

Naming in Two Modalities: Manual and Mouth Gestures in Hearing and Deaf Children

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Abstract

Studies on various sign languages have pointed out that some kind of mouth action co-occur in sign language utterances together with other body components. Although the consistency of such phenomenon has been studied in adult signing, no research has been conducted so far on the mouth actions occurring in the signing of school-aged children. In this paper, mouth actions will be described in a developmental perspective and paralleled with co-speech gestures of hearing children. In particular, mouth actions and manual gestures will be investigated in two groups of 10 bilingual Italian/Italian Sign Language (LIS) deaf and hearing children (from 6 to 14 yrs old) by using a naming task. The aim is to parallel quantitatively and qualitatively mouth actions and co-verbal gestures in order to understand their role with respect to sign and vocal naming. Furthermore, three adult signers were

considered as models for understanding the typology and occurrence of mouth action in adult signing and compare it with children signing.

Keywords: Bilingualism, Sign language, Italian, Deafness, Mouthing, Mouth gestures, Gestures

1. Introduction

Several studies have explored the role and function of gesture in the acquisition and development of spoken language (Bates, Camaioni, Volterra, 1975; Volterra et al., 2005; Goldin-Meadow, 2003; Weisberg et al, 2020; Caselli & Pyers, 2020; Kayabaşı & Gökğöz, 2022). The available data suggest that the role of gesture in spoken language acquisition and development changes according to different stages and communicative/interactional contexts. As for gestures accompanying spoken naming, a study (Stefanini et al. 2009; Novogrodsky & Meir 2020; ByJenny, 2021) has found that children between 2 and 7 years of age produce gestures when asked to label pictures representing objects or actions. In particular, two types of gestures were frequently produced in the context of naming: deictic and representational gestures. Both types of gestures play a crucial role in communicative interaction as well as in the construction and expression of meaning in the first two year of life (Volterra, Erting, 1990; Butcher, Goldin Meadow, 2000; Iverson, Goldin-Meadow, 2005; Volterra, Caselli, Capirci, Pizzuto, 2005; Krebs, 2020). Among deictic gestures (REQUESTING, SHOWING, GIVING and POINTING) POINTING plays a special role in the first crossmodal combination (gesture + vocalization/word). These co-speech gestures decrease with the increase in age and in spoken naming abilities even if they never disappear. In fact, at later stages, metaphoric, abstract, deictic gestures and beats appear frequently in the narrative production of school aged children (Colletta, 2004; Kita, Ozyurek, 2003) or in problem solving contexts (Alibali & Goldin-Meadow, 1993; Pine, Lufkin, Messer, 2007) and are very rarely found in the context of naming.

In adult communication, gestures interact with speech in order to allow a clear understanding of the utterance (Kendon, 1981, 1988, 1997, 2004; McNeill, 1992, 2000, 2005; Kita, 2000). Gestures and speech are closely timed with one another: they are highly synchronous and display a reciprocal relationship because each of them contributes to the utterance's meaning. According to McNeill (1992, 2005) gestures have a function in the process of *thinking for speaking* and constitute a single unit with speech in that they convey another dimension of meaning. Gestures play a crucial role at the linguistic and at the cognitive levels. They help speakers by modelling thought to be packaged into linguistic expression and benefit listeners by providing them with visual cues of the vocal message (Alibali, Kita, 2010). In other words, gesture and speech constitute two different material carriers of thought. They are “co-expressive but not redundant [because they] express the same underlying idea unit but express it in their own ways- their own aspects of it, and when they express overlapping aspects do so in distinctive ways” (McNeill, 2005:22).

Sign language, spoken language and gestures are linked by common perceptive, motor and cognitive systems. The view of adult language as a gesture-speech and gesture-sign integrated system has prompted the need to understand how this relationship is established in

infancy and how it evolves towards the adult system (Capirci, Volterra, 2008; Volterra, Iverson, Castrataro, 2006).

If signed and spoken languages “represent coordinate functionally equivalent modes of communication” (cf. Stokoe and Marschark, 1999:164), gesture should serve the same linguistic and cognitive functions in both languages. In a multimodal perspective, Kusters et al. (2017) have introduced the notion of semiotic repertoires. Gestures represent not only communicative resources but also material carriers of thinking as they “adds substance to the speaker’s cognitive being” (McNeill & Duncan, 2000:141). Hence, gestures in sign language should function in the same way as in spoken language although they could exploit a different modality.

In sign language there should be a gestural level functionally similar to co-verbal gestures which could be oral or in other words which uses the mouth in a gestural way in co-occurrence with signing (Fontana, 2008, 2009a; Pizzuto, 2003; Sandler, 2009; Perniss, Vinson, Vigliocco, 2020). Indeed, various research has explored the form and function of oral components (Note 1) in adults’ signing. Mouth actions are all the mouth movements that co-occur with the manual signs with a particular function and that are traditionally grouped into two categories. *Mouth gestures* consist of a series of mouth configurations or sounds that might be onomatopoeic because they evoke acoustic or visual aspects associated to certain referents (such as ‘woof, woof’ for a barking dog, puffed cheek to refer to a fat man); they can be metaphorical when they convey a more abstract meaning by recurring to concrete images such as air emission in co-occurrence with the sign RELIEVE. *Mouthings* refer to components which are easily identifiable as spoken language lexemes and consist of movements made with the mouth as if a word or a part of a word is being pronounced (e.g. in Italian Sign Language [hereafter LIS] with or without voice, the complete or incomplete articulation of the Italian word “casa” (house) co-occurring with the manual sign HOUSE) (Fontana and Fabbretti, 2000; Volterra et al., 2022). Mouthings can be considered a communicative option whose source is the spoken language used by the hearing majority, that result from the systematic linguistic contact situation experimented by the deaf community (Johnston, van Roekel & Schembri 2016; Giustolisi, Mereghetti & Cecchetto 2017).

On one hand, mouthings are connected to the spoken language conventional system but such link becomes evident only if we look at the manual level because signers pronounce only the more phonetically relevant part of the word mirroring the rhythm of the sign; on the other, mouth gestures can be said to be grounded on a substrate of perceptuo-motor experience, but how this can be considered conventional requires further enquiries (Fontana, 2008).

The two kinds of mouth actions convey different kind of information with respect to signs. They interface signing with another dimension of meaning related to some inherent aspect of the object/referent. Their function in signing is constrained by the neural motor-perceptual structure which links the oral articulation to the sign execution time (Woll, 2001).

Research based on different kinds of data and on different sign languages (Boyes-Braem, Sutton-Spence, 2001; Bisnath, 2022), has shown that mouthings occur more frequently than mouth gestures and both of them co-occur with the manual sign. Nevertheless, whereas

mouth gestures are typically considered a part of sign language, mouthings are viewed as a sociolinguistic phenomenon due to the oral education of most deaf children (Hohenberger and Happ, 2001) and to the situation of bilingualism of most deaf adults (Boyes Braem, 2001; Bogliotti and Isel, 2021) to the interplay of the modalities of signed, spoken and written languages (Bauer, Kyuseva, 2022). Although mouthings has been considered as remnants of an oralist education (Hohenberger and Happ, 2001), not only are they very persistent in signing, but they also seem to be considered part of the language by native signers (Fontana, 2015; Bisnath, 2022) that consider ‘unnatural’ signing without mouthings. In a study comparing two different age groups who had a different education and access to sign language, Van De Sande and Crasborn (2009) have pointed out that there is no difference between late and early signers of NGT (Sign language of the Netherlands). In addition, Lin (2019) has shown that mouthings are necessary to identify the exact meaning of interrogatives in Zhōngguó Shǒuyǔ (pinyin)/中国手语 (simplified Chinese)/中國手語 (traditional Chinese) (CSL, Chinese Sign Language). Finally, deaf signers who had no access to oral education and no contact with the local deaf community tended to use mouthings linked to the local dialect (Torigoe and Takei, 2002; Fontana, 2009b)

Crasborn et al. (2008) have proposed a typology of mouth actions according to three properties: (1) the independent or dependent meaning carried by the mouth; (2) whether the mouth action is or is not lexically associated with the manual sign; and (3) whether the mouth component is or is not borrowed from the spoken language. Furthermore, by comparing the frequency of mouth actions in three typologically different sign languages (Dutch Sign Language, British Sign Language – BSL and Swedish Sign Language), Crasborn et al. (2008) have observed a similar tendency across all three sign languages: 50% to 80% of manual signs were produced with mouth actions. Mouthing was the most frequently occurring type of mouth action and appear to be a useful clue to the lexical specification of a sign. Balvet and Sallandre (2014) highlighted that mouth gestures and mouthings seem to play a different role in narration. Whereas mouthings marks not only the realization of a lexical unit and the change of topic or the introduction of new participants in narratives, mouth gestures can be considered as modifiers as, together with facial expression, they convey information on how fine, broad, big, small etc. the depicted object is, according to the signer.

According to Vinson et al., (2010) manual and mouthings components do not constitute a single lexico-semantic representation. In an experimental study based on picture naming task semantic errors did not always co-occur in the two channels. These findings support the hypothesis that mouthing cannot be considered as part of the sign language system. Bogliotti and Isel (2021) argued that mouthing is a crucial factor in lexical access.

Anyway, a complex role and a remarkable variation have been associated to the use of mouthings (Fontana e Fabbretti, 2000; Ajello et al., 2001; Boyes Braem, 2001; Rainà, 2001; Sutton Spence, Day, 2001; Vogt-Svendsen, 2001; Woll, 2001; Van De Sande, Crasborn, 2009; Mohr, 2014; Roccaforte, 2017).

In the light of such research, we maintain that a developmental perspective can further

enlighten the nature of mouth actions at various levels:

- It can reveal the relationships between mouthings and spoken language as deaf children are in the process of learning spoken language.
- It can allow us to understand whether the role played by mouth gestures can be comparable to adults signing and reveal a developmental stage as far as mouth gestures are concerned.
- It can either confirm or disconfirm the hypothesis that the mouth actions function as gesture in sign language (Fontana 2008, 2009).

Although various studies have investigated the relationship between co-verbal gesture-speech in children, no research has been conducted so far on the mouth actions occurring in the signing of preschool or school-aged children. Our hypothesis is that mouth actions can be paralleled to manual gestures in their interactions with signing and that they may be part of the motor vocabulary like manual gestures, although they convey information at a different level.

2. Gesture in Two Modalities

Research on narration (Fontana 2000; Fontana 2009; Fontana 2015) has shown that the role played by mouth actions can be paralleled to gesture in the way they function in relationships with signing. Native signers used systematically the same mouth gestures to reproduce the noise of a gun ('pa-pa-pa'), a crowd fleeing down the stairs (air emission), or metaphorically the reduction of a state of anxiety as air emission with the sign RELIEVED. In these cases, such mouth gestures seem to be rooted in perceptual experience like, for example, the metaphorical extension of the evocative potentialities of the activity of breathing, as suggested by Gianfreda (2011). They are rooted in perceptual experience and they can be considered as gestalts resulting from the sensorimotor organization. Gestaltic wholes constitute the internal nature of the image schema proposed by Johnson (1987), as a dynamic pattern connected to a wide series of different experiences sharing similar structures and resulting in an abstract structure of an image. In other words, such gestalts have meanings which derives from perceptual categorization. Interestingly, mouth gestures provide phonosymbolic cues to the items. In other words, they are iconic phonosymbolic resources that are associated to signs by deaf users.

The form of mouthings seem to be linked to the context and to discourse demands and play a very important role in signing both on the syntagmatic and on the paradigmatic level. On the paradigmatic axis, mouthings function as specifier for classifier constructions, manual homonyms, neologisms and regionalisms, exploiting the resources of a more standardized language. On the syntagmatic level, they function as a cohesion mechanism through redundancy to maintain reference and continuity by specifying the key referents in the message (Fontana and Fabbretti, 2000). Although their origin can be traced back to oral education and the linguistic contact situation of the deaf community, their function in signing is constrained by the neural motor-perceptual structure which link the oral articulation to the sign execution. Analysis of data collected in different communicative situations (Note 2) confirms that what is sensitive to sociolinguistic variables is not the rate but the form and structure of mouthings. Indeed, old homesigners used some Sicilian mouthings in conjunction with manual signs (more

frequently lexical units) which appeared to be crucial in their communication with hearing people. They used also mouth gestures similar to those found in LIS signers such as ‘pa-pa-pa’ co-occurring with the signs GUN or SHOOTING (Fontana, 2009b).

This means that mouthings integrates signing dynamically and may share the same prosodic function of the co-speech gesture named ‘beats’ (McNeill, 1992). Gestures appear to be shaped in relation to the nature of language: if speech is the dominant modality, the gesture occurs as a bodily action; conversely, when gestures shift to sign language, the vocal modality shifts in function and becomes gestural. In other words, the two modalities speech-gesture/sign language-mouth actions interplay in parallel ways according to which modality takes on the traits of a linguistic system. Hence, in conjunction with sign language we have mouth gesture or mouthings, whereas a more articulated mouthing co-occurs with contact signing, a variety strongly interfered by spoken language described in the interaction between deaf and hearing people (Lucas and Valli, 1989; Volterra et al., 2022). Mouth actions in sign language, like co-verbal gestures (except for emblems, which are conventional gestural units, McNeill 2005), are not independent units nor do they appear to have a stable meaning without their corresponding manual level. The recognizable link to spoken language in mouthings is perceivable only in conjunction with the manual level. Mouth actions are perceived as meaningful only in synchrony with signing. It seems that the relationship between mouth actions and sign language and between manual gestures and speech can support one of the basic laws of gesture:

(...) we see one of the basic facts of gesture life: the gesticulations with which speech is obligatorily present, are the least language like; the signs, from which speech is obligatorily absent, have linguistic properties of their own. This is not so paradoxical as it may seem. It reveals that ‘gesture’ has the potential to take on the traits of a linguistic system, but as it does so it ceases to be a component of the spoken language system. (McNeill, 2005:9)

Mouth action seem to integrate signing in similar ways to what gestures do with speech and in particular: 1. mouth gestures have a certain degree of conventionalization that should be investigated; 2. mouthings are not dependent on external sociolinguistic variables but are part of sign language; 3. external variables seem to affect the form rather than the quantity of mouth actions; 4. mouth actions always convey non-redundant information in relation to the sign level.

The form and function of mouth action in children's signed production compared to the form and function of hearing children production of *manual co-speech gestures*, may reveal new insights not only on the parallel between the two kinds of gestures, but also on the way mouth action integrates speech in a developmental perspective.

3. Method

3.1 Participants

3.1.1 Deaf Children

The data we analysed are a sample of a wider corpus used in the studies of Author (2005) and

Author *et al.* (2010). For the present study we have selected 10 deaf children and adolescents (6 females and 4 males) out of 30, with an age ranging from 6 years 1 month to 13 years 9 months, (mean age 10 DS 2,5). Some of them have deaf parents and were exposed to and use LIS at home, other learned LIS in preschool contexts (see table below).

All deaf children were mainstreamed, from primary to secondary school and were enrolled in a bilingual program Italian/LIS (For more details see Author 2010).

We have chosen our sample according to the following criteria:

- 1) severe or profound bilateral deafness;
- 2) lack of other deficits;
- 3) daily use of LIS;
- 4) absence of cognitive impairments: abilities were taken from health record and were measured via non verbal Visual Motor Integration test (VMI) and were in the normal range.

All relevant information about deaf participants are reported in Table 1. In particular: gender (F =female; M= male), chronological age, degree of deafness (severe or profound), parent hearing status (D= at least one deaf parent; H= both hearing parents), the first environments where children were exposed to LIS (family from 0 to 3 years, pre-school from 3 to 5 years, the use of LIS in the family (Y= yes; N= absent).

Table 1. Information about deaf participants

	Gender	Age (years, months)	Degree of deafness	Parent hearing status	First exposure to LIS	Use of LIS at home
1	F	6,1	Severe	D	Family	Y
2	M	7,5	Severe	H	preschool	N
3	M	8	Severe	H	preschool	Y
4	F	9,4	Severe	D	Family	Y
5	M	9,7	Severe	D	preschool	N
6	M	9,11	Severe	H	preschool	Y
7	F	11,2	Severe	H	preschool	Y
8	F	11,9	Severe	H	preschool	N
9	F	13,3	Profound	H	preschool	Y
10	F	13,9	Severe	H	preschool	N

Just one of the children was profoundly deaf. All the children made regular use of hearing aids, except for one who partially used them. None of them had a cochlear implant. All children were enrolled in a speech intervention program based on spoken Italian supported by Signed Italian (bimodal communication).

Seven children had hearing parents and three children had deaf parents. Six families used Italian Sign Language (4 cases up to 6); whereas one child (number 5) had deaf parents but they did not use Italian Sign Language at home since he was born. The socio-cultural level of

all families was medium-low. Only two children out of ten were exposed to LIS since birth in the family (native signers), whereas eight children were exposed to LIS since preschool years (early signers).

3.1.2 Hearing Participants

Hearing participants were recruited for the present study in order to be comparable to the deaf group by age (mean age 10,2; DS 2,4), since the hearing sample of Author (2010) was not video-recorded. Hearing children were recruited at school to match the socio-economic background of deaf children. All came from monolingual Italian-speaking households.

Non verbal intelligence was assessed also for hearing participants through the Visual Motor Integration test (VMI) and resulted in the typical range. In Table 2, the characteristics of the hearing sample are reported.

Table 2. Information about the hearing participants

	Gender	Age (years, months)
1	M	6,6
2	F	7,9
3	M	8,3
4	F	9,3
5	F	9,7
6	F	9,9
7	M	11,5
8	F	11,8
9	F	13,2
10	M	13,9

Materials: BOSTON NAMING TEST – BNT.

The Boston Naming Test – BNT – (Kaplan, Goodglass, Weintraub, 1983) is a lexical production task which consists of 60 line drawings representing nouns, objects and animals. This test has been adapted to other spoken languages, such as Italian and it has also been widely used with Italian children with typical and atypical development (Bello et al. 2004; Riva et al. 2000).

In order to ascertain if all BNT items could be labelled in LIS, we asked a deaf native signer to undertake the test and his performance was video recorded. Another deaf native signer, lecturer of LIS, undertook the test in order to provide another sample of mouth actions co-occurring with the signs. A further deaf native signer, bilingual in LIS and Italian, watched the “standardized” signs and wrote the corresponding Italian words. The labels he provided corresponded to those considered correct for the Italian spoken version of the same test. This was a further confirmation that the Italian and the LIS versions of the same naming task corresponded to one another.

Interestingly, in sign language production mouth actions took part to the labelling process and led us to check this aspect first in the deaf children group and then to test hearing children in

order to compare mouth actions and co-verbal gestures. All deaf and hearing children were videotaped while naming each picture following the same order of items presentation.

A naming task has several advantages in a context in which gesture is investigated. First, the investigator has a high degree of control over the target word to be produced. Second, picture naming provides a common set of referents for communication, that are known to the experimenter and the coder. Third, many of the items that in Italian are expressed with a noun, in LIS are expressed as an action (eg: WHISTLE, expressed in LIS with the *action of whistling*). Obviously, the nature of this test allowed us to focus on the role the two kinds of gestures investigated play only at the lexical level.

3.2 Procedure

The test was administered individually to children in a quiet room; responses were video recorded. The task was administered by a deaf native signer experimenter to deaf children, and by an Italian hearing experimenter to hearing children.

The same procedure was used for deaf and hearing children: the only difference was that deaf participants were requested to perform the task in LIS and hearing participants in spoken Italian. In the administration of the BNT a small number of adjustments were made with respect to the standard procedure:

1. number of pictures: we asked the children to name all 60 items (while the standard administration is interrupted after 6 consecutive errors);
2. test duration: we fixed no time limitation (the standard administration provides 20 seconds for each picture);
3. cue: we did not provide semantic or phonological cues. If the child did not recognize the picture, we asked: “What is that?”, “What do you call it?”, or “How do you sign it?” (in the standard administration the examiner gives first a semantic cue and then a phonological cue);
4. training for the task: at the beginning we showed the child three new drawings not included in the BNT test (sun; mouse; fish); the standard administration does not provide these 3 training items.
5. gestures: during the administration the experimenters avoided to produce any kind of gesture (except for few pointing gestures, used to address the attention of the child to the item target) in order not to influence the production of spontaneous gestures.

Informed parental consent was obtained before starting the observation. Following the research, feedback meetings were conducted on the phone with all the parents of the participants.

3.3 Coding

Gestures and mouth actions analysed in the present study, have been codified with a system based on translation or glossing. As far as manual gestures are concerned, all visible actions

produced by hearing children as they interacted with the experimenter were coded as such (Kendon, 2004). These included gestures produced with and without speech, and those occurring both before and after the spoken response.

For the present study, we adopted a classification partially inspired by recent works conducted on young preschool children (Butcher, Goldin-Meadow, 2000; Bello, Capirci, Volterra, 2004; Stefanini, Caselli, Volterra, 2007) and also reported in Stefanini *et al.* (2009). Each gesture was classified into one of the following three categories:

- *Deictic gestures* include gestures referring to contextual information: their referent can be identified only by inspecting the physical context of interaction (McNeill, 1992; Pizzuto, Capobianco, 2005). Since the participants did not produce any *request*, *showing* and *giving* gesture, we could focus only on *pointing gestures*. In the present study all actions of pointing were an extension of the index finger or of multiple fingers extended;

- *Representational gestures* are pictographic representations of the meaning (or meanings) associated with the represented object or event;

- *Other gestures* include manual gestures, such as *beat gestures* (e.g., the hand moving in time with the rhythmic pulsation of speech, or in the air while pronouncing a particular word); and *thinking gestures* (also named as Butterworth gestures, that “are made when a speaker is trying to recall a word or another verbal expression”, Kendon 2004: 101).

Mouth actions have been classified in mouthings and mouth gestures following the categorization explained in the first two paragraphs. The components of *mouthings* consist of movements made with the mouth as if a word or a part of a word is being pronounced. They have been annotated as they occurred using the alphabetic writing and, if necessary, the complete word or explanation have been written next. For example, if the mouthing occurring with the LIS sign CANE (dog) is ‘ca’, the incomplete and complete mouthings have been both annotated. International phonetic alphabet was not chosen as mouthings seem to be based more on gestalt images of labial articulation or written forms of words rather than on the sound of articulated words.

Various configurations of the jaw, lips, cheeks and tongue and some air movement or ‘noises’ is implied in mouth gestures. They have been annotated as alphabetic combinations when possible or described as, for example, in the case of air emission.

4. Results

Deaf children systematically accompanied their productions with mouth actions. Table 3 shows the number of mouthing and mouth gestures out of the total responses produced by deaf signing participants. It is also quite evident that mouthing was more frequently produced than mouth gesture (367 vs 210). As for the similarities and differences between mouth actions produced by deaf signing children and manual gestures produced by hearing speaking children, the number of mouth actions and manual gestures produced together with the items are also reported in Table 3. In particular, for each item of the BNT list, the number of mouthings and mouth gestures produced by deaf signing children and the number of pointing gestures,

representational gestures and other gestures produced by hearing speaking children are reported.

Table 3. Gesture action and gestures of deaf and hearing children at BNT

Items	Deaf		Hearing		
	Mouthings	Mouth gestures	Pointing gestures	Representational gestures	Other gestures
1 Bed	10	0	0	0	0
2 Tree	10	0	0	0	0
3 Pencil	10	0	0	0	0
4 House	9	0	0	0	0
5 Whistle	3	7	0	0	0
6 Scissor	9	1	1	0	0
7 Comb	8	0	1	0	0
8 Flower	10	0	1	0	0
9 Saw	6	5	0	0	0
10 Toothbrush	3	7	1	1	0
11 Helicopter	7	2	0	0	0
12 Broom	8	0	1	1	0
13 Octopus	6	5	0	0	0
14 Mushroom	9	1	0	0	0
15 Hanger	5	2	1	0	0
16 Wheelchair	4	5	2	0	0
17 Camel	8	1	2	0	0
18 Mask	9	1	0	0	1
19 Pretzel	9	2	3	1	1
20 Bench	9	1	1	0	0
21 Racquet	3	7	0	1	0
22 Snail	9	1	0	0	1
23 Volcano	5	6	0	0	1
24 Seahorse	6	0	1	0	1
25 Dart	5	8	0	2	1
26 Canoe	6	4	1	0	3
27 Globe	10	1	0	0	1
28 Wreath	7	4	1	0	3
29 Beaver	6	5	4	0	1
30 Harmonica	0	9	0	2	0
31 Rhinoceros	2	1	1	0	0
32 Acorn	6	3	4	0	5
33 Igloo	4	5	7	0	2
34 Stilts	3	5	9	2	0
35 Dominoes	6	4	1	0	3
36 Cactus	8	3	0	0	2
37 Escalator	4	6	0	1	1

38 Harp	3	4	2	2	0
39 Hammock	6	5	4	2	1
40 Knocker	7	5	11	5	2
41 Pelican	5	6	2	1	0
42 Stethoscope	2	5	3	1	7
43 Pyramid	5	3	2	0	2
44 Muzzle	7	5	2	0	1
45 Unicorn	9	4	2	1	0
46 Funnel	6	5	2	0	0
47 Accordion	1	7	4	4	3
48 Noose	5	2	4	2	1
49 Asparagus	8	1	2	0	3
50 Compass	5	3	5	2	2
51 Latch	6	7	1	3	7
52 Tripod	5	6	7	1	4
53 Scroll	4	3	0	1	9
54 Tongs	6	4	4	2	1
55 Sphinx	8	3	3	0	0
56 Yoke	7	6	5	5	2
57 Trellis	6	4	11	2	5
58 Palette	3	4	3	0	1
59 Protractor	5	2	4	0	2
60 Abacus	6	4	3	1	3
tot	367	210	129	46	83

The incidence of gesture in spoken and in sign language naming performance is quantitatively different. Manual gestures are produced less frequently than mouth actions. All hearing children, except one, produced co-speech gestures. The other 9 remaining hearing children produced at least one representational gesture and 8 of the remaining hearing children produced other gestures.

As shown in Table 3, signed items are produced always with some kind of mouth actions, whereas some spoken item can occur without any kind of manual gesture. Deaf children used less mouth gestures (36% of the total response) than mouthings, which co-occurred with all items except one (63% out of total responses). Hearing children produced mainly pointing gestures (50% out of total responses), other types of gestures (32% out of total responses) and less frequently representational gestures (18% out of total responses) ranging for each item from 0 to a maximum of 5.

To better understand the nature of this quantitative difference, a possible correlation between the presence/absence of gesture and the difficulty of the item was investigated. Hearing children use representational gestures (e.g. for ‘knocker’ and ‘yoke’) or thinking gestures (‘latch’ and ‘scroll’) in order to provide visual cues to the process of naming pictures which are also the most difficult to label in speech.

All deaf signing children produced mouthing and mouth gestures. Mouth gestures regularly

occurred together with some signs: WHISTLE, TOOTHBRUSH, RACQUET, VOLCANO, DART, HARMONICA, ESCALATOR, PELICAN, ACCORDION, LATCH, TRIPOD, YOKE. The majority of mouth gestures in our sample seem to serve iconic and metaphorical functions in co-occurrence with signing in a sort of “echophonology” (Woll, 2001). For example, the child grit his teeth while performing the act of brushing them with the TOOTHBRUSH, or emits air from the lips (visual correlate – without sound – of the act of WHISTLING), or opens and closes the mouth in synchrony with the opening and closure of the hands performing the sign for OCTOPUS. A characteristic emission of air was observed when an object, such as the TRIPOD, is placed in some place in front of the signer. Children adopt specific configurations of the mouth in correlation with the act of showing the shape or the dimension of an object (for example, puffed cheeks while describing the beak of the PELICAN or other big, rounded objects. Mouth gestures provide phonosymbolic cues to the items. They can be said to iconically convey inherent characteristic of the object in a manner which parallel manual gestures. In these cases mouth gestures provide additional information integrating the meaning provided at the manual level of the sign: e.g. KNOCKER – ‘bum, bum’; TOOTHBRUSH with a particular mouth configuration (clenching teeth). Mouth gestures occur also with signs that describe the size and shape of the object such as IGLOO, mirroring the description of the object with some sort of air emission or sound production. Furthermore, mouth gestures are often produced when it comes to music instruments such as HARMONICA (air exhalation), and noisy objects such as VOLCANO (abrupt emission of air).

Mouthing was produced mainly with the items which are considered easiest to be labeled in speech (which are at the beginning of the BNT list) but also with items which tend to be underspecified in LIS, such as GLOBE signed as BALL, ASPARAGUS signed as STICK, UNICORN whose sign is not standardized. Mouthings mirror the meaning of the sign: the child signs HELICOPTER and pronounces the Italian word ‘elicottero’ or some part of it, such as ‘elico-’. In other cases, oral productions convey a different meaning with respect to signs, adding information or disambiguating their semantic content. For example, the child says ‘tipo Natale’ (“as for Christmas”) immediately after producing the sign WREATH, or ‘medico’ (“doctor”) accompanying the sign STETHOSCOPE.

Interestingly, very often mouthings and mouth gesture together co-occur with the sign and convey supplementary information, especially in more complex items. A correlation between the complexity of the item and the nature of mouth actions has also been noted. In particular, the first four items are always accompanied by the corresponding mouthings in Italian, whereas the most complex items may co-occur either with a combination of mouthings and mouth gestures, or with supplementary explanations to clarify the sign. For example, the sign UNICORN is accompanied by the complementary item only in one case out of ten. Some children use the horse-sound mouth gesture ‘iiii’, others mouth the word ‘cavallo’ (“horse”) in co-occurrence with the sign. Another example is the sign for MUZZLE that mostly occurs with the mouthings ‘cane’ (“dog”) or with a combination of this mouthing and the mouth gesture “open mouth”. These kind of combination or supplementary mouthed explanations have been found also in adult sample for most complex items. Furthermore, very often, in some cases children use the same kind of supplementary mouthings as our adult signers. The sign for

TRELLIES co-occur with the mouthings ‘fiori’ (“flowers”) and ‘legno’ (“wood”) both in some children and in adult sample.

Representational gestures like mouth gestures can display several iconic forms which aims at providing more information on the spoken referent: they can either depict an inherent characteristic of the object following BNT visual input. (e.g. TRIPOD: an hearing child moves the hand on the table as for placing the tripod), or act as size and shape specifier (e.g. for the item YOKE, the child moves the hand to the neck and traces the form of the yoke), or finally describe an action (e.g. for the item KNOCKER, the child moves his fist hand as for knocking at the door). Interestingly, most mouth gestures occur with the same item.

5. Discussion and Conclusion

The results of our quantitative and qualitative analysis indicate that mouth actions are a robust feature of children’s signing as they co-occur with the signed item, and convey various information related to the signed level. Although manual gestures are far less in number than mouth actions, they behave in a similar way as mouth actions do. Given the fact that the 10 hearing children were chosen in order to be similar in age with the deaf group, three major reasons can enlighten the difference between the number of manual gestures and of mouth actions:

1. A different behavior related to the complexity of the item: mouth actions and manual gestures seem to function differently with respect to co-speech gestures. As our results showed, mouth actions were produced mainly with the items which are considered easiest to be labeled in speech. Interestingly, the most complex items occur with supplementary mouthed explanations. See for example the sign TRELLIES that co-occur with the combination of two mouthings ‘fiori’ (“flowers”) and ‘legno’ (“wood”). Also mouth gesture and mouthing can be combined. For example, the sign MUZZLE is accompanied by a combination of the mouthing ‘dog’ and the mouth gesture ‘open mouth’. Hence, additional mouth actions are required when complexity increases. In other cases, complex items were described by using representational strategies (Volterra et al., 2022) without being accompanied by any mouth actions. Like mouth actions, manual gestures (representational and thinking gestures) increase if the item is difficult serving as support when the children is not able to easily find a spoken label for the picture. This is probably due to the fact that the use of gesture changes following the development of language, as briefly described in the *Introduction*. Evidence for this hypothesis comes from a study (Stefanini et al 2009) which shows that hearing children (age range: 2;3 -7;6 years) produced pointing and representational gestures, performing a Lexical Spoken Production Test (LPT), but these co-speech gestures decreased with the increase in age and spoken naming accuracy.
2. The lack of standardization of some signs related to the lexical items of the BNT can also explain the minor number of manual gestures compared to mouth actions. For example, the signs for ASPARAGUS, UNICORN or TRELLIES, are not standardized like BED or TREE. Further explanations are required either through the mouth actions or through representational strategies (Volterra et al., 2022).

3. The nature of the task may affect the use of gesture and of mouth actions which tend to occur in an utterance rather than on a single lexical item. In fact, low communicative dynamism can also explain the absence of gesture (McNeill, 2005:103). Recent research on narratives abilities refers a frequent use of different types of gesture in school age children (Capirci, Cristilli, De Angelis & Graziano, 2011). The age range of hearing participants of our study was 6.6-13.9 and it is possible that the BNT was too easy to elicit co-speech gestures in children with this age range.

Among the critical aspects of the present study, the BNT and the artificial setting of data collection should be mentioned. The BNT fails to capture the multimodal strategies used for successful naming both for deaf and for hearing children, that were highlighted by the coding. Furthermore, the notion of increasing complexity should take into account the sociolinguistic status of a minority language, such as sign language.

Nevertheless, we maintain that the naming task, if properly designed, might enlighten the multimodal strategies adopted by the children in lexical processing. Although the artificial setting for data elicitation may have influenced the nature and the number of multimodal phenomena, we argue that such task has allowed us to select our sample and collect homogeneous data that are necessary for our research scope.

In conclusion, from the qualitative point of view, the present study has revealed that the two kinds of gestures do share some properties:

1. They co-occur with signed/spoken items;
2. They convey additional information related to sign/speech.

The two modes of expression seem to interact in similar ways, although there is some degree of variability in the two kinds of gestures. In fact, they provide additional information related to aspects which cannot be spoken or signed or which are underrepresented in one mode of expression. Manual gestures express visual qualities of a referent; mouth actions convey phono-symbolical information related to the sign (mouth gestures) or clarify the lexical value of underspecified or non-standard signs.

In contrast with Vinson et al. (2010) and with Giustolisi et al. (2017), our findings show that the two kinds of gestures do constitute a single lexico-semantic representation with the sign/word and have to be considered as part of language.

We maintain together with other scholars (Fontana e Fabbretti, 2000; Boyes Braem, 2001; Sutton-Spence, 2001; Crasborn et al., 2008; Roccaforte, 2017; Kusters, 2017; Lin, 2019; Bogliotti and Isel, 2021; Bisnath, 2022) that mouth actions cannot play an external role in lexical access as they function always in correlation with the manual sign and they convey information shaped in relation to the manual sign and to the user's need. The principal results of this study seem to support the hypothesis that manual gestures and mouth actions act dialectically with the spoken or signed mode of expression and both carry meaning in two different ways. Hence, this preliminary study shows that manual gesture and mouth actions can be considered gestural correlates.

Two other important insights of this investigation are worth to be mentioned:

1. The role played by mouth actions in children signing is as crucial as in adult signing;
2. The importance of looking at a multimodal product when testing lexical competence because, as our data show, communication is based on a dialectic between language and imagery (McNeill, 2005) and exploits two modalities whose interplay is shaped following the linguistic mode of expression.

Further studies are needed to explore the developmental pathways of mouth actions and better understand the relationship between mouth actions and signs as well as manual gesture and speech in children's spontaneous production in interactional context (eg. discourse and narrative). These investigations can be conducted only through tasks and methods that take into consideration the multimodality of expression starting from the concept of semiotic repertoires as suggested by Kusters (2017) and the sociolinguistic status of the languages tested and the community. The results reported here provide preliminary evidence that gesture and language are tightly coupled both on the cognitive and on the linguistic level, no matter what the language is.

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Notes

Note 1. See Boyes Braem and Sutton-Spence (2001) for a review. In ASL only Liddell (1980) described the mouth movement ‘cs’ within the study of various facial configurations.

Note 2. Data have been collected in different settings which involve different participants. The interaction was between hearing and deaf people, or between deaf people in a informal situation (Fontana, 2009a e 2009b).

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