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TOWARDS THE ALPHABET AND THE LEXICON OF GESTURE, GAZE AND TOUCH

1. How many languages do you speak?

In how many ways can we tell "I love you"? By a sentence, a glance, a flower, a kiss, a good meal... But how, also, can we say: "I hate you", or "a teeny tiny bed", "I am trying to remember" "a wooden square box"...?
Humans use several communication systems: words, facial expression, gesture, posture, touch, all exploiting different modalities; and a relevant task in semiotic research is to describe as many different communication systems as possible: the wider the range of systems we study, the clearer our view of communication
In the last ten years much research has focused on multimodal communication, and multimodality is now a fashionable word. But what is modality in communication, how are different communication systems linked to different modalities, and what are the differences and commonalities among the various systems?
In this paper I define the notions of communicative modality and communicative system; then I argue that several communication systems can be acknowledge the status of "lexicon", and that a relevant goal for semiotic research should be to find out the lexicon and the alphabet of each of these systems. Finally I provide some examples of how this can be done, by presenting some research on the lexicon and alphabet of three communicative systems: the Italian symbolic gestures, and then the systems of touch and gaze.

2. A goal and belief model of communication

According to my view of communication (Castelfranchi & Poggi 1998; Poggi & Pelachaud 2000), which is based on the notions of goal and belief, communication is a process that starts when a Sender *S* has a goal of communicating *b*, a set of beliefs represented in a sensorimotor or in a propositional format, to an Addressee *A*; and to reach this goal *S* delivers a signal *s* (a physical stimulus produced by body movements or morphological traits) which *S* (whether at a level of awareness or not) supposes is linked, in the minds of both *S* and *A*, to the belief *b*, through a set of rules that I call a "communication system" *CS*.
A *signal* is any physical stimulus that in the Sender's mind (and, according to the Sender's assumption, also in the Addressee's mind) is linked to some *meaning*, that is, to the mental representation of some beliefs. Any physical stimulus may be or function as a signal provided that it has some meaning attached to it: a word, a picture, a kiss, a slap, a strike, a resigning letter, a terrorist action... More generally, what can function as a Signal is any perceivable event (say, a movement of a hand, the march of a crowd) and any perceivable object (say, a monument, a uniform) or any part or feature of an object (say, the lights of a traffic light) or of an organism (the spot on the beak of mother seagull) that is linked to some meaning.
In my view of mind and social interaction (Conte & Castelfranchi 1995; Castelfranchi & Poggi 1998), I distinguish internal goals of the individual (that include conscious intentions, but also unconscious desires and tacit – that is, automatic goals) from external goals (that impinge on the individual for the sake of the group or biological fitness – say, social norms, biological functions and instincts). Similarly, signals may be of different kinds depending on the goals that govern them: when the goal of communicating is an internal goal, signals are generally movements deliberately performed by the system; but for external goals also objects and morphological features are often signals. Status symbols and uniforms, the most typical cases of social communicative signals, generally consist of whole objects; while biological communicative functions are often fulfilled by morphological features: permanent, as the secondary sexual features of male and female, or transitory features, as in the case of human blushing (Castelfranchi & Poggi 1990).

3. Signals and modalities

A system of signals makes a Communication System. And humans, as well as other anamals, use several communication systems, exploiting several modalities and several body organs. But what do we mean by modality? Any signal, qua a perceivable stimulus produced by the Sender, can be classified according to its sensory-motor modality: that is, any signal is produced by the Sender through specific physical actions and perceived by the Addressee through a specific sensory system. A spoken word is produced by vocal articulatory movements and perceived by auditory organs: a frown is produced by movements of some facial muscles and perceived visually; the bees' dance is a vibration of the bee's abdomen and it is perceived through tactile perception by the other bees' antennas (von Frisch 1950). The smell by which the male antelope marks his territory is secreted by glands around his eyes and perceived through olephaction by other antelopes (Tinbergen 1953).
Therefore, we must distinguish two senses of modality. We speak of a sensory (or receptive) modality as we take into account the sensory organs of the Addressee which should receive the signals, and of a motoric (or productive) modality

as we consider the body organs that produce them. Thus we may have as many production modalities as are the parts of the body or the kinds of movements used by the systems or organisms that perform signals; and we have as many sensory modalities as are the sensory systems by which signals are received: a word communicates through audition, a gesture and a grimace through vision, a punch or a caress through touch, a perfum through smell. And finally, even organic artifacts produced by human hands (raw or cooked food) can communicate through the sensory modality of taste (for example, when someone makes a delicious food to show me his love, or to exhibit his cooking skill).

In human communication, the receptive modalities are our five senses: audition, vision, touch, taste, holefaction. As for the productive modalities, in the human body we can count a number of productive organs, that is, body organs that produce communicative signals. For example, simply considering the visual and the acoustic modality, we can distinguish a fair amount of body parts that produce communicative signals: starting from the head, we have the head itself, and then face, hands, trunk and legs; moreover, not only each of these parts of the body, but even each of their subparts produces its own system of signals: for instance, face may be subdivided into regions, like forehead, eyes, nose, mouth (Magno Caldognetto and Poggi, 2001).

In some cases we can view each of these organs and parts of organs as bearing its own specific communicative repertoire, that is, its own system of signals, its "mode-specific communication system" (Table 1). The head produces head movements, the eye region (eyebrows, eyelids, eyes) all the signals of gaze; the nose can wrinkle or dilate nostrils; the mouth produces, in the auditory modality, words and prosodic signals, in the visual, visemes but also smile, laugh and grimaces; shoulders, arms and hands produce gestures, while trunk and legs produce postures, movements, orientations and proxemic signals. In other cases, though, a communication system is somehow distributed across different organs: getting out of only the visual and acoustic modalities, various organs of the human body (hands, legs, mouth, nose, eyelashes, hair, sexual organs) communicate by touch, while different glands produce different smells.

Of course, during communication more than one modality is often used both on the motoric and on the sensory side, even if sensory and motoric modalities do not show a one-to-one correspondence. For instance, as S talks to A, A receives the signal through two receptive modalities, auditory and visual; but if we look at how many things S is doing, we see S is using at least five different productive modalities: S is not only uttering sentences (verbal modality) but using a given prosody and intonation (prosodic-intonational modality), making gestures (gestural modality) and facial expressions (facial modality), while assuming different postures and moving trunk or body (bodily modality). Nonetheless, if our goal is to understand how (multimodal) communication works, I think it is useful, from a heuristic point of view, to study each single communicative system by itself, set out its differences from the others, and then see how two or more systems combine and work together in producing multimodal messages. In some cases, then, the task may be to single out even a very limited system of a single productive organ (say, the system of head movements) and to describe it and analyse it in depth.

Table 1
Productive organs of the human body and their corresponding communication systems in the visual and acoustic perceptive modality

PRODUCTIVE ORGAN			MODE-SPECIFIC COMMUNICATION SYSTEM	
Head			*Head movements*	
Face	Forehead		*Forehead movements*	
	Brows Eyelids Eyes		*Gaze*	
	Nose		*Nose curlings* *Nostril dilation*	
	Mouth	Jaw Lips Teeth Tongue Vocal chords Velum	*Fonemes* *F0*	*Words* *Prosody* *Intonation*
			Visemes	*Words* *Grimaces* *Smile* *Laugh*
Hands	Shoulders Arms Hands		*Gesture*	
Body	Trunk Legs		*Movements* *Posture* *Spatial location*	

4. Communication systems

I define a communication system as a set of rules to link meanings to signals. I distinguish two kinds of communication systems, according to whether the links between signals and meanings are "codified" or "creative" (Magno Caldognetto & Poggi 1995; Poggi & Magno Caldognetto 1997). In a "codified" communication system, the signal-meaning link is shared and coded in the memory of both a Sender and an Addressee (as it is the case, for example, with words or symbolic gestures) and a whole set of these links makes a "lexicon". I define a "lexicon" as a system of rules of correspondence between a set of signals in a given modality and a set of meanings, codified in the Agent's long-term memory: in other words, a "lexicon" is a list of signal-meaning pairs written in memory. As a Sender has the goal to communicate some meaning *m1*, he looks in memory, and if he finds out a lexical pair whose meaning is *m1*, he just has to produce the signal *s1* that corresponds to that meaning; and as an Addressee perceives the signal *s1*, he looks in memory and finds out that it means *m1*. In a "creative" system, instead, what is coded in memory is only a small set of inference rules about how to create a new signal starting from a given meaning, or about how to retrieve a meaning from a given signal: like in pantomime (Klima & Bellugi 1979) and in McNeill (1992) "iconics", or in the creation of new words in natural languages. If a Sender has the goal of communicating a meaning *m2*, and looking up in his memory cannot find a signal corresponding to that meaning, he has to resort to his creative system, that is, to the set of inference rules, and produces a completely new signal *s2*; and the Sender, when perceiving *s2*, has to apply the same inference rules in order to draw the meaning *m2* from the signal *s2*.
A step in investigating the structure of communicative systems is then to find out the rules that link signals to meanings. For "creative" communication systems we have to find out the inference rules that state how new signals may be created by a Speaker and understood by an Addressee: that is, for instance, how do we invent an iconic gesture to represent the idea of climbing, of a spiral staircase, a bird, a cello or the wind. Some studies accomplishing this task are for example McNeill (1992), Magno Caldognetto & Poggi (1995), Poggi & Magno Caldognetto (1998), Yan (2000), Sowa & Wachsmuth (2002).
For "codified" systems, that is, "lexicons", the task is to compile lexicons of systems in all modalities. Some examples in this field are the dictionaries of Sign Languages and, more recently, the flourishing of dictionaries of symbolic gestures for many different cultures (Morris 1997 for gestures all over the world; Morris et al. 1979 for the Mediterranean area; Payratò 1993 for Catalan gestures, Tumarkin 2001, 2002, for Japanese gestures, Kreidlin 2001 for the Russian, Posner & Serenari 2001 for Berlin gestures, Poggi 2001 a for the Italian).

5. Lexicons of nonverbal signals

In my hypothesis, many of the communication systems outlined in Table 1 are of a lexical kind: I think that not only words or symbolic gestures, as it is generally accepted, but also other kinds of gestures, like batons, affect displays or some adaptors (with the exception, perhaps, only of iconics and metaphorics), and even gaze, facial expression, posture shifts, are in fact "lexical" systems. This means, in my definition, that each item in these systems has a precise meaning that is coded in the conversants' minds, and this meaning is precisely stated, so much that if we substituted one item for the other the overall meaning of the interaction would not be the same. I hold, in fact, that if these signals did not have each a precise meaning which is shared across minds, people could not understand each other.

5.1. Lexicons?

In previous works (Poggi & Magno Caldognetto 1997; Poggi 2001 a) I have argued that, among communication systems different from verbal languages, the systems of symbolic gestures used in different cultures, including the signs in the Sign Languages of the Deaf, constitute lexicons: they are lists of codified signal-meaning pairs where each signal has its canonical rules of production (what shape, location, movement, orientation you should impress to hands), and where a given meaning systematically corresponds to each given signal.
A system of symbolic gestures used by Hearing people in a particular culture (as the Jews' community of Efron 1941, or the Neapolitan people of De Jorio 2000) is different from a verbal language, but also from a Sign language of the Deaf in that these include both a lexicon (rules of correspondence between signals and meanings) and a syntax (rules for the combination of signals), whereas symbolic gestures only include a lexicon (Poggi & Magno Caldognetto 1997). But the status of a lexicon was not usually acknowledged to other signals in the gestural and other modalities. In fact, it is easy to say that symbolic gestures are "lexical" because they can be translated into words or sentences, that is, for each symbolic gesture used in a culture Speakers of that the culture can offer a corresponding verbal formulation which is quite shared and easily available in memory: for instance, among Italian symbolic gestures, moving the hand facing the gesturer with index and middle finger in V shape back and forth before one's mouth can be translated as "smoke" or "cigarette", while bending open hand down towards oneself means "Come here".
In my view, though, the possibility of translating a non verbal signal into words or sentences, that is, of providing a corresponding verbal formulation of its meaning, does not belong exclusively to symbolic gestures. In other works (Poggi & Magno Caldognetto 1996) I have shown that any communicative signal of any kind and any modality is by definition meaningful, and therefore its meaning can be paraphrased in a verbal language. Thus, also gestures different from the symbolic ones, as well as signals in other modalities, may be attributed some meaning, and then can be reformulated by a verbal paraphrase. Raising the eyebrows, for instance, can be paraphrased as "I'm surprised"; a baton like dropping both hands down, as "What I am saying is important"; a posture shift, as "I am changing the topic of my discourse" (Cassell et al. 2001). The only difference between these signals and symbolic gestures is that in symbolic gestures a verbal translation is systematically linked to the gestural signal, like in a bilingual system where an item in one system is somehow directly linked to one in the other system; while in other systems like gaze or batons the verbal translation is not represented explicitely; this is why it is quite easy to detect the meaning of a symbolic gesture, while it is not as clear what a posture shift or a specific gaze means. But this does not imply that gaze or posture do not have a meaning at all. This only means that for each of these items, the meaning is represented in memory, but the translation, the corresponding verbal formulation, is not. In my view, not only symbolic gestures but also gaze and touch (and may be posture, head-nods and so on) do make lexicons: they do because each item in these communication systems has a precise meaning, and this meaning does not float from context to context in an a-systematic fashion.
To the idea of seeing systems as gaze, touch or posture as "lexical" systems an objection is often opposed: that these kinds of signals are the domain of homonymy, polysemy and vagueness, while a "lexical" system is typically formed by one-to-one correspondences between signals and meanings. But in fact this is not the case even for verbal lexicons, where each lexical item generally has more than one meaning: synonymy, homonymy and polysemy then, far from being an exception are, on the contrary, a typical feature of lexical systems. Therefore, both in verbal languages and in the systems of gestures, gaze, touch, a single signal may correspond to more than one meaning, or (almost) the same meaning may correspond to two or more different signals; and yet, both in verbal languages and in other lexical communication systems, even when the same signal seems to have a number of different meanings, in all the occurrences of it a common core of meaning can be found.

5.2. Polysemic but lexical

A way to demonstrate that a signal has a precise meaning is to show that, even if it apparently has different meanings in different context, nonetheless some link holds among these meanings.

Take the eyebrow raising. According to Eibl-Eibesfeldt (1972), Ekman (1979) and Poggi & Pelachaud (2000 b), the raising of the eyebrows may have a small number of meanings that are, at least at first sight, different from each other. But both Eibl-Eibesfeldt (1972) and Poggi and Pelachaud (2000 b) have shown that in all the different meanings of this signal we can find a shared semantic element. According to Poggi and Pelachaud (2000 b), the eyebrows are raised: **a.** when facing an unforecast situation, thus meaning : "I am surprised"; **b.** to show doubt of incredulity as our interlocutor is talking; **c.** to accompany the word *but* or another adversative word, thus conveying a contrast between segments of our discourse; and finally, **d.** to mark emphasis of one's sentence. But underlying all of these meanings there is a common semantic core: in case of surprise, as well as in case of doubt, of an adversative, of an emphatic statement, there is a new information that cannot be inferred (it cannot be explained, it is contradicted) by previous knowledge. And this meaning might, moreover, be traced back to the action of opening eyes wide (of which the raising of the eyebrows is a side-effect), that is instinctively performed when we try to enhance our sight capacity in order to keep alert and pay attention to any potential new information (Ekman 1979).

If we accept this analysis, we may conclude that, also when a signal apparently seems to have different meanings, it is usually possible to reconduct all its readings to one and the same meaning, thus having a one-to-one systematic correspondence between one meaning and one signal.

But how can we generally account for the fact that the different meanings of a signal all share one and the same piece of meaning? The link between two meanings of an item can be of at least two kinds: either a componential or an inferential link. In some cases, the meanings *a*, *b* and *c* share one and the same semantic component *x*, to which each of them adds a different component: *a* means *x+y*, *b* means *x+z*, *c* means *x+k*.

An example of this kind is the italian gesture with fists palm down approaching with extended fingers parallel, that is usually paraphrased "they have an understanding with each other" (see Table 6, gesture 1). This gesture, in its most frequent reading, bears a sense of complicity, then it implies the meaning of a LINK between TWO PERSONS for some ILLICIT, and then SECRET, affair. But it can also mean "they love each other", where the meanings of a LINK between TWO PERSONS is still present, but that of an illicit affair is not (at least not necessarily). Moreover, the gesture can also simply mean "there is some link between two facts", where the components PERSON, ILLICIT and SECRET do not hold. We can then conclude that this gesture does have three different meanings, but they all share one and the same component: the idea of a LINK between two facts or persons (Poggi 2001 a).

While in cases like this the link between different meanings is that they all contain the same semantic component, in other cases, instead, the different meanings are linked to each other in that one meaning *b* can be inferred from a meaning *a*, *c* can be inferred from *b*, and so on.

In previous works (Poggi & Magno Caldognetto 1997; Poggi 2001 b) I have shown that as well as verbal words or sentences, also other signals often have an indirect meaning beside their literal meaning. An indirect meaning is one that can be inferred (and that the Sender wants to be inferred) from the literal meaning of a word, a sentence, a gesture, a gaze, a touch, a picture. The indirect meaning may be either creative or idiomatic: it is creative when the inference to apply to the literal meaning is different from time to time, and the resulting indirect meanings differ across contexts, just as in a Gricean implicature (Grice, 1975). It is idiomatic, instead, when the inference to catch it is always the same, and it has been codified in memory, like in an Indirect Speech Act (Searle, 1969).

When the indirect meaning is idiomatic (memorized), the literal and the indirect meanings may coexist: like in the gesture of clapping hands, which can be interpreted either as a real praise or as an ironic praise, then really a blame, according to the context (Table 6, gesture 3). Sometimes, though, the literal meaning fades away, obscured by the indirect meaning which is the only one left. And this may give rise to diachronic change: the original (literal) meaning of the item is no longer valid and it is replaced, in the Speakers' mental representation, by the indirect meaning. For example the metaphorical meaning of the Italian gesture of beating the hand with closed fingertips, palm down, on one's breast or stomach, that means "I can't bear him" derives from a literal meaning "I have it on my stomach", "I can't digest it" (Table 6, gesture 4): the gesture previously referred to something difficult to digest, but this meaning changed through a process of metaphor and now e concrete meaning of digestion is no longer felt in the Italian gesturers' intuition. This is in fact the same process that holds with ritualization in animal communication and cultural evolution (Eibl-Eibesfeldt, 1970).

So, "before" the indirect meaning there is a literal meaning. But what comes "before" the literal meaning? It often derives from a physical action, an action that is not yet communicative proper. For example the eyebrow raising, which communicates the meaning of some unforeseen information, has been supposed to derive from the physical action of opening eyes wide to catch more information. This action, aimed at the goal of understanding more, triggers the inference that there is something surprising, something one does not know, something one needs more information to explain. And this is just the literal meaning of the surprised eyebrow raising. Thus, a non communicative action (a "degree zero" of meaning, in terms of Posner and Serenari 2001) of trying to see better gets ritualized and thus acquires the meaning ("degree one") of showing that something is surprising.

In fact, as we will see below also in the three lexicons of gesture, gaze and touch, for many items it is possible to find three meanings: one is the literal meaning of the item, another one is an indirect meaning that is inferrable from the literal one, but in some cases has obscured it; and finally, at times, somehow hidden behind the literal meaning, it is possible to find out a previous meaning, sometimes not even a meaning proper: a "degree zero" of meaning, something that is simply the mention of a physical action, a still non-communicative action. For example, like the gesture "I can't bear him" derives from a literal meaning "I can't digest this" almost faded away, the meaning of the touch gesture of

embracing, "I love you", might derive from the action of trying to incorporate the other, to show how one needs him; the eyebrow raising comes from the action of opening eyes wide to catch more information, while the frown comes from our trying to sharpen our sight as we need to see better (to catch more precise information) in order to solve some problem (Poggi, 2001 b) (Table 2).

Table 2

SIGNAL	ORIGINAL MEANING	LITERAL MEANING	INDIRECT MEANING
Gesture: *"Beat hand on breast"*	Beating one's stomach to help digestion	I can't digest this	I can't bear him
Gesture: *"Clap hands"*		I praise you	I blame you
Touch: *"Embrace"*	I want to incorporate you	I love you	
Gaze: *"Eyebrow raising"*	I try to see more	There is something I can't explain: I'm surprised	Emphasis: I want you to be surprised: this is new and important
Gaze: *"Frown"*	I try to see better	I concentrate to solve a problem	I can't understand

5.3. Synonymic but lexical

One more advantage in accepting that a nonverbal item may have both a literal and an indirect meaning is that this accounts for some cases of synonymy among apparently very different (sometimes, even opposite) signals. Take this example. When I listen to my interlocutor and something in his discourse does not convince me completely – either because I cannot believe him or because I don't agree with him – then I can provide two different back-channel signals with gaze: either raise my eyebrows, then showing surprise, or frown, showing that I don't understand completely. Now, even if these two signals are different and have different literal meanings, both may imply the same indirect meaning: "I don't completely accept what you are saying". If I'm surprised (eyebrow raising), what you're saying is strange, finally unbelievable; then I indirectly communicate I don't believe what you're saying. But on the other hand, showing I don't understand (frown) is a rhetorical (reticent) way to communicate that I don't agree with you. This is why both signals can be used by an interlocutor to provide a negative backchannel to the Speaker (Table 3).

Table 3

SIGNAL	MEANING 1	MEANING 2	MEANING 3
Eyebrow raising	I'm surprised	what you're saying is unbelievable	I don't accept what you're saying
Frown	I don't understand	it is not that I don't understand, in fact I don't agree	I don't accept what you're saying

One more example: as I put a question, I can accompany it either with an eyebrow raising or with a frown. How can both signals mean "I am asking you a question"? They do because both when I'm surprised (eyebrow raising) and when I don't understand something (frown) I look for some information to explain what I don't know or understand. And putting a question is just asking for some information (Table 4).

Table 4

SIGNAL	MEANING 1	MEANING 2	MEANING 3
Eyebrow raising	I'm surprised	there is something I cannot explain	I am looking for some information
Frown	I'm in concentration	I don't understand	I am looking for some information

In summary, if we consider not only the literal but the possible idiomatic indirect meanings of signals in all modalities, we can account for the polysemy and synonymy of signals, and therefore we can hold that also communication systems different from verbal languages can be acknowledged a lexical status, since the correspondences between signals and meanings are systematical and encoded in the Speakers' memory.

5.4. Universal or cultural lexicons?

One more issue that may be raised by the idea of writing down lexicons of gestures, gaze and touch (and possibly, posture shifts, head nods and so on...) is whether the lexicons we are going to find out are culturally or biologically coded, and then whether they are lexicons of a particular culture or they may be thought of as belonging to all humans in the world. I can't obviously deal with such a formidable issue in detail, but I only want to state what I think of the lexicons I am presenting in this paper, the lexicons of Italian symbolic gestures, of gaze and of touch. As far as Italian symbolic gestures are concerned, we know they are by definition culturally coded: they are used in a particular culture, they have to be learned by young children through direct experience; and, for example, a child born blind cannot make these gestures (unless he was not specifically taught through hand modeling) because he cannot see them. As to the lexicon of gaze, on the contrary, my personal hypothesis is that it might be at least in general biologically coded, just as the facial expressions of basic emotions have been shown to be. In other words, I think that, just as it was hypothesized by Ekman (1972) the rules of correspondence between given signals and their meanings in gaze might be universally shared, while what is very different from one culture to another are the norms of use of those lexical rules. We know that cultures differ a lot in the norms they impose on the use of gaze (Argyle & Cook 1976; Duranti 1992); but I think this leaves room for the hypothesis of a universally shared repertoire: it is just because staring fixedly at someone has the meaning of a defying gaze, or an oblique glance is seductive, that these kinds of gaze will be prescribed or sanctioned according to how prescribed or sanctioned it is to show that social attitude in different situations or different cultures. Of course, there will be some rare cases of lexical items that are specifically cultural (for example, in Italy and in other countries winking is used as a sign of complicity); but I think that the bulk of the lexicon of gaze is universally shared: the gaze items exhibitied in a conversation among the Papua look quite familiar to those of my country. And the same hypothesis of gaze could be put forward for the lexicon of touch.

6. Lexicons and Alphabets

I hold, then, that also for communication systems different from words or symbolic gestures we can write down lexicons; and in fact, Ekman and Friesen's (1978) FACS, for instance, can be considered a lexicon of face; a sketch of a lexicon of gaze is Poggi & Pelachaud (2002); and also lexicons of very specific systems may be written, like the fragment of lexicon of "performative faces" (Poggi and Pelachaud, 2000), the lexicon of the orchestra Conductor's face (Poggi 2002), the lexicon of deictic gestures and gaze (Rickel, Johnson and Lester 2000; Lester et al. 2000), or the lexicon of lip-pointing (Enfield 2001).

More. A lexicon is a list of rules of correspondence between signals and meanings, where the meanings can be analysed in terms of mental images or semantic components that can be expressed in a propositional format. But in a lexicon of gesture or gaze, how can the signal be analysed? To analyse the signal side of a lexicon we should find out the "alphabet" by which the signals of that lexicon is composed. Here I use the term "alphabet", in a quite metaphorical sense, to mean the set of sublexical components, parts or aspects of signals, that, variously combined symultaneously or in sequence, form all the possible signals in the lexicon of a given modality.

A task somehow included in the construction of lexicons is then the discovery of "alphabets" of nonverbal systems. In this view, important examples are Laban's notation (Laban, 1974) and Birdwhistell's (1952) system, the seminal work of Stokoe (1978), and then Calbris (1990) for French gestures, Kendon (1988) for the Australian Aboriginal Sign Language, Sparhawk (1978) for Persian gestures.

Other systems for coding and annotating nonverbal items are FACS by Ekman and Friesen (1978), MPEG notation, and Martin's system (2001).

To find out the lexicons and alphabets of systems in all modalities is of course a very long and hard endeavour. In this work I only want to show some steps I moved in this line. I will present some studies aimed, if not at definitely

compiling, at least at providing a first sketch of a lexicon and an alphabet of three communication systems: the symbolic gestures of Italian hearing people, the system of gaze and the system of touch.

7. Formational parameters in gesture, gaze and touch

How can we find out the sublexical components of signals in a communication system? A precious hint is the work of Stokoe (1978), who proposed the notion of "formational parameters" for analysing signs in Sign Languages of the Deaf. He has shown that each sign is produced by a particular Handshape, Movement, Location, to which Orientation has then been added. Now, as was shown in other works, an analysis into formational parameters can be used to describe not only the signs of a Sign Language but many (perhaps all?) signals in different modalities: namely, the symbolic gestures used by hearing people (as it has already been shown by Calbris 1990, Kendon 1988, and Sparhawk 1978); but also, as we are going to show below, the signals in the system of gaze (Poggi and Pelachaud 2002) and those in the system of touch (Cirella 2001; Zollo 2001); as well as, very likely, body movements, body postures, head movements and so on.
We can view Formational Parameters as criteria to analyse all signals in a communication system. Each signal (sign, gesture, gaze or touch) can be analyzed in terms of different parameters, each with a small number of possible values, in such a way that each signal is described as a combination of all the possible values it assumes against all parameters. Each value in each parameter of a gesture, gaze or touch has a "phonological" status, in that changing that value on that parameter transforms the item either from one signal to another signal or from a signal to a non-signal.

8. How to construct lexicons of the different modalities

To make a lexicon of a particular modality requires an extensive work of collecting all the items of that lexicon and an intensive work of semantic analysis for each item.
For both kinds of work, three methods can be used in order to find out the meaning of the items to write down in the lexicon. One is the Chomskian method of the Speaker's judgements: it consists in judging if the item under analysis is semantically acceptable in one or another context, if it is ambiguous (has more than one meaning), how it can be paraphrased in the verbal language, which other items in the lexicon of the same or other modalities may be synonyms of it, and so on. This may be done even through judgements of the researcher alone. The resulting lexicon will be in this case the representation of his/her single communicative competence; but from a theoretical point of view this is yet a good way to discover the mechanisms of that communication system, since each single competence is a selfconsistent system. This method has proved useful for both the extensive overview of a whole lexicon (Poggi & Magno Caldognetto, 1997), and for the intensive analysis of single items (Poggi 1981; Poggi & Magno Caldognetto 1997; Poggi & Pelachaud 2000).
Of course, if one aims at a real dictionary of nonverbal items that can represent the lexical nonverbal competence shared by all people in a culture, another method is necessary: one based on test or interviews through which the researcher can verify to what extent his/her own intuitions are shared. This is perhaps the most used method in gesture literature (Morris et al. 1979; Payratò 1993; Posner & Serenari 2002).
Finally, when one goes into the semantic analysis of single items, a detailed intensive analysis is needed. The third one is then an observational method: the researcher collects several videorecorded occurrences of a single nonverbal item used in real-life situations, and tries to single out first its meaning in each occurrence, then the core meaning that is common to all occurrences. This method has been used for detailed analyses of single gestures (for instance, by Kendon 1995, and Mueller 2002), and for single items of gaze (Poggi 2001). (Of course, it is more difficult to imagine how to use it for items of touch).
But how can we find the meanings of nonverbal items? In compiling dictionaries of natural languages, Linguists have generally started by collecting words in a language and then tried to outline their meanings. To use a such method looks quite obivous for verbal languages, since signals in these communication systems are fairly segmentable, and introspection of their meaning is made easier by their being used with total awareness. Neither condition, though, always holds for communication systems in other modalities, where the signals are seldom produced at a high level of awareness, and the job of finding out "lexical" units has not yet been accomplished thoroughly. For this reason, in this case it is both easier and more heuristic to start the other way around: first try to guess what in principle may be all the possible kinds of information an Agent may need to provide other Agents for its adaptive goals; and then wonder if, which and how those kinds of information are generally conveyed in such or such modality, such or such communication system. I use this method, starting from the idea that in whatever communication system it is possible, and often useful, to distinguish at least three classes of meanings: Information on the **World**, Information on the **Speaker's Identity**, and Information on the **Speaker's Mind**.
Information on the World. When we talk we provide information on the concrete or abstract events we communicate about, their actors and objects, and the time and space relations among them. This is provided, of course, mainly

through the words of sentences and their syntactic structure; but often also by deictic, iconic and symbolic gestures. In fact, a deictic gesture indicates something in the surrounding environment: a way to set the reference of our discourse, then a way to explain what, in the external world, we are going to talk about. An iconic gesture instead describes (with a literal or metaphorical sense) the shape, size or movements of some referent we are mentioning. Finally, some symbolic gestures directly mention some object, feature or action. But not only gesture can indicate or describe; sometimes this is done also through gaze, voice, head or body movements: we may point at things or persons in the context even by eye, lip or chin direction, and we may refer to some feature of some word or person also by gaze, prosody and body movement: we squeeze our eyes to refer to something small or difficult, open eyes wide to refer to something huge, lenghten a vowel to say something is long, or speak in a staccato way to indicate precision; we may mime another person's movement by moving as she does.

Information on the Speaker's Identity. While talking, we provide information on our Identity: with physiognomic traits of our face, eyes, lips, the acoustic features of our voice, and often our posture, we provide information on our sex, age, socio-cultural roots, and personality. Of course, these signals are usually governed by biological goals, the goal of being recognized by other people, and these goals are not usually conscious or deliberate, to the extent that they may conflict with other conscious goals of ours: as it happens, for instance, when I try to mask my original accent to mix up with a guest country better.

Information on the Speaker's Mind. While we talk about events of the external world, we also communicate why we want to talk of those events, what we think and feel about them, how we plan to talk of them and so on: we provide information on the **beliefs** we're mentioning, our own **goals** concerning how to talk about them, and the **emotions** we are feeling while talking (Poggi 2002).

More specifically, among information concerning our own **beliefs**, we may inform:

1. on the degree of certainty of the beliefs we are mentioning, by words like *perhaps*, *certainly*, or the conditional or subjunctive verb mode, but also by frowning, which means: "I am serious in stating this", or by opening hands, which means "this is self-evident";
2. on the source of the beliefs we mention, whether they come from memory, inference, or communication (Castelfranchi & Poggi 1998): we look up when trying to make inferences, snap fingers while trying to remember, we make the gesture "quote" with index and middle fingers curved twice to mean that we are quoting other people's words for which we are not responsible.

The **goals** of ours that we inform about while talking concern:

1. the performative of our sentence, that may be conveyed by performative verbs, but also through intonation or through performative facial expression (Poggi & Pelachaud 2000);
2. the topic-comment distinction within a sentence or discourse, which may be conveyed by batons, by eyebrow raising, by intensity or pitch of a tonic vowel;
3. the discourse rhetorical relationships: a list may be scanned by words (*first*, *second*, *third*...), but also by counting on fingers, or marking all the items in the list with the same intonational contour; topic shift may be expressed through posture shift;
4. the turn-taking and backchannel structure of conversation: we raise our hand for asking turn; we nod to reassure the Interlocutor we are following, understanding, perhaps approving of what he's saying.

Again, we may inform on the **emotions** we are feeling while talking, not only by affective words, but with gestures, emotional intonation, facial expression, gaze and posture.

This semantic taxonomy is, in my view, a useful framework to build "mode-specific" lexicons, that is, to single out the correspondences between signals and meanings in systems of different modalities. Once we have a list of possible meanings, we can go and see if and which signals in a given system can convey each of them. Indeed, the taxonomy has proved useful in constructing Artificial Agents that communicate by face and gaze (Poggi, Pelachaud & de Rosis 2000). It is then starting from this framework that I now try to outline the lexical structures of, respectively, gesture, touch and gaze.

9. Italian symbolic gestures

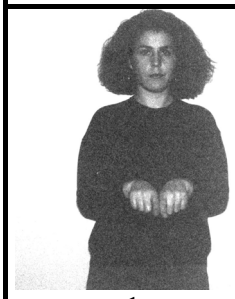
9.1. Formational parameters in the symbolic gestures of Italian Hearing people

In a previous work Poggi & Magno Caldognetto (1997) proposed the construction of a Gestionary, that is, a Dictionary of symbolic gestures. Research is now in progress to compile the Italian Gestionary of the symbolic gestures used by Italian hearing people (Stefani 1998; Romagna 1998).

In the Italian Gestionary, the signal part of each gesture is analysed through its formational parameters: hand configuration, location, orientation and movement. In a dictionary of gestures, the analysis of parameters may be provided either in terms of a symbolic notation like the ones used by Stockoe (1978), Volterra (1987), Radutzky (1992) or Kendon (1988); or in terms of a verbal description of how the hand is shaped and moves; or, finally, simply through a picture.

In the "Italian Gestionary" (Poggi 2001 a), each gesture is presented through a picture and a verbal description. The verbal description of how each gesture is analysed according to its formational parameters is shown in Table 5.

Table 5

Gesture	Verbal formulation	Handshape	Orientation	Location	Movement	Non-manual components
 1	They have an understanding with each other	extended index fingers (both hands)	palms down, metacarp to Hearer	neutral space	parallel index fingers get close to each other	
 2	I am very sorry	right index finger extended	palm to Speaker, fingertip up	on zygoma	down from zygoma to cheek	inner parts of eyebrows raised, lip corners down

250 symbolic Italian gestures have been analysed in terms of these formational parameters (Romagna, 1998), and the following values have been found for each parameter: 40 handshapes, 33 locations, 6 orientations. The parameter "movement" has been distinguished into subparameters, for which the following values have been found:

- *direction* (whereto the gesture is directed), comprises the following values, with tehir combinations: forward (toward the Hearer), backward (toward the Speaker), outward, inward, upward, downward;
- *path* (the kind of route the gesture outlines in space): straight, circular, half-circular, thrumming, oscillation;
- *part of the hand* involved: wrist, whole hand, fingers, knuckles;
- *tension*: tense, relaxed, normal, delicate;
- *impact*: normal, block, skim;
- *tempo*, distinguished into: *duration* (short, long), *speed* (slow, medium, speedy), *repetition* (unique, continuous, alternate).

In fact, also non-manual components (facial expression and body posture) might be considered as a parameter in their own right, because they are sometimes distinctive of the meaning of gestures, as it has been shown for Signs in the Sign Languages of the Deaf (Volterra 1987), and for Italian symbolic gestures by Poggi (1983) and Ricci Bitti et al. (1987). This is completely coherent with my view that multimodal communication is an integrated net of signals coming from different communicative systems. Nonetheless, I think that the global meaning that is built out from a multimodal act of communication results from the combination of the single meanings of single signals in different modalities. That is why my bet is to find out the single meanings of the different signals, and only after that to find out the meanings of their combination.

9.2. The lexicon of Italian symbolic gestures

In the "Italian gestionary" (Stefani 1998; Romagna 1998; Poggi 2001 a), as far as the meaning part of symbolic gestures is concerned, for each gestural item the following information is represented (Table 6).

1. **verbal formulation**: the gesture is glossed with its most frequent verbal paraphrase(s). For example, the gesture 1., fists palm down approaching with extended fingers parallel, may be paraphrased as "they have an understanding with each other", or "they are lovers" or simply "there's a link";

2. **context**: some contexts are provided where the gesture can be used: gesture 1. may be used while speaking of two persons or two events;

3. **synonyms**: other gestures are eventually mentioned that have (about) the same meaning as the analyzed one; a synonym of 1. is the hand oscillating on wrist with thumb and index open curved;

4. **semantic content**: a definition is provided of the meaning of the gesture, similar to those of word dictionaries. An effort is made to single out the semantic components of its meaning, to be expressed in a metalanguage that may be a natural language like English or Italian, or a formal system of logical propositions or so. Here the meaning of 1. is simply analysed as "link between two persons or events";

5. **morphological classification**: gestures can be classified according to a somewhat proto-morphological distinction between holophrastic and articulated gestures (Poggi 1983), depending on their having the meaning of a whole sentence, with its built-in performative, or of a single word or semantic predicate. Gesture 1. is articulated, because the mentioned link may be either asserted in an act of information or asked in a question. Gesture 2., clapping hands, instead, is holophrastic because it has the performative of praise incorporated in it, it cannot be a simple information, nor a question, nor a command.

6. **pragmatic classification**: holophrastic gestures, that have their built-in performative, may be classified as to their specific performative as, say, questioning, requesting, threatening gestures and so on. Gesture 2. has a performative of praise, 3., "I can't bear him/her", has a performative of information.

7. **semantic classification**: the semantic content of the gesture is classified according to the typology presented above. Gesture 1. bears an Information on the World, 3. and 4. an Information on the Speaker's Mind: respectively, 3. a performative, 4. a social emotion.

8. and 9. **rhetorical devices** at work in the gesture. Sometimes the meaning of a gesture is a rhetorical reading, that is, a meaning resulting from the operation of a rhetorical figure, like metaphor (see Calbris 1990; Kendon 1992; Poggi & Magno Caldognetto 1997), irony (Poggi 1983), hyperbole, synecdoche (Poggi 2001 a) and so on. Just like indirect meanings in general, rhetorical readings have a role both in the polysemy of gestures and in their historical change. As we have seen in Sect. 5, an indirect (in this case, rhetorical) meaning of a gesture may cause its historical change by giving rise to a new meaning that may subsequently substitute and obscure the previous meaning. Like in gesture 4, "I can't bear him/her" which in its originary meaning means 'I have it on my stomach', 'I can't digest it', but metaphorically comes to refer to rejecting not a food but a person. Here the meaning of a concrete digestion is the literal originary meaning now obscured, while that of an unbearable person is the indirect rhetorical meaning, the only valid now. In other cases, though, the operation of a rhetorical figure simply adds one more meaning to a pre-existing one, and the two meanings presently coexist, thus causing a polysemy of the gesture. Gesture 3 of clapping hands still has both its literal sense of praise and an ironical-sarchastic meaning of blame. The two quite different meanings, one deriving from the other, coexist, thus causing a polysemy of the gesture. Line 8 of Table 6 then contains the previous meaning from which the present one derives ("I can't digest it" for gesture 3.); while line 9 contains the further coexisting meaning(s) of the analysed gesture ("I blame you" for gesture 3). Both lines in addition mention the rhetorical figure that is responsible for the new meaning (metaphor for gesture 4, irony for gesture 3).

Table 6
The semantic analysis of gestures in the Italian Gestionary

Gesture	1 	3 	4 
1. Verbal formulation	- *se l'intendono*= they have an understanding with each other; - *c'e' del tenero* = they are lovers - *connessione* = link	*bravo!* = very good!	*mi sta qua* = he's on my stomach
2. Context	- speaking of two persons; - speaking of two facts	commenting on something done by B	commenting on some person
3. Synonyms	Hand with thumb and index open oscillates on wrist	"ring" with thumb and index	
4. Meaning	**link between persons or events**	**Sender praises Addressee**	**Sender can't bear some person**
5. Morphological classification	articulated	holophrastic	holophrastic
6. Pragmatic classification		praise	evaluative information
7. Semantic classification	world	mind: performative	mind: social emotion
8. Source rhetorical meaning			metaphor: difficult to digest
9. Coexisting rhetorical meaning		irony: blame	

More information on a gesture that is generally provided in the Italian Gestionary is whether the gesture is iconic or arbitrary, and possibly the degrees of its iconicity. Finally, information is provided about variation in use of each gesture across time (diachronic change), space (geographic distribution), users (male, female, child) and situations (formal, informal, solemn).

9.3. Types of meanings in Italian Symbolic Gestures

What types of meanings do Italian symbolic gestures convey?
Some convey Information on the World: iconic gestures mainly convey actions ("to cut", "to smoke", "to walk") and properties ("thin"), among which evaluative properties ("stubborn" or "stupid", "good"); relations ("link between two"); times ("yesterday"); quantifiers ("two", "much or many"); persons ("indian","communist"); animals ("horse", "donkey"); objects ("scissors","sigarette"). Since among symbolic gestures, different from signs of the Deaf, it is not usually possible to distinguish verbs from nouns, in some cases the same gesture may mean both the action and the object used to perform that action ("to cut" – "scissors", "to smoke" – "cigarette").
Some few gestures convey information on the Speaker's Identity, mainly social Identity, like "communist", "fascist", "feminist".
A number of gestures finally convey Information on the Speaker's Mind. Among gestures that inform on the degree of certainty of beliefs delivered by the Speaker, moving fist with raised index finger from left to right means "no"; opening flat hands with palms up, means perplexity, the cognitive state of being uncertain and questioning on something. Snapping fingers may provide the metacognitive information "I am trying to remember, and it is difficult".
Among gestures informing on the Speaker's goals, some specifically mention a performative: pulling back flat hands, palms to Hearer, means "I apologize"; raising fist with extended index finger, "Pay attention, please". Other gestures, like Kendon's "finger bunch" (1995) are often used while marking the topic and the comment of a sentence. When the hand is up it means "this is the topic", when it's down it means "this is the comment".
The italian gesture of oscillating curved thumb and index finger means "causal link between two events" (something like "therefore"); then it states a rhetorical relation between sentences in a discourse. Finally, raising a hand is a way to ask for speaking turn. Among gestures informing on the Speaker's emotions, Churchill's gesture for "Victory", or raising fists up, mean elation; hands on one's hair means despair, covering one's eyes with hands means shame.

10. Touch

As we mentioned, touch is a communication system that, different from gesture and gaze, cannot be located in a single body organ. As we shall see, the different parts of our body by which we touch represent one parameter of the touch system. Nonetheless, since touch may be in some cases considered similar to gesture (at least because any act of touch performed by hands can also be considered a *gesture* of touch), I'll deal with it just after gesture, and before gaze.
I define an act of touch as "communicative touch" when a physical contact occurs between a part of the body of a Sender and a part of the body of an Addressee, and when this physical contact is caused by the Sender with the goal of communicating something to the Addressee (that is, of having the Addressee understand some Belief). For instance, a caress communicates something like "I want to give you pleasure – then – I love you tenderly"; a slap means instead "I want to hurt your (physical, but also symbolic) face". Of course, the communicative goal of a Sender in "telling something" through touch is usually a tacit – not totally aware – communicative goal; and in the same vein, when the Addresse "understands" the meaning of an act of touch s/he may not "understand" it at a cognitively sophisticated level. But nonetheless, in the view of communication stated above, this does not mean that touch is not a way of communicating something which we can paraphrase as a social/communicative act.
Some recent work at the University "Roma Tre" has studied touch as a communicative signal (Zollo 2001; Cirella 2001). A list of 84 items of touch has been investigated both on the signal and on the meaning side.

10.1. Formational parameters of Touch

As for the signal part, the formational parameters of touch that seem relevant to distinguish all the different items of touch are the following:

1. *touching part* (hair, forehead, head, eyelash, nose, cheek, beard, lips, teeth, tongue, shoulder, arm, back, elbow, hand, fingers, nails, side, genitals, glutei, thigh, knee, foot);
2. *touched part* (hair, forehead, head, eyebrows, eyelash, eye, temple, nose, cheek, ear, beard, lips, tongue, neck, shoulder, arm, forearm, breast, trunk, stomach, back, elbow, hand, fingers, side, genitals, glutei, thigh, knee, calf, ankle, foot);

3. *pressure* of the act of touch by the touching person, which can be low, medium or high; this parameter, which in some way includes the subparameters of gesture movement *tension* and *impact*, is quite important since it typically distinguishes friendly from aggressive touch;
4. *location* or space touched in the touched person: a point, a line, an area (a kick falls on a point, a caress on a line, a scratch on an area);
5. *movement before touch*
6. *movement during touch*

Within both movements, that is, both when the touching part is directed towards the touched part, and when it moves over it, the following subparameters can be distinguished:

a. *path* (perpendicular, oblique, circular-oblique, arched-oblique; parallel, circular parallel);
b. *tempo*, which in its turn includes: *duration* (short, long), *speed* (slow, medium, speedy), and *rhythm* (unique, single, repeated in jerks, neutral, continuous). The movement is *unique* in a kick, a slap, a kiss on the forehead, since it is very short and not repeated; we call it a *single* movement if it remains a bit on the touched surface and can be repeated, but in a continuous manner; while it is *repeated in jerks* if touch is alternated speedily with non-touch; it is a *neutral* movement when the touching part remains on the touched part without moving, while it is *continuous* if the movement is repeated with no pause.

10.2. The lexicon of touch

Beside finding out the formational parameters of touch, the 84 items of communicative touch were analysed in terms of a number of criteria. For each item the following information was provided (Table 7):

1. **name** or **verbal description** of the act of touch;
2. a **verbal paraphrase** or other verbal expression that may accompany the gesture of touch: for example, the gesture of drying the other's tears may be accompanied by the expression "C'mon, don't cry"; while caressing someone we may tell him "I love you";
3. the **literal meaning**: drying the other's tears means "I want to console you"; a caress, "I want to give you serenity and pleasure";
4. the **indirect idiomatic meaning**: sometimes one caresses somebody to give him serenity, but this in turn has the goal of let him be calmer; so the indirect meaning of a caress may be "I want to calm you"
5. the **originary meaning**, that is, the primitive goal of the act from which the literal meaning might have evolved (e.g., through ritualization): for example, embracing might derive from a desire to wrap the other person, to incorporate her in oneself.

Table 7

1 **TOUCH**	2 **PARAPHRASE OR VERBAL COOCURRENT PHRASE**	3 **LITERAL MEANING**	4 **INDIRECT IDIOMATIC MEANING**	5 **ORIGINARY MEANING**
Drying the other's tears	c'mon, don't cry	I want to console you		I want to wipe your stress away as well as I wipe off your tears
Caress	oh nice, I love you	I want to give you serenity	I want you to be calm	I want to give you a pleasant sensation
Slap		I want to punish you	I want to send your face away from me violently	I want to take you your "face" (your dignity) away
Embracing	I love you	I love you		I want to wrap you all, I want to incorporate you in me

Again, for each item some variables of use were taken into account:

1. the **social attitude**: a slap is aggressive, "gimme five" is friendly (peer relationship), a kiss on the forehead is protective (the toucher and the touched person respectively have a higher and a lower status), a kiss on the mouth is erotic. It was also considered that some items of touch are aggressive or erotic only or mostly at an ironical level;
2. degree of **intimacy**: whether each gesture of touch can be used only by lovers, or by friends, acquaintances, or even unknown people;
3. **time**: at which point in an encounter each touch is usually performed, whether during the welcome, opening, during the encounter, or in the closing;
4. the **power** relationship between toucher and touched person: whether a gesture of touch can be performed only with lower status, peers, or also with upper status persons (Zollo 2001).

For a subset of all the touch items analysed, both the semantic analysis and the use variables were tested through questionnaires, by asking subjects, through multiple choice questions, the meaning they would attribute to each touch and when and with whom they would use it. The hypotheses about the use variables were largely verified, while the results of the semantic test are ambiguous in some cases, but generally very interesting and promising. In subsequent research this topic will be investigated in more depth.

11. Gaze

11.1. Formational parameters of Gaze

In previous works (Pezzato & Poggi 1998; Poggi and Pelachaud 2001), an analysis of gaze was carried on, and it was shown that the notion of Formational Parameters may be usefully applied also to gaze. Around one hundred cases of gaze, videotaped from tv talkshows, were collected, and for each item of gaze both the signal and the meaning were analysed.
To analyse the signal, each single gaze was described in terms of a number of parameters, which proved useful in distinguishing the items of gaze from each other (Table 8).
Some parameters to consider are the parts of the eye region (brows, wrinkles, eyelids...), others are features, movements and other aspects of the eyes per se (humidity, direction...). In fact, several parameters are pertinent, in that they have a communicative import. For example, the **eyebrow** movements, as it has been shown by scholars (mostly, Eibl-Eibesfeldt 1974; Ekman 1979), are typically engaged in the expression of emotions like fear, anger, surprise, worrying, but also in topic-comment marking and emphasis (Torres et al. 1999). **Eyelids** are also obviously important because they determine the openness of eyes, thus marking the withdrawing from interaction in cut-off, underlining excitement in flirting eyes and so forth. **Wrinkles** are particularly relevant in emotional expression: typically crow's feet are a cue to positive emotions, so much that they make the difference between a felt and a false smile (Ekman & Friesen 1982). Coming to eyes, **humidity** may be relevant both in joy or enthusiasm (bright eyes) and in sorrow (tears); **reddening** may be a cue to crying, and then sadness. **Pupil dilation** is a cue to sexual excitement or other kinds of arousal. As for the eyes' spatial behavior, on can distinguish **eye position** (the position of the iris in the sclera) from **eye direction**; moreover, the reciprocal relationship between eye direction and head and trunk direction is particularly important. The default is the case where head and eyes are all directed to the interlocutor; and any case departing from this is marked and then meaningful.

Table 8

Portion of the eye region	Part or aspect	Values
Eyebrows (right / left)	Inner part	up / down / central
	Medial part	up / down / central
	Outer part	up / down / central
Eyelids (right / left)	Upper	default / raised / lowered
		default / tense / corrugated
		blinking / winking / closed
	Lower	default / raised / lowered
		default / tense / corrugated
Wrinkles	Vertical / horizontal / curved / oblique	
	Central / lateral / all along forehead / between brows	
	Crow's feet / bulging (lower lid) / bagging (lower lid)	
Eyes (right / left)	Humidity	dry / wet / tears
	Reddening	default / reddened
	Pupil dilation	default / dilated / narrow
	Eye position	center / left / right / up / down / right corner / left corner
	Eye direction	forward / up / down / right / left / in the vacuum

11.2. The lexicon of gaze

As to the meaning of gaze, a complete lexicon has not yet been compiled but some classes of the meanings that gaze can bear have been found, and for each class some specific examples of gaze selected. Gaze can convey more types of information than one could think. (Table 9).

Within information on the World, eyes can make reference to **places** and **entities** located in them: we can point at things or people in a spatial context with a *"deictic gaze"*, which can be paraphrased as: "I am referring to some referent in that place", where the referent might be either a single entity, like a person or an object, or a whole event. Moreover, eyes may also have an adjectival function, in that they may mention a small number of physical **properties** of things: by squeezing eyes we may refer to very small objects, by wide open eyes to very large things. This is a case in which gaze is not a completely arbitrary signal, since it refers to a property of an object by squeezing eyes in the same way one would in adjusting vision to the object size. Examples of this gaze are often found in people telling tales to children, where every expressive device is spontaneously used in order to be better understood and to communicate even the emotional nuances of the tale better. Allusion to size may also be used in a metaphorical sense, for instance in talking of something conceptually subtle or precise.

Among information on the Speaker's Mind, gaze may provide information about the **degree of certainty** of our beliefs: we raise eyebrows to show perplexity and doubt on something we are mentioning, while we exhibit a slight frown to show assertiveness and self-confidence in saying something. And also, we provide **metacognitive information** by looking down obliquely when we try to remember something, and looking up when we try to make inferences.

Within information on the Speaker's goals, gaze may communicate the **performative** of our communicative acts. A peremptory order is communicated by a strict, serious gaze, with inner parts of eyebrows slightly closed as in an angry face (Poggi & Pelachaud 2000), while in an imploring gaze the inner parts of eyebrows are raised like in sadness: staring fixedly to our Interlocutor may be part of a defiant gaze. Again, eyes inform on the **topic-comment** structure of our sentences. While I am uttering the topic part, I do not look at the Interlocutor, while as I am on the comment, I look at the Interlocutor possibly also raising my eyebrows and opening eyes wide.

Types of gaze that provide **metadiscursive information** are not frequent; but we have some examples also in this class. For instance, an eyebrow raising generally accompanies adversative words like *but*, thus meaning that a rhetorical relation of contrast holds between a preceding and a subsequent sentence; squeezing eyes means something like "I am

going to be more precise now", thus providing the metadiscursive communication that one is going more in depth in the same topic as before.
Again, eyes have a function in turn-taking and backchanneling. Simply gazing at a conversant is a way to pass **speaking turn**; while asking for a speaking turn is better done by wide opening eyes, like in breathing to start speaking.
Among **back-channelling** goals, frowning signals that I do not understand what you're saying.
Finally, our gaze may show **social emotions**, those one can only feel towards another person, like love, admiration, scorn, anger at somebody; or else **individual emotions**, eventually triggered by natural events but not directed toward anyone in particular: fear, terror, joy, sadness, surprise, excitement, worrying, dismay.
Also in gaze, as well as in speech and other kinds of signals, we may have to distinguish between a literal and an indirect meaning. For instance, both looking down obliquely and looking up, at the literal level provide a metacognitive information ("I am trying to remember" or "I am trying to make inferences"), but at a second level (Poggi, 2001) they may imply a turn-holding request: "Let me think, please, let me finish expressing my thoughts".
The work for the construction of a lexicon of gaze is still in progress. After finding out the classes of meanings above, research is now directed to specify the different possible types of gaze in each class, that is, for instance, to distinguish, among the metacognitive class, what is the signal for "I am trying to make inferences" as opposed to that for "I am trying to plan a problem-solving", or, in the metadiscursive class, what is the gaze for "I am skipping this, since it is not important", and so on. This work will be carried on by analysing several videotaped examples of gaze and after that, possibly, through questionnaires to test the observers' intuitions about what is the meaning of that specific signal of gaze in that context.

Table 9

Some meanings of gaze				
World	Deictic			*Gaze at X* = I am referring to X
	Adjectival			*Squeeze eyes* = small, subtle, difficult *Open eyes wide* = big
Mind	Beliefs	Certainty		*Small frown* = I assert this, I am serious *Eyebrow raised with eyes not wide open* = I am in doubt about this
		Metacognitve		*Look down left* = I am trying to remember *Look up* = I am trying to make inferences
	Goals	Performative		*Fixed stare* = I dare you
		Topic-comment		*Gaze far from the Interlocutor* = this is the topic *Gaze to Interlocutor while raising the eyebrows* = this is the comment
		Discourse relations		*Raised eyebrows* = but *Squeeze eyes* = I precise
		Conversation regulation	Turn-taking	*Gaze at a conversant* = Please take the turn *Open eyes* = I want to take the turn
			Back-channel	*Frown* = I don't understand
	Emotions			***inner eyebrows raised*** = I am sad

12. Conclusion

Humans are endowed with a number of different communication systems in different modalities, some codified in memory and some creative, allowing to create signals on the spot. In this work I have argued that, among the codified systems, not only words or symbolic gestures, but also many other communicative systems in the visual and tactile modality may be acknowledged the status of lexicon, because their signals are linked to respective meanings in a systematic fashion. To argue this I have shown that, like in verbal languages, also in the systems of gesture, gaze and touch among the differentmeanings of a signal a common semantic core can generally be found, and I have proposed an explanation of how these different meanings may be linked to each other. I have finally shown that for these systems it is possible to find out their formational parameters and their values, thus writing down their alphabet, that is discovering their sublexical structure; and as for the investigation of the meanings in these lexicons I have presented a semantic taxonomy that can lead this lexical research. Finally, I have overviewed some work in progress aimed at writing down the lexicon and the alphabet of Italian symbolic gestures, touch, and gaze.

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