occur; speakers direct interactive gestures at their addressees, thus involving them in the interaction. The specific functions they fulfil at any given moment depend on the context in which they are embedded.

Bavelas et al. [4], [5] have shown through systematic, fine-grained analyses that it is possible to interpret the functions of individual interactive gestures when considering the gestures in social context. These studies have led to a categorisation scheme including four broader categories (delivery gestures, citing gestures, seeking gestures and turn gestures), and twelve specialised sub-categories. The present paper

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focuses on one of the sub-categories of delivery gestures, called 'shared information gestures', which comprises gestures that refer to information the addressee is assumed to already know. Their meaning can be paraphrased as 'as you know'. Bavelas et al. [4] provide the example of a speaker referring to the subject he studies, and referring back to this information about a minute later (while still talking to the same addressee). Together with this second reference, 'his hand quickly came up from his lap and rotated toward the addressee; his fingers uncurled to point at the addressee; then his hand returned to his lap' ([4] p.395). The meaning and function of this type of interactive gesture is, in their analyses, based on the analyst's interpretation (in the form of a verbal explication), supported by strong inter-observer agreement between several independent judges. In addition, Bavelas et al. [4] have provided empirical evidence that the functions of interactive gestures they attributed to the different gesture categories do indeed elicit the predicted addressee responses.

The knowledge, beliefs and assumptions that are mutually shared by interlocutors in a conversation tends to be referred to as their *common ground* (e.g., [6]). We already know from a host of experimental and field studies that this kind of common ground influences our use of verbal language. For example, the use of definite references, such as in the utterance 'Have you ever seen the movie showing at the Roxy tonight?' [7] presupposes mutual knowledge, here about the fact that a film is playing that evening, which film is being shown, and what the Roxy is. Experimental studies have shown, for example, that speakers tend to use fewer words [8], [9], [10] and less informative utterances [11] when more common ground exists.

The vast majority of studies investigating the influence of common ground on language have focused on the verbal side of utterances. However, some studies have started to explore the connection between speech, co-speech gesture and common ground (e.g., [12], [13], [14], [15], [16]). These studies have yielded mixed results. Some suggest that gestures become less precise, carry less information and are produced at a lower rate when common ground exists compared to when it does not, whereas others have shown that gesture rate increases and that the gestures often remain informative and full-blown. More research is clearly needed in this area.

Another aspect which we know very little about is the use of interactive gestures in connection with common ground. The studies mentioned above have focused exclusively on iconic, metaphoric and abstract deictic gestures. In terms of interactive gestures, all we know (such as from the example by Bavelas et al. [4], cited above) is that certain gestures seem to refer specifically to mutually shared knowledge (i.e., 'shared information gestures', in their terms). The present paper is a step to advance this area of research. It aims to do so by experimentally testing the claim that certain interactive gestures are specifically used to mark mutually shared information. So far, we have evidence that independent analysts can reliably identify and agree on the paraphrasing of these shared information gestures [4]. While this is compelling evidence that the respective gestures evoke the same interpretation in different observers of an interaction, critics could argue that this does not necessarily mean that individuals directly participating in it actually use these gestures with the intent to mark common ground.

Experimental studies manipulating common ground and measuring speakers' use of such gestures could provide further insights here. In the present study, dyads either had pre-existing mutual knowledge about parts of a video one speaker was telling

the other about, or they did not. Thus, the experiment involved a manipulation of the kind of common ground which is based on 'prior physical co-presence' [7]. The focus of the analysis is on the narrative of those parts of the video that formed part of the interlocutors' common ground in one condition but not in the other. If there are indeed interactive gestures whose function is to mark common ground, then speakers in the Common Ground condition (CG) should use more of these gestures than those in the No Common Ground condition (NCG). (Of course, in the NCG condition some common ground-related gestures may still occur due to the fact that mutually shared knowledge also accumulates over the course of an interaction [based on 'linguistic co-presence' [7]]; however, this should be the same in both conditions and therefore should not interfere with the experimental manipulation.)

The second way in which the study explores the link between interactive gestures and common ground is by examining differences in the form of these shared information gestures. When eye-balling the data it was noticeable that speakers appear to use two forms of gestures here. One is a deictic gesture, pointing directly at the addressee, with a clearly protruding index finger (in a couple of cases the middle finger was also extended) and with the palm facing either to the side, down or upwards. The second type of gesture involves a flat hand (although the fingers may be slightly curled in), no individual finger protruding distinctly, and with the palm facing upwards (Palm Up Open Hand, or PUOH [17], see also [18]; the example provided by Bavelas et al. [4], cited above, also seems to belong into this category, as all of the fingers are pointing towards the addressee). In both cases the gestures motion towards the addressee, although the pointing gestures tended to often flick out more rapidly and with more emphasis. Of course, this difference in hand shape might seem small and may not matter at all. In fact, Bavelas et al. [4] state that, while all interactive gestures share the general feature of palm or finger orientation towards the addressee, the function of interactive gestures does not depend on the exact form, which is idiosyncratically determined and improvised. In other words, unlike with emblems [19], for example, there is no simple form-function mapping. A PUOH gesture can, for instance, have the function of someone handing over the speaking turn to another (thus belonging to the class of 'turn gestures'), but it can also be used to indicate someone else's earlier conversational contribution (thus falling into the category of 'citing gestures') or to provide new information (thus being a 'delivery gesture'). However, we also know that, in certain contexts at least, the form of gestures (in particular pointing gestures) is not idiosyncratic, with the morphological parameters and exact hand configuration being 'a patterned component of the utterance ensemble' ([18], p.223). The second part of the present analysis focuses on differences in the form of gestures which have the same general function (i.e., both are 'delivery gestures' used to mark shared information). In other words, this analysis focuses on differences *within* one of the sub-categories established by Bavelas and colleagues. From their 1995 analysis, it is clear that there is some variation in addressee responses to interactive gestures from the same sub-category. For example, for shared knowledge gestures (as for some other categories, too), they predicted a 'confirming response *or* no new response (Bavelas et al. [4], p.402, emphasis added). The second part of the present analysis therefore aims to uncover whether there is any particular pattern underlying this variation which is based on morphological differences in gesture form.

The rationale behind this idea is that hand gestures are believed to have evolved from manipulations of the physical world (e.g., [20], [21]). As such, using a PUOH gesture is like offering, presenting or giving something imaginary placed on the surface of the hand, such as the current discourse focus, or to receive something, such as feedback or a comment ([18]; see also [17]). A pointing gesture, on the other hand, does not direct attention to something that is placed on top of the palm. Rather, it has a trajectory which singles out a referent in the surrounding environment (or in fictive space). Here, the gesture's trajectory singles out the addressee. It thus reaches, through its vector, into the addressee's gesture space. If we assume that gestures evolved from object manipulation and acting in a physical world, then one possibility is that pointing gestures evolved from touching or reaching with the index finger. This would mean that through the trajectory the interactive pointing gesture is somewhat like touching the addressee. As such, this pointing gesture may be perceived as somewhat more imperative, a more demanding request for a response than one which *offers* something that may be *considered* for responding to, or not.

Speakers' use of these two different kinds of gesture forms to mark common ground may relate to Clark's [6] notion of 'projected evidence'. In order for the joint activity of conversation to be successful, interactants need to ground their discourse contributions [22]. Grounding is the process by which interactants establish the mutual belief that they have understood the meaning of a discourse contribution 'to a criterion sufficient for current purposes' ([22], p. 129). For this to happen, contributors require from their partners some form of positive evidence of understanding (or, in case of negative evidence, the contributor can rephrase or in some other form repair their previous contribution). One way in which addressees often provide such positive evidence is through acknowledgements, such as 'yeah', 'ok' or 'uhu'. A might say to B 'I'm gonna go to a gig at the Academy tonight' to which B responds 'uhu'. In this case, A's contribution has been grounded. Another basic form of positive evidence is continued attention. In face-to-face interaction, speakers can express their undisturbed attention through eye gaze (e.g., [22]). In order to ground contributions in discourse, and thus to accumulate common ground in a conversation, contributors signal when they need positive evidence of understanding from their addressee. Further, by presenting an utterance in a particular way, speakers project which kind of evidence they require [6]. According to Clark [6], gestures are one way by which speakers can elicit this evidence, including interactive gestures. The idea tested here is that speakers may use different forms of shared-knowledge gestures depending on what kind of positive evidence they require and how urgent this response is. The focus is on how speakers use interactive gestures in grounding references to common ground that they acquired through prior physical co-presence with their addressee.

In sum, the first part of the analysis aims to provide experimental evidence for speakers' use of interactive gestures in association with experimentally induced common ground. The second part of the analysis tests whether two forms of gestures occurring with references to common ground function the same or differently in terms of involving the addressee in the communication process. To test this, the focus is on two aspects, namely whether a new response occurs or not, and how quickly this response is elicited.

Of course, it would be interesting to also consider a range of other aspects. Because of this, and because the present study uses a dataset that is more monologue-like in nature with one person in each dyad having the speaking part, the present analysis needs to be considered work in progress. However, it offers a first insight into how speakers may use interactive gestures in the context of common ground.

2 Method

2.1 Participants and Design

80 students (40 female and 40 male) from the University of Manchester took part in the experiment (for either payment or experimental credits). All individuals were right handed native English speakers, unacquainted with each other prior to the experiment. Each participant was allocated to a same-sex pairing, which was then randomly assigned to one of two experimental conditions: 1) a 'common ground' (CG) condition, in which mutually shared knowledge about the stimulus material was experimentally induced, and a 'no common ground' condition (NCG), in which participants did not share any experimentally induced common ground.

2.2 Apparatus and Materials

A video recording, about 8 minutes in length, from a children's television program (showing various characters involved in a range of everyday activities, such as grocery shopping, playing in a barn) was used as the stimulus material ('Neues aus Uhlenbusch', ZDF, Germany; the video was played without the sound, but was still easily understandable). Six individual scenes, each just a few seconds long, were selected from this video and recorded onto a second tape to induce common ground. Participants were filmed split screen with two wall-mounted video cameras, each providing a view of one of the participants.

2.3 Procedure

In both the CG and the NCG condition the participants were randomly allocated to a speaker and to an addressee role. The speaker was asked to watch the stimulus video while the addressee was absent. However, in the CG condition, both participants first watched the six selected scenes together before the speaker saw the entire video. (In the NCG condition, the speaker also watched the six scenes, alone, to keep salience and memory constant across conditions). The addressee was then asked back into the room and the speaker was instructed to tell them what happened in the story as a whole. In the CG condition, the speaker-participant was reminded that the addressee already shared some knowledge about the video with them. In the NCG condition they were reminded that their addressee had no pre-existing knowledge about the story. In both conditions, addressees were told to not interrupt the speaker with questions but that they could signal their understanding or lack thereof in any other way they deemed appropriate (such as backchannel responses, *uhum, yeah, ok*, or nonverbally). The reason for this restriction was that the dataset was also used for an analysis of gesture rate [14], and differences in the number of questions asked by

addressees would affect gesture frequency [23] and thus could result in a confound with differences due to the experimental manipulation of common ground.

2.4 Analysis

Gesture Categorisation. In the first instance, all gestures identified were categorised according to Bavelas (e.g., [3]) into 'topic' and 'interactive' gestures. The inter-observer reliability between two independent coders using these two categories to code the data from six randomly selected participants (three from each condition) was 95%.

Then, the gestures were divided into more detailed categories, distinguishing iconic, metaphoric and abstract deictic gestures [1], as well as interactive pointing gestures towards the addressee with the hypothesised function of marking common ground, and palm up open hand gestures [17] related to common ground. In addition, a category including all other forms of interactive gestures was used, as well as a category for pragmatic gestures [18]. The agreement of two independent judges categorising all gestures using these seven categories was 86%.

The data from this experiment were subjected to a range of different analyses. However, the present study focuses exclusively on common ground related pointing gestures made towards the addressee (hereafter termed CG-ADD-pointing gestures) and common ground related palm up open hand gestures (hereafter termed CG-PUOH gestures), as described in the Introduction. Only gestures accompanying parts of speech that referred to content from the six selected scenes were considered (see [14], for more detail on the segmentation of the narratives)).

Addressee Responses. The second and third analyses take into account i) whether addressees responded, and ii) how promptly this response was issued. In terms of addressee responses, both verbal and nonverbal responses were included. Usually, the responses consisted of either a head nod or a backchannel response (such as *uhu, yeah, ok*), or a combination of the two. These were 'new' responses in a way, as addressees usually respond through continued attention, signalled, for example, through eye gaze directed at the speaker. The responses coded here were therefore new responses which occurred in addition to continued eye gaze. With regard to response timing, the delay from the peak of the gesture to the onset of the addressee's immediate response was evaluated, with a maximum delay of two seconds being considered immediate. Although this criterion is somewhat arbitrary, the decision was based on Bavelas et al.'s statement that most of the addressee responses to interactive gestures occurred within a 2 second window in their analysis ([4], p. 402-403). Two delay categories were used, *0s delay*, capturing responses whose onset coincided with the peak of the gesture (or even preceded it due to the response starting towards the end of the preparation phase of the gesture), and up to *2s delay*, which captured any other new responses occurring after the peak of the gesture. A third category called 'no response' captured those cases where either no new response occurred at all, or the delay was longer than two seconds and therefore the response did not seem directly related to the gesture.

3 Results

This section reports three analyses. The first one tests the link between shared information gestures and common ground. The second and third one consider the two forms of shared information gestures found in the present dataset individually to compare the frequency with which they elicit addressee responses, and how prompt these responses are.

3.1 Do Interactive Gestures Mark Common Ground?

This analysis tests the claim that there are indeed certain kinds of interactive gestures associated with the delivery of shared information. If this is the case, speakers in the CG condition should use more CG-PUOH and more CG-ADD-pointing gestures when referring to the six selected scenes than speakers in the NCG condition. While the latter group of speakers may, on occasion, use these gestures to refer to information they have already provided (i.e., when referring to shared knowledge that has accumulated during the conversation), speakers in the CG condition should use them also when referring to the information from the six experimental scenes as common ground. And this is what we found (see Table 1). A Mann-Whitney *U* test showed that speakers in the CG condition used significantly more CG-PUOH gestures and CG-ADD-pointing gestures towards the addressee (combined data) when referring to the six selected scenes (*Mdn* = 1.5, *Range* = 6.00) than speakers from the NCG condition (*Mdn* = 0.00, *Range* = 2.00), $U = 59.50$, $n_1 = 20$, $n_2 = 20$, $p = .0001$.

Table 1. Frequency of CG-ADD-pointing and CG-PUOH gestures in the common ground (CG) and no-common ground (NCG) conditions

	Interactive gesture type	
	ADD	PUOH
CG	31	11
NCG	1	3

3.2 Do CG-PUOH and CG-ADD-Pointing Gestures Differ in the Amount of Addressee Responses They Elicit?

This analysis focuses only on speakers in the CG condition. It compares the frequency with which addressees provide a feedback response immediately following the two kinds of interactive gestures marking shared information. Goodman and Kruskal's Tau (dependent variable = response) showed a significant association between interactive gesture type and response frequency ($\tau_B = .098$, $p = .045$), with CG-ADD-pointing gestures eliciting proportionally more responses than CG-PUOH gestures.

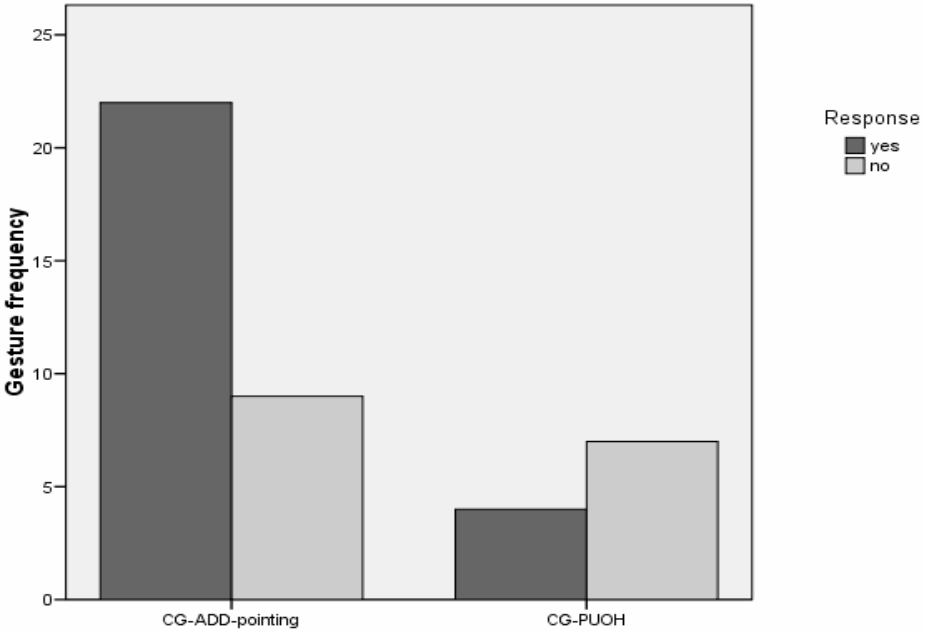

Fig. 1. Frequency of CG-ADD-pointing gestures and CG-PUOH gestures receiving an addressee response

3.3 Do Addressees Respond More Promptly to Either CG-PUOH or CG-ADD-Pointing Gestures?

This analysis is based on those gestures examined in section 3.2 that did receive a response within the 2s time window (see Table 2). It tested the hypothesis that the two different forms of the common ground related interactive gestures identified in the present corpus affect the speed with which addressees respond. When speakers refer to the information that constitutes common ground and mark this with the respective interactive gestures which aim to involve the addressee, then addressees should provide some feedback as to whether they have understood and recall the respective aspects of the video. One idea is that they may do so with more urgency in response to CG-ADD-pointing gestures, as they could be viewed as more imperative and a more direct demand for feedback (compared to the possibly more 'subtle' CG-PUOH invitation to provide feedback). However, although we see a pattern that could be interpreted as suggestive of such an association (in that in almost a third of the cases participants' responses coincided with the peak of the CG-ADD-pointing gesture, whereas for CG-PUOH gestures, none of the responses coincided with the peak of the gesture), no significant association was found, $\tau_B = .055$, $p = .243$.

(Only two CG-ADD-pointing gestures occurred within the 2nd second following the peak of a gesture; although the pattern becomes slightly stronger when excluding these two cases when reducing the time window to 1 second as an alternative analysis (with almost half of the responses to CG-ADD-pointing gestures then coinciding with the gesture peak), the association remains statistically non-significant, $\tau_B = .067$, $p = .216$.)

Table 2. Frequency of gestures eliciting addressee responses coinciding with (0s) or following (2s) the gesture

	Response delay	
	0s	up to 2s
CG-ADD-point	6	16
CG-PUOH	0	4

4 Discussion

The present analysis set out to show two things. First, it tried to experimentally validate the claim that one particular category of interactive gestures fulfils the function of marking shared knowledge. Previous studies have provided some evidence for this in that independent analysts agree in their identification of such gestures and on the interpretation of the function they fulfil. The present analysis has provided supporting experimental evidence for this claim. From examining the data, it appeared that there are at least two different forms of interactive gestures that speakers use for marking common ground (i.e., two different gesture forms that would both fall into Bavelas et al.'s [4] category of 'shared information gestures'). One is a flat hand shape, the palm facing up, fingers (either slightly curled or extended) facing towards the addressee, without any individual fingers protruding distinctly more than the others in an indexical manner. This type of hand gesture has been termed 'palm up open hand' (PUOH) by Müller [17] and is considered to be part of the 'open hand supine' (OHS) family of gestures [18]. The other form is a common pointing gesture, with the index finger (and in a few cases also the middle finger) clearly protruding more than any other finger, and with the point being directed at the addressee. Here, we termed these gestures CG-PUOH and CG-ADD-pointing, respectively.

The findings from the first analysis showed that, indeed, speakers who talk to addressees with whom they share experimentally induced common ground (based on a prior shared visual experience and experimental instructions) use significantly more of both of these types of interactive gestures than speakers who talk about the same semantic events but without these being part of the common ground. This is clear evidence that common ground between interlocutors encourages the use of interactive gestures which fulfil the specific function of marking this mutually shared knowledge for the addressee. Important to note is that co-speech gestures were *not* more frequent in the common ground condition in general. An earlier analysis based on data from the same experiment [14] focused on iconic and deictic gestures (here pointing gestures used in a non-interactive manner) and found no significant difference between the CG and NCG conditions; in fact, the tendency was in the opposite direction, with numerically more gestures being used in the NCG than in the CG condition. In addition, this earlier analysis also found that speakers in the CG condition used significantly fewer words than when no experimentally induced common ground existed. This means that, in the present analysis, the higher number of common ground related interactive gestures in the CG condition can*not* be accounted for simply by the fact that speakers talked more and therefore had more

opportunity to produce more of these gestures. As another side point, the present findings relate mainly to common ground based on prior co-presence, but in some cases shared knowledge gestures were also used for the kind of common ground that builds up during conversation (based on linguistic co-presence) [7].

Whereas the first analysis combined the two different gesture forms to tap the general category of shared information gestures, the second and third analyses considered them individually. They showed that the difference in form seems to be functional at a micro-level (i.e., *within* the category of shared knowledge gestures established by Bavelas et al. [4]). There was a clear association between CG-ADD-pointing gestures and new addressee responses, whereas this was not the case for CG-PUOH gestures. (Although the third analysis also revealed a tendency for CG-ADD-pointing gestures being responded to more promptly than CG-PUOH gestures, this association was not significant.) It therefore seems that, in the context of communicating mutually shared knowledge, pointing gestures directed at the addressee are perceived as somewhat more urgent requests for addressee feedback than palm up open hand gestures are.

Although the relationship between form and function of interactive gestures is idiosyncratic with no fixed one-to-one mapping (e.g., a PUOH gesture may occur in any of the main categories of interactive gestures [4]), it seems that within one sub-category, small differences in the morphological form of gestures may impact on the interactive process between speaker and addressee (at least in the case of shared knowledge gestures). Thus, within the group of gestures sharing the general function of marking common ground, CG-ADD-pointing gestures may be considered the more imperative form of common ground related interactive gestures. With reference to Clark [6], we may conclude that different gestural signals are used by speakers to project different kinds of evidence of understanding. Whereas in some cases the speaker may perceive continued attention (e.g., expressed by the addressee's eye gaze) a sufficient indicator that their contribution has been understood 'well enough for current purposes', they may require more explicit evidence in others (such as a new response in the form of a verbal or nonverbal acknowledgement). This suggests that interactive gestures may play an important role in the process of grounding – at least in the context of grounding speakers' reference to common ground based on prior physical co-presence.

However, because the present analysis constitutes work in progress, we have to be tentative with interpretations. After all, there are a host of additional, unexplored factors that may play a role here. One of the most important next steps is to examine the interplay of these interactive gestures with the verbal components of the utterances they form part of. Also, the kinds of responses addressees provided have here been grouped together. A more fine-grained analysis differentiating verbal, nonverbal and multi-modal responses (including gaze, facial expressions and intonation) is needed. Moreover, the current findings are restricted in generalisability as they are based on more monologue-type contexts where one person speaks and the other provides backchannel responses, similar to telling an anecdote, a close-call story, a joke, and so forth. More dialogic interactions may potentially differ in terms of how speakers mark common ground and how addressees respond to these markers. Yet another avenue for advancing this work is to apply a more micro-analytic procedure taking into account morphological differences also at other parameter

levels, such as differences in palm orientation (for pointing gestures). This may yield further sub-classifications. It is obvious that much work remains to be done on this issue, but the present study has thrown light on some potentially very important associations between interactive gestures, common ground and grounding.

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