

# Hand gestures in speech: studies of their roles in social interaction

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## Abstract

When people talk, they often move their hands and their arms. These movements seem to have some type of relationship with concurrent speech. Some of the results of a research project on gestures are presented here. These studies aimed at describing different gestures occurring during speech, and at understanding their roles in different contexts of social interaction. Research topics therefore are: categorization of gesture communication, reliability of tools for coding hand gestures, and functions of gesture in speech and in interaction. In particular, these studies had two aims in mind:

- a) the development of a reliable coding system and a relative multi-medial support for the categorization of hand gesture (descriptive-structural aim);
- b) individuation of gesture functions in conversation through statistical analysis of significant speech-gesture co-occurrences (descriptive-functional aim).

The main theoretical premises relating to each aim are here synthetically explained.

**Key-words:** *gesture structure, gesture function, gesture-speech coordination.*

## 1. Introduction

### 1.1. Coding hand gesture

A starting point to study any object is to make it recognizable. Typically, in the study of nonverbal communication, the definition of the categories and of the dimensional structure of the phenomenon under examination is particularly crucial, even in respect to the scientific field, or to the different functions that one may want to deepen (Meherabian, 1972). Classifying a behavioural phenomenon, such as hand gesture, into a system of exhaustive and mutually exclusive categories has both a theoretical and methodological utility, because it helps make the examined phenomenon not only conceptually clear, but also operatively observable and quantitatively analysable, passing from the empirical procedure of data collection to successive statistical analysis.

Behavioural coding systems and codes that compose them are elective “instruments” of observational research (Bakeman, Gottman, 1997). And, as shown by literature on gesture, different classifications, as many coding system of gestures are described (see, amongst others, Bavelas, Chovil, Coates and Roe, 1995; Ekman and Friesen, 1969; Kendon, 2004; McNeill, 1985). Each classification follows a specific and unique taxonomic criterion that is different from others. Nevertheless, in observational research on communicative phenomena, it is appropriate and desirable to “adopt” or “adapt” common category systems that are shared by the literature as well as valid and reliable. Such a tool is a necessary, although non-sufficient, condition to increase sharing and comparisons within the scientific community. In addition, it can be particularly helpful in generalizing results and favouring the process of knowledge accumulation within a scientific domain on a certain topic or object of study (see Kendon, 2004, for a historical report about gesture study tradition).

In order for a coding system to be used as a shared tool for empirical research, the composing categories have to be shown clearly and described in detail. It is moreover necessary to verify its reliability in different interactive contexts. The most frequently used approach to assess reliability of the measurements in observational research is to calculate agreement between independent observers (Pedhazur, Pedhazur-Schmelkin, 1991). It is possible to calculate inter-observer agreement as an agreement percentage ( $P_a$ ), defined as the ratio of total agreements ( $N_a$  is the number of behaviours coded by two observers with the same code) and the sum of total agreements and total disagreement ( $N$ ) per 100; nevertheless, percentage agreement can produce an over-estimation of agreement, because it could be artificially increased by agreement due to mere case. Therefore, the most frequently used index for inter-observer agreement is Cohen's  $K$  (Cohen, 1960), which takes into account the probability of agreement due to the case. Although inter-rater agreement is not necessarily a reliability or validity index, it can be considered as a necessary, but not sufficient, condition for observational research (Pedhazur, Pedhazur-Schmelkin, 1991): in absence of agreement, data are certainly unreliable (codified data become an observer's subjective vision of the phenomenon). Therefore, observational research, given the relative subjective nature of coding, places the emphasis on inter-observer agreement as an obligatory step in demonstrating the reliability of the research (Bakeman and Gnisci, 2005). In the literature on gesture study, different classifications, often non-exhaustive, are used in so far as a single interactive context at one time.

The focus of this article is therefore to present and validate a coding system based on a taxonomy of hand gestures which integrates existing classifications and which can be carried out within different social contexts and situations.

## 1.2. Hand gestures in speech

Different, and often qualitative, studies that put into relation hand gesture and verbal communication, tried to explain gesture functions by often referring to only some types of gestures, such as those linked to discourse gestures (see, amongst others, Beattie and Shovelton, 2000; Contento, 1999; Kendon, 1983). Some authors indicated that gestures occurring during speech, could have an important role in conveying and communicating semantic information to the receiver (see, amongst others, Alibali, Flevares and Goldin-Meadow, 1997; Kelly and Church, 1998; Kendon, 1995). Other authors suggested that gestures could be useful even for some aims of the speaker: such as facilitating linguistic and syntactic production of speech (see, Krauss, Chen and Chawla, 1996; Rimé and Shiaratura, 1991), or together with other nonverbal signals, persuading or obtaining consents (see, Argentin, Ghiglione and Dorna, 1990; Burgoon, Birk and Pfau, 1990; Carli, LaFleur and Loeber, 1995). Gestures, in fact, can represent some aspects of verbal content: through their iconographical proprieties, they can figuratively describe objects, actions, movements, relationships among objects or entities contained in verbal utterance (e.g., "iconic gestures", (McNeill 1992); see also Beattie and Shovelton, 2000, 2002)); they can also embody objects, entities and movements as metaphors of abstract concepts which they refer to (i.e., "metaphoric gestures", McNeill, 1992). In the last case, since metaphors are often socially conventional, metaphoric gestures can be similar to "emblems". Emblems (Ekman and Friesen, 1969) are hand gestures with highly conventional means and are translatable into words and/or into sentences, especially within a certain culture. Other gestures have a deictic component (i.e., "deictic gestures", see McNeill, 1992): pointing to objects present in the physical environment surrounding the speaker or to objects present in the discourse content (indicating virtual objects, places, time period, etc.), using different hand configurations (index, palm up, thumb, etc. (Kendon, 1995)).

In speech, structural dimension and stress of rhythm of discourse are present; these can also be observed in some types of gestures: "cohesive gestures" (McNeill, 1992) could provide discourse

with continuity and coherence, while “rhythmic gestures” (i.e., “beats” (McClave, 1994; McNeill, 1992)) mark stress and rhythm of utterances, supplying parts of them with emphasis for persuasive speech.

Particular types of hand movements are described by Ekman and Friesen (1969): they are not connected to the co-occurring discourse (neither semantically nor structurally); however, they can be used by the speaker during speech, so they can be perceived and valued by the receiver (listener). Ekman and Friesen considered them as movements aimed to manage particular emotional states, such as tension or anxiety; few authors have studied if and how these gestures can be valued by the receiver (see, Vrij, (2000) on evaluation of gestures occurring during interrogations, in case of lie), or if speaker uses them to manage communicative interaction.

The literature offers, therefore, only few suggestions for speech-gesture coordination. The existence of some stability in the co-occurrence between some hand gestures and some specific aspects of verbal communication in different contexts is yet to be verified empirically and, above all, statistically. Until now the literature has proposed such correspondence only through qualitative evidence. Instead, to statistically verify which gesture categories correspond to which specific verbal aspects should be essential, such as: discursive markers, marking syntactic structure of discourse (see, amongst others, Fraser, 1999; Shiffrin, 1987); rhetorical functions, that are an emphatic and persuasive modality to present discourse content (see, Atkinson, 1984; Edwards and Potter, 1992); features of talk turns in conversation as marking interaction management and relationship with the interlocutor. The focus of the second study is to better understand gesture function through specific speech-gesture correspondences.

## **2. First study**

The first study examines taxonomical and methodological problems concerning acknowledgement and reliability of hand gesture coding in depth.

### **2.1. Objectives**

The aims are as follows:

- 1) To verify, through inter-observer agreement, the reliability of a hand gesture coding system (Bonaiuto, Gnisci and Maricchiolo, 2002), which synthesizes, joins and combines previous classifications that exist in the literature (see, amongst others, Ekman and Friesen, 1969; Kendon, 1985; McNeill, 1992) according to a criterion of link with speech and placing particular attention to its generalization across different social interaction contexts. The evaluation of the reliability regards the following two fundamental tasks in which the observer is engaged:
  - a) identification of the codifiable event, i.e., the gesture (coding unit);
  - b) appropriate coding of the event, according to the adopted category system.Moreover the appraisal of the inter-observer agreement will have to regard the reliability of:
  - c) each category of the taxonomy;
  - d) the whole category system in each specific interactive context within the range analysed.
- 2) To realize a digital multi-media tool that offers audiovisual support to gesture study, and in particular, to the use and the learning of this gesture category system, in order to make such taxonomy shared and more easily consultable.

### **2.2. Method**

#### **2.2.1. Samples from different contexts**

Twenty minutes of video-recording are selected from each of five contexts: two “field” (political interviews and courtroom examinations, broadcasted by Italian television) and three “laboratory” setting (simulations of small groups and dyadic discussion and of suspicious interviews). All the subjects, whether interviewed, questioned, or participating in a discussion, were blind to the objectives of this research. The total length of the sample video-records was 100 minutes.

### 2.2.2. Procedure and coding

Hand gestures observation and coding was lead independently by two observers, trained to the use of the coding system and blind to the research aims. Conversation transcriptions, according to jeffersonian method (Jefferson, 1985), as well as systematic observation schemes were used in support for the coding (Bonaiuto et al., 2002). In the first modality (conversation transcriptions) each codified gesture is linked to the word or to the sentence with which it occurred; in the second one (observational schemes) it is linked to the time of occurrence, as indicated by the timer in the videotapes. As far as the coding system (Figure 1), it refers to the hand gesture taxonomy previously elaborated (Bonaiuto et al., 2002), where gestures are distinguished in two macro-categories: gestures connected to the speech and gestures non-connected to the speech. The first macro-category comprises all the gestures that are executed during verbal expression and connected with either speech content or discursive structure – they comprise: “cohesive gestures” (repetitive hand and/or finger movements which accompany speech development, providing it with continuity, coherence and cohesion); “rhythmic gestures” (up/down, right/left beats of hands that accompany speech, providing it with emphasis and following rhythm of its vocal stress (McClave, 1994)); “ideational gestures” (hand movements whose shape or direction refers directly to the speech content); iconics, metaphors, deictics and emblems, or symbolic gestures. Gestures non-connected to the speech refer to the non-intentional signs of adaptation described by Ekman and Friesen (1969); but here they are understood as gestures that do not have any apparent relation with speech, although they can also be used during its occurrence (neither structural-cohesive nor of content) – they comprise self-, object-, and person-adaptors, i.e., where the hand(s) touches/touch part of own body or objects or other persons, respectively.

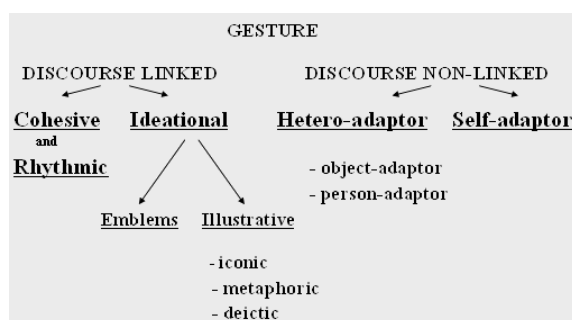


Figure 1. Classification of hand gestures (adapted from Bonaiuto et al., 2002)

For the realization of the multi-media manual for coding hand gesture, digital support on CD-Rom was developed: normal text is thus supported by important information in form of images as well as video, reproducing speakers producing hand gestures. Text, image and video were assembled through *Macromedia Flash MX*. The CD-Rom is in Italian.

### 2.2.3. Data analysis

As far as the check of reliability, inter-observer agreement was calculated: agreement percentage on coding unit (gesture occurrence), Cohen’s *K* index on whole category system, on each gesture category, and on each interactive context analyzed.

## 2.3. Results

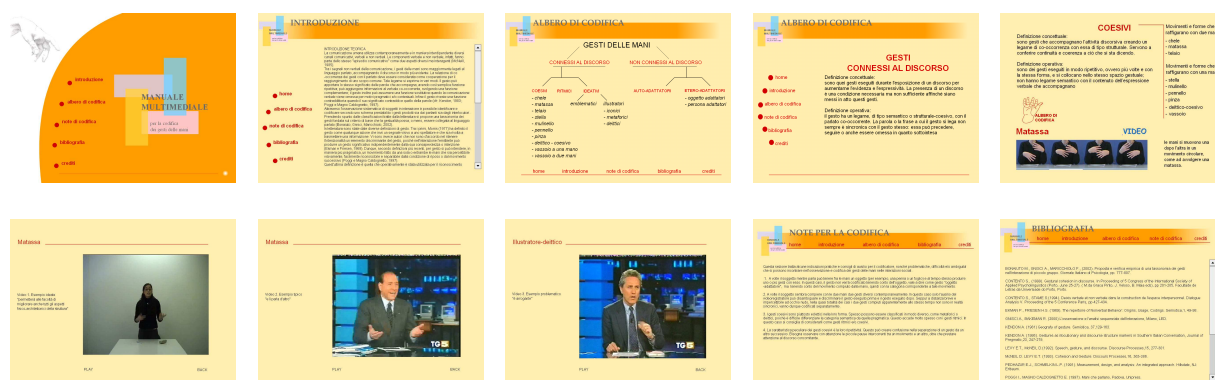
- 1) Category system is reliable in each of five contexts: agreement percentage on coding unit is 91.6%; agreement on the whole coding system is  $K = .82$ ;  $K$  value for each category (Table 1) and for the whole coding system in each context (Tables 2) is more than .75. According to Bakeman and Gottman (1997),  $K > .75$  represents a good inter-rater agreement, indicating the reliability of the measures.
- 2) A digital manual for hand gesture coding was realised on interactive multi-media CD-Rom, in Italian, and is composed as follows:
  - a) a home page (start page, Figure 2) and a brief theoretical introduction (Figure 3), with hypertext, summarizing salient point of basic principles on which the taxonomy (Figure 4) is based, and with bibliographical references to literature (Figure 11);
  - b) a brief paragraph for each gesture category (as an example, see Figure 5), including both a conceptual and an operative definition, as well as verbal description of movement(s) performed by hand(s) (for examples see Figure 6);
  - c) three examples (“ideal”, “prototypical”, and “problematic”), for each gesture category, in video images taken from *ad hoc* video (“ideal” examples, for example see Figure 7) and from “field” sample (both “prototypical”, i.e., “good”, and “problematic”, i.e., dubious, examples, see Figures 8-9);
  - d) example of gesture category through a sequences of three or four *ad hoc* photos aimed at showing “prototypical” shape and movement of the gesture category (e.g., Figure 6);
  - e) notes about coding and possible problems a coder could find during assignment of a code to each gesture (Figure 10).

| Gesture           | K    |
|-------------------|------|
| Cohesive          | 0.76 |
| Rhythmic          | 0.75 |
| Emblems           | 0.80 |
| Iconics           | 0.94 |
| Metaphorics       | 0.75 |
| Deictics          | 0.78 |
| Objector-Adaptors | 0.92 |
| Self-Adaptors     | 0.94 |

Table 1.  $K$  indexes on each gesture category of the taxonomy

| Contexts                         | K    |
|----------------------------------|------|
| Political interviews             | 0.88 |
| Courtroom examinations           | 0.86 |
| Group simulations                | 0.78 |
| Dyad simulations                 | 0.85 |
| Suspicious interview simulations | 0.75 |
| Total K                          | 0.82 |

Table 2. Agreement  $K$  indexes on the whole gesture categories system in the different contexts analysed.



Figures 2-11. Some digital pages of the multi-media tool for coding hand gestures.

## 2.4. Discussion

The coding system of hand gesture taken into consideration in this study integrates and synthesises different classifications of the literature (amongst others, Ekman and Friesen, 1969; McNeill, 1985;

Contento, 1999; Bonaiuto et al., 2002), with the aim of individuating a category system useful for coding hand gestures in observational research, and for studying gestures in different social contexts. Inter-observer agreement indexes calculated to measure system reliability are satisfying – in respect to the criterion of Bakeman and Gottman (1997). Therefore, the results about inter-observer agreement – both on gesture presence/absence and on individuation of each gesture category among the others, in each context analysed – demonstrate the reliability of hand gesture taxonomy. This result not only allows the use of this taxonomy as an elective tool for coding and studying hand gesture in different settings, but it also indicates the presence of a differentiated and hierarchically articulated structure of gestures, which are shown in different recurrent forms. It could be possible to formulate the hypothesis that such differentiation in hand gesture can correspond to a functional differentiation of gesture used in speech. The test of such hypothesis represents the main aim of the next study. As far as the present one, the main objective, regarding the test of category system reliability, has been achieved.

The coding manual referring to the verified category system was developed in digital format but in compliance with traditional methodological criteria for coding manual realisation (see, Bakeman and Gottman, 1997): a phenomenon description articulated in conceptual and operative definitions of different gesture categories, with ideal, real, typical and problematic examples of them. The advantage of this is that the digital support in multi-media CD-Rom permits the addition of important information, such as photographic and audio-visual examples, to the text: these are fundamental for completely and appropriately understanding any coding system, as well as for sharing it. Some authors, in fact, maintain that in observational research it is desirable that the scientific community has at its disposal shared tools, permitting the researcher to compare own data and outcomes with that of others (Bakeman and Gnisci, 2005).

### **3. Second study**

The second study is focused on speech-gesture coordination and co-occurrence in different interactive contexts.

#### **3.1. Objective and hypotheses**

The aim of this study is to understand what type of functions (discursive, interactive, rhetorical) are assumed by each gesture category. Such aim is achieved through the analysis of significant associations between gesture categories and different linguistic-discursive aspects of oral communication. According to the literature, on the basis of qualitative or single case analysis (Atkinson, 1984; Beattie, Shovelton, 2000; Bull, 1986; Contento, 1998; Ekman and Friesen, 1969; McNeill and Levy, 1993), the following significant association are expected:

- 1) Association between gestures and discursive markers:
  - a. cohesive gestures – demarcation markers;
  - b. rhythmic gestures – focalisation markers;
  - c. ideational gestures (iconics, metaphors, deictics, emblems) – not marked speech
  - d. adaptor gestures – interaction and social cohesion markers and pauses.
- 2) Association between gestures and rhetorical devices:
  - a. ideational gestures – rhetorical devices;
  - b. rhythmic gestures – rhetorical devices.

#### **3.2. Method**

##### **3.2.1. Samples from different contexts**

Subjects and contexts are the same as those in the previous study (measure of reliability) where 20 minutes of video-recording were selected, with the exception of group discussion, which we have considered as a context similar to dyadic discussion. Total length of each context is about 100 minutes, for a total of about 400 minutes (426 min. observed and analysed).

### 3.2.2. Procedure and coding

Coding work has regarded, in addition to hand gesture according to the above described coding system, the main discursive markers according to the literature (e.g., Fraser, 1999): metatextual functions (discourse demarcation, focalisation, and reformulation); social cohesion markers (relationship modulators and markers of shared knowledge); interaction managing functions (turn-taking, interruptions, back-channelling, conversation management); and rhetorical devices (see, amongst others, Atkinson, 1984; Edwards and Potter, 1992) – with reference to the list, extreme case formulation, contrast, denial, metaphor, humour, proverbial expression, and use of pronouns in the first person plural.

### 3.2.3. Data analysis

With the aim of individuating significant correspondences between gesture categories and verbal variables (as indicated above), analyses of chi-square and standard or adjusted residual were carried out.

### 3.3. Results

Chi-square and residual analyses show that there are significant associations between gesture categories and discursive markers ( $X^2(18) = 3144.1$ ;  $p < .001$ ;  $N = 20797$ ) and between gesture category and rhetorical devices ( $X^2(3) = 89.5$ ;  $p < .001$ ;  $N = 17162$ ). Specific significant association (as showed in Tables 3 and 4) are as follows:

- cohesive gestures are significantly associated with demarcation markers ( $z = 12.77$ ;  $p < .001$ ), that is markers having functions of structuring and cohesion of speech text, and with reformulation ( $z = 7.98$ ;  $p < .001$ );
- rhythmic gestures are significantly associated with focalisation markers ( $z = 8.52$ ;  $p < .001$ ), that is, markers of discourse focal point emphasis, with demarcation markers ( $z = 4.18$ ;  $p < .001$ ), and with non-marked speech ( $z = 5.63$ ;  $p < .001$ );
- ideational gestures are significantly associated with presence of rhetorical devices in speech ( $z = 7.71$ ;  $p < .001$ ) and with non-marked speech ( $z = 23.67$ ;  $p < .001$ );
- adaptor gestures are significantly associated with interaction markers ( $z = 23.02$ ;  $p < .001$ ), social cohesion markers ( $z = 7.27$ ;  $p < .001$ ), and pauses ( $z = 44.03$ ;  $p < .001$ ).

| Markers         |   | interaction    | social cohesion | focalisation  | reformulation | demarcation    | speech         | pauses         |
|-----------------|---|----------------|-----------------|---------------|---------------|----------------|----------------|----------------|
| <b>Gestures</b> |   |                |                 |               |               |                |                |                |
| Cohesive        | f | 167            | 229             | 221           | 148           | 532            | 2147           | 70             |
|                 | z | -1.67          | 1.81            | 1.07          | <b>7.98**</b> | <b>12.77**</b> | -7.74          | -7.75          |
| Rhythmic        | f | 94             | 159             | 340           | 92            | 431            | 2721           | 19             |
|                 | z | -8.85          | -5.09           | <b>8.52**</b> | 0.16          | <b>4.18**</b>  | <b>5.63**</b>  | -13.2          |
| Ideational      | f | 311            | 475             | 497           | 131           | 697            | 6844           | 109            |
|                 | z | -10.70         | -3.35           | -2.24         | -7.58         | -7.45          | <b>23.67**</b> | -19.95         |
| Adaptor         | f | 536            | 356             | 169           | 118           | 296            | 2161           | 727            |
|                 | z | <b>23.02**</b> | <b>7.27**</b>   | -6.39         | 1.73          | -6.67          | -27.08         | <b>44.03**</b> |

$X^2(18) = 3144.1$ ; \*  $p < .05$ ; \*\*  $p < .001$   $N = 20797$

Table 3. Gesture-marker association in all four observed contexts: frequency, (f), standard residual (z), and  $X^2$  (significant values in bold).

| Gestures<br>Rhetoric |   | cohesive | rhythmic | ideational    | Adaptor |
|----------------------|---|----------|----------|---------------|---------|
| present              | f | 376      | 404      | 1257          | 318     |
|                      | z | 1.14     | -2.91    | <b>7.71**</b> | -7.84   |
| absent               | f | 2230     | 2918     | 6641          | 3018    |
|                      | z | -1.14    | 2.91     | -7.71         | 7.84    |

$\chi^2(3)=89.5, p<.001$  N=17162

Table 4. Gesture-rhetorical device association in all observed contexts: frequency (f), adjusted residual (z) and  $\chi^2$  (significant values in bold).

### 3.4. Discussion

As far as the first objective of this study, on significant co-occurrence between hand gestures and discursive markers for the individuation of discursive functions of gesture categories, the results confirm the research hypotheses. In general, in fact, cohesive gestures are associated with markers having demarcation and reformulation functions; rhythmic gestures with meta-textual markers of focalisation; adaptor gestures with markers of social cohesion, of conversational turn management, and to pauses; ideational gestures with non-marked speech (that is, absence of discursive markers). Significant association between cohesive gestures and metatextual markers (see Extract 1: in italics transcript translated into English from Italian) demonstrates, for the first time through statistical testing, that such gestures have an intra-discursive function of verbal text cohesion: i.e., demarcation and reformulation that marks passages from one part of a discourse to another, referring to already cited topics, elaborating and reformulating discourse, etc. As known, such function of cohesive gestures was already assumed and described previously by other authors (see amongst others, Contento, 1999; McNeill, 1985, 1992; McNeill and Levy, 1993), but only on the basis of qualitative observations of single-case based conversational evidence.

The strong association of rhythmic gestures with focalisation markers (see, Extract 2) also permits to confirm, on a wider statistical basis, the function already attributed by the literature to rhythmic gestures on the basis of the association between such gestures – beats and vocal peaks – (McClave, 1994), or of mere qualitative observations (McNeill, 1985, 1992); that is, such gestures provide discourse with rhythm for emphasising focal and salient points.

Extract 1: TV Political interview of S. Berlusconi, 03/05/2001, lines 193-196 (co: cohesive; mt: metaphoric; demarcation markers and co-occurring gestures are in bold)

193 [.h e quindi quando io] [volevo fa:re: (.) in:] eh:  
     *[.h and therefore when I] [wanted to ma:ke: (.) in:] eh:*  
 194 [ co ] [ mt ]  
 195 prateri:e [desolate,] [addirittura]  
     *meado:ws [desolate,] [even*  
 196 [ co ] [ co ]

Extract 2: TV Political interview of F. Rutelli, 04/05/2001, lines 404-407 (mt: metaphoric, r: rhythmic; focalization markers and co-occurring gestures are in bold)

404 [non è giusto.] [ecco **perché**: bisogna] [separa:re.]  
     *[it is not right.] [here because: it is necessary] [to sepa:rate.]*  
 405 [ mt ] [ r ] [ mt ]  
 406 [MA NON per andare **contro**,] gli uni o gli=altri.  
     *[ BUT NOT for going **against**,] the ones or the=others.*  
 407 [ mt ]

Adaptor gestures are significantly associated to discursive markers of interaction, with function of conversational management and social cohesion, as well as to absence of speech (pauses). The last

association (see, Extract 3) confirms the non-discursive role traditionally attributed to adaptor gestures. Such evidence allows interpreting pause moments between conversants, or intra-turns, as moments of conversational “embarrassment” (see, Sacks, Schegloff and Jefferson, 1974), according to the classical notion that considers adaptor gestures as produced during states of psychological distress (Ekman and Friesen, 1969). Intra-turn pauses have also been considered as moments of cognitive elaboration of lexical construction of verbal text (Goldman-Eisler, 1954), or as signals of discourse emphasis (Sacks et al., 1974; Tannen, 1985). In the first case their classical intra-personal function would be confirmed, because they would “alleviate” the tension due to such cognitive effort; in the second case, an indirectly discursive function of adaptor gesture should be assumed instead, given their co-occurrence with intra-turn pauses, aimed at giving more emphasis to speech. The other two associations of adaptors with interaction marker (conversation management) and with social cohesion markers (see Extracts 3 and 4) can be considered as evidence of possible discursive functions of such gestures. Such result should indicate that the moments of social relationship and conversation management are probably accompanied by particular emotional states (anxiety, tension, embarrassment), if we assume that, according to the literature, adaptor gestures typically have such a function (Ekman and Friesen, 1969).

Extract 3: TV Political interview of S. Berlusconi, 03/05/2001, lines 137-140 (oa: object-adaptor; d: deictic; r: rhythmic; c: cohesive; in bold turn-taking markers, pause, and co-occurring gestures)

137 [beh io] [ho avuto] m:odo di leggerlo: [(.)] [una  
[well I] [had] the opportunity to read i:t [(.)] [a  
138 [ oa ] [ d ] [ oa] [ d  
139 notte,] [eh- ho fatto] [molte osservazioni:..]  
night,] [an- I made ] [ many observations:.. ]  
140 ] [ r ] [ c ]

Extract 4: TV Political interview of S. Berlusconi, 03/05/2001, lines 209-212 (oa: object-adaptor; d: deictic; in bold social cohesion marker and co-occurring gesture)

209 [e tante altre cose.] [.h quando sono entrato] [nel  
[and many other things.] [.h when I entered ] [in the  
210 [ d ] [ d ] [ oa  
211 mondo dello sport,] [lei] [lo deve ben ricordare:,  
world of sport, ] [you] [have certainly to remembe:r it,  
212 ] [ d ] [ oa

The significant association between ideational gestures and non-marked speech confirms the main function of such gestures, which consists of the illustration of an utterance’s verbal content (see, Ekman and Friesen, 1969; Kendon, 1983, 1995). Therefore, ideational gestures should have the same function as verbal communication verbs (description of states or actions), nouns (objects, persons, concepts, places, descriptions), and some temporal or place adverbs (e.g., yesterday, than, here, above, etc.) have, which illustrate space-temporal position. Such illustrations can be visually depicted through shapes and movements of the hand(s): that is via gestures. As far as ideational gestures, moreover, a significant association with rhetorical devices was assumed, since they are a particularly efficient expressive form to set up verbal content. Such hypothesis was confirmed by the results, which point out significant association between ideational gestures (particularly for metaphors and deictics) and content presentation through rhetorical devices (see, Extract 5, showing in bold two examples of metaphor-metaphoric gestures association; Extract 6, showing in bold an example of association between extreme case formulation and metaphoric gestures; Extract 7, showing in bold association between the use of a first plural person pronoun and deictic gestures)

Extract 5: TV Politica interview of F. Rutelli, 10/05/2001, lines 143-407 (mt: metaphoric; d: deictic)

143 interno [molto più grosse,] vedete, [Cossiga che già  
internal [very larger, ] see, [Cossiga who already

144 [ d ] [ ]  
 145 sbatte la porta,] [la Lega] che non si capisce (.)  
*bangs the door, ] [the Lega] which you don't understand (.)*  
 146 mt ] [ d ]  
 147 [se rema a favore] [o se remi co:ntro:,]  
*[ if it rows pro ] [or if rows a:gai;nst, ]*  
 148 [ mt ] [ mt ]

Extract 6: TV Political interview of S. Berlusconi, 11/05/2001, lines 42-45 (**mt: metaphoric; r: rhythmic**)

42 ma [la sinistra,] [ha messo in piedi,] [la campa:gna]  
*but [the left, ] [set up, ] [the campa:ign]*  
 43 [ r ] [ mt ] [ r ]  
 44 elettora:le, [peggiore,] che si sia mai vista.  
*electora:l, [worst, ] you have never seen*  
 45 [ mt ]

Extract 7: TV Political interview to F. Rutelli, 04/05/2001, lines 286-289 (**d: deictic; co: cohesive**)

286 [siamo lì.] (...) [le elezio:ni] [le vinceremo] [noi]  
*[we are there] (...) [electio:ns ] [we'll win them] [we*  
 287 [ d ] [ d ] [ d ] [ ]  
 288 dell'Ulivo,] [<nell'interesse,>] [dell'italia.]  
*of the Ulivo, ] [<in the interest,> ] [of Italy. ]*  
 289 d ] [ d ] [ ch ]

Such results seem to give, therefore, precious indications as to the functions of different shapes assumed by hand gestures in concurring speech, adding statistical support, contrary to previous specific literature. On the other hand, it is necessary to remember that this is a correlational study. Far from being definitive, these results supply a starting point and directions to research routes which should be undertaken for further testing of hand gesture functions in interpersonal communication.

This study, moreover, represents one of the very rare attempts to quantitatively explain the relationship between verbal and gestural parameters, in order to highlight their functions, by analysing a large conversational data set (a total of over 400 minutes of interaction observed and codified) taken from different social contexts.

## 4. Conclusion

The results of the two studies confirm the research hypothesis and supply a set of empirical and statistical results about the importance of hand gestures in social interaction. In conclusion, the coding system turns out to be reliable across different interaction contexts. The basic concept of reliability related to a coding system is the inter-observer agreement: if two observers observing the same materials agree, then the category system is reliable (Bakeman and Gnisci, 2005). And although some authors do not agree on such an approach, arguing that possible sources of error in observational studies can also be of other natures (Pedhazur, Pedhazur and Schmelkin, 1991), all authors at least agree that agreement is the *sine qua non* condition of the reliability (Bakeman and Gottman, 1997). Since inter-observer agreement indexes are not necessarily reliability indexes, it is desirable that future studies estimate through a standard protocol the reliability of the gesture coding system studied here (see Bakeman and Gottman, 1997), and added to the digital coding manual. An important value of this study is the verification of the category system usability and reliability in five different social contexts, unlike previous specific studies that deal almost exclusively with one context at a time (e.g., Beattie and Shovelton, 2000; 2002; Bavelas et al., 1995; Contento and Stame, 1997; Feyereisen and Havard, 1999). The high score of agreement indexes calculated in all

contexts confirms not only the system reliability, but also its effectiveness as an instrument for the observation and study of gestures in different fields of social interaction. This aspect provides the outcomes with a sort of generalization, which has to be submitted to a full inspection through an analysis of generalizability (Cronbach, Gleser, Nanda and Rajaratnam, 1972), which is presently a development project for this coding system. Through such a generalizability test it will be possible to estimate if, and how much, this category system discriminates between subjects or between contexts (between variability), and between gesture categories, rather than between observers (within variability).

The digital support in multi-media CD-Rom adds important information (in the form of videos and photos) to the manual's written text, which is fundamental for a better understanding and sharing of the gesture coding system.

A planned improvement to develop the digital manual is an exercise section for the user, aimed at training him/her to use the taxonomy and, therefore, to calculate the reliability of his/her measure with reference to a coding standard protocol. In this way it will be possible to compare the reliability of observers trained through digital manual support with the reliability of observers trained through a traditional method (only textual manual and confrontation with researchers). On the whole, the first study analyses in depth methodological aspects of systematic observation of hand gestures, and of reliability measure of observational research, with the value of having studied the same phenomenon across different contexts.

As far as the second study, in general, the significant associations offer specific indications on possible functions of gesture in speech: discourse, structure and cohesion, for cohesive gestures; focal point emphasis for rhythmic gestures; content illustration in different rhetorical forms for ideational gestures; emotional state channelling and/or management of discursive interaction and social relationship for adaptor gestures. On the basis of speech-gesture co-occurrence, a prevalent function can be attributed to each gesture category. Such gesture-function association had already been affirmed in the literature, but it has been illustrated only qualitatively or only for a single gesture category at a time (Bavelas, Chovil, Lawrie and Wade, 1992; Beattie and Shovelton, 2000; Bull, 2001; Contento, 1999; Kendon, 1985; McNeill, 1992, 2000). The results on gesture-rhetorical devices co-occurrence, moreover, enrich previous literature (Atkinson, 1984; Bull, 1986; Heritage and Greatbatch, 1986), which was based on few talks or oratory contexts and referred only to few rhetorical devices and only to some gesture categories, often described in an unclear manner (e.g., "synchronized", "bilateral", "non-contact gestures" (Bull, 2002, p.111)), without reference to an exhaustive classification. On the contrary, this study analysed different contexts and numerous rhetorical devices taken from the literature, using an exhaustive hand gesture classification, and various verbal aspects and their associations: in this way it allows to bestow more validity and generalizability to the knowledge about hand gesture functions in speech and in interaction.

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