

Bosco, F.M., Tirassa, M. (1998)
Sharedness as an innate basis for communication in the infant.
Proceedings of the 20th Annual Conference of the Cognitive Science Society.
Madison, WI, August 1-4, 1998.

This paper is copyright of the authors and of Lawrence Erlbaum Associates.
Please go to <http://www.erlbaum.com/> if you want to purchase the whole volume.

Sharedness as an innate basis for communication in the infant

Francesca Marina Bosco and Maurizio Tirassa

Università di Torino
Dipartimento di Psicologia — Centro di Scienza Cognitiva
via Lagrange, 3 — 10123 Torino (Italy)
email bosco,tirassa@psych.unito.it

Abstract. From a cognitive perspective, intentional communication may be viewed as an agent's activity overtly aimed at modifying a partner's mental states. According to standard Gricean definitions, this requires each party to be able to ascribe mental states to the other, i.e., to entertain a so-called *theory of mind*. According to the relevant experimental literature, however, such capability does not appear before the third or fourth birthday; it would follow that children under that age should not be viewed as communicating agents. In order to solve the resulting dilemma, we propose that certain specific components of an agent's cognitive architecture (namely, a peculiar version of sharedness and communicative intention), are necessary and sufficient to explain infant communication in a mentalist framework. We also argue that these components are innate in the human species.

1. Introduction

Cognitive pragmatics is concerned with the mental processes involved in intentional communication. A theory in cognitive pragmatics aims at describing what goes on in the mind of an agent who is communicating with a partner. To view intentional communication as part of the mental events and of the interactions with the world that real agents entertain imposes to frame one's specific research within some broader perspective on the nature and functioning of the mind.

The topic of the architecture of the human mind lies at the intersection of several lively debates within cognitive sciences. Our work is grounded in three perspectives, namely, classical pragmatics and speech act theories, the literature concerning the so-called *theory of mind* (i.e., the capability of understanding another individual's mental states), and current advancements in developmental and evolutionary psychology. We consider cognition a biological, innately structured phenomenon, which finds its remote roots in the evolutionary history of the species, and develops in each individual through the history of the interactions between her¹ innate endowment and the surrounding environment.

This research is concerned with the innate predispositions underlying intentional communication. By communication we refer to an agent's faculty of intentional action overtly aimed at the modification of a partner's mental states (Grice 1989). This requires dedicated components of the cognitive architecture (Airenti, Bara & Colombetti 1993), which have to be common to all

¹ Individual agents will be referred to with the feminine; in the case of communication, the feminine will be used for the first agent only, and the masculine for the partner(s).

the members of the species; in other words, we view communication as a species-typical competence (Tirassa 1997, in preparation).

The minimal specific components of communicative competence are two mental state types, namely, *shared belief* (i.e., the agent's ability to unilaterally construe her own mental states as mutually known to a partner), and *communicative intention* (i.e., the agent's ability to act so that a partner will notice her actions and ascribe them a suitable communicative meaning). A third component, which we will not discuss here, is an adequate (set of) input/output channels like language, gesture, etc.

In a Gricean definition of communication as the overt attempt to modify a partner's mental states, it is necessary that each party involved possess the ability to represent and understand the other's mental states. This capability commonly goes under the name of *theory of mind* (henceforth, ToM). Most of the relevant literature agrees that this capability starts to appear around the third or fourth birthday (Baron-Cohen 1995; Clements & Perner 1994; Perner 1991). A serious problem then arises: children under this age should not be viewed as communicative agents, which is rather implausible in the light of any everyday observation of an infant's behavior.

To solve the resulting dilemma, we propose to consider sharedness as the basis for intentional communication in the infant, and to view it as a primitive, innate component of her cognitive architecture. This will also imply a redefinition of the concept of communicative intention. Communication can then build upon the common background that she shares with her caregivers. We view this capability as a theory of mind in a weak sense (cf. Premack & Woodruff 1978), namely, as the infant's plain capability of recognizing certain other world entities as agents in their own respect, and therefore as plausible communicative partners.

A full-fledged ToM requires instead an agent to be able to explicitly represent and therefore possibly verbalize such recognition; and, most of all, to construe each entity she views as an agent as endowed with his own private and autonomous mental states, which may resemble but are not necessarily identical to those of the child herself. This high-level capability develops later, as the child acquires the ability to discriminate between what is actually shared with each specific (set of) partners and what is not, i.e., as she realizes that certain mental states are private of her own and that only some of them may be considered shared with other agents.

Our position does not contravene the available experimental data concerning ToM, in that we do not argue that explicit ToM is already manifest in the young child, but that she can communicate by resorting to a more primitive ability of plain sharedness.

Cognitive pragmatics

We have defined cognitive pragmatics as the study of the mental processes involved in intentional communication. The roots of this relatively new field may be traced to mentalist readings of work done in the philosophy of language by Austin (1962), Grice (1989) and Searle (1969, 1979), as well as to later attempts to formalize it in a computational perspective (e.g., Allen & Perrault 1980; Cohen, Morgan & Pollack eds. 1990; Cohen & Perrault 1979). The works which are most relevant for our current goals are those developed by Airenti, Bara & Colombetti (1993), Clark (1992, 1996), Sperber & Wilson (1986), and Tirassa (1997, in preparation).

Our approach, like the others we have mentioned, is cast in terms of the mental states that an agent has to possess in order to be able to engage in intentional communication with a partner. It has to be remarked, however, that we consider as mental states not only the classical set of epistemic and volitional states like beliefs and intentions, but also other types of awareness like emotions or the mental correlates of inner physiological states (e.g., hunger, fear, and so on).

The idea behind many such theories of pragmatics is that the actual meaning of any communicative action is not univocally predefined as an *a priori* by the actor, but results from a cooperative process in which both agents involved take an active part. Communicative interactions, in other words, may be conceived as only existing against a common background (Airenti, Bara & Colombetti 1993; Clark, 1992, 1996; Tirassa 1997). This common background includes an amount of knowledge about each agent's private and public mental states, reciprocal expecta-

tions, and other types of social knowledge: it provides a framework within which each agent can plan and understand the meaning of communicative actions. A dialogue can only proceed if the interactants continuously contract and revise this background, whose creation and flexible modification requires each of them to actively play her own role.

This implies that we deal with communicative meanings in terms of ascription. The meaning of a communicative action is the meaning that the agents involved sharedly give to a certain event brought about by one of them. Communicative actions, in this framework, have no meaning *per se*: their meaning is to be found in the mental states that each party shares with the other.

These approaches to communication require each agent involved to recognize the partner as another agent in his turn, i.e., as an individual endowed with mental states: no one attempts to engage in communicative interaction with an entity she does not perceive as a plausible partner. This requirement is commonly known as the requirement that the agent entertain a theory of mind. This, however, creates a problem: since most current literature on ToM concludes that a child has no such capability before the third or fourth year of age, it follows that children younger than that should not be viewed as communicating in a Gricean framework.

In principle, this problem might be solved by adopting two completely different theories of communication: a mentalist one, based on the reciprocal modification of the interactants' mental states and capable of explaining adult communication, and a nonmentalist one (which we will later call *ethological*), based on some completely different process and solely dedicated to the explanation of infant communication. We will argue below that it is instead reasonable to adopt the same mentalist approach both to adult and to infant communication (see also Airenti, in press). On the other hand, this framework implies that children be viewed as agents capable of taking an active role of their own in communication, in spite of not being able to explicitly theorize about the partner's mental states. This requires in turn that the whole approach we have described be reconsidered from a different point of view.

Sharedness and intention in infant communication

In order to adopt a cognitive perspective on infant communication, we propose to take, as a necessary and sufficient basis for communication, a more primitive recognition of agency than a full-fledged ToM. This basic capability is the first means a child has to engage in communicative interactions with her social environment. However simple from an adult's viewpoint, these protointeractions are the child's first steps toward a full ToM-based communication, building upon a later, explicit understanding of what goes on inside a partner's mind, i.e., of what his mental states are and what differences they bear to those of her own.

The ability to recognize other entities of the world as individual agents is innate in the human species (Leslie 1994, Premack 1990); the later acquisition of a ToM and of the ability to engage in adult-like communication is thus due to the interaction between specific innate components of an agent's cognitive architecture and her social environment, rather than to a process of simple learning.

We adopt the basic framework of a computational theory of cognitive pragmatics, formulated by Airenti, Bara & Colombetti (1993), and modify it so to account for the early development of communicative competence. In our account, the two basic architectural components that allow an infant to communicate are a peculiar version of *sharedness* and of *communicative intention*.

Airenti, Bara & Colombetti (1993) prove that these concepts are logically necessary for communication. Their argument traces back to a drawback in Grice's (1957) account of non-natural meaning (i.e., of communication). In Grice's analysis, communication involves the agent's intention that the partner recognize her intention as communicative. To be more precise: if Ann says to Bob "Don't forget your umbrella when you go out: there's going to be a rain-storm", her utterance is communicative iff she intends, by uttering it: (i) to induce Bob to take an umbrella, (ii) to let Bob recognize intention (i), and (iii) to let such recognition be (at least part of) Bob's reason for taking an umbrella.

The problem with Grice's account is that it involves an infinite regression, whereby it is always necessary that the agent entertain a $(n+1)$ -th intention that her n -th intention be recognized

(Strawson 1964; Schiffer 1972). To avoid this pitfall, Airenti, Bara & Colombetti (1993) introduce the concept of overttness, and deal with it in terms of shared mental states. They define *shared belief* as a unilateral primitive mental state, rather than the end point of an infinite nesting of mental states of the *Ann believes that Bob believes that Ann...* sort. In other words, an agent sharedly believes that p with a certain partner iff she believes both that p and that the partner sharedly believes that p with her.

This definition allows Airenti, Bara & Colombetti (1993) to also define *communicative intention* as a circular primitive of the same sort: in particular, as the intention to overtly make some of the agent's private mental states shared with the partner. *Overttness* here means that the very intention to communicate has to be made public in its turn. To be more precise: an agent intends to communicate that p to a partner iff she intends to share with the partner both that p and that she intends to communicate that p to him. Colombetti (1993, 1998) has provided formalized definitions of both the mental state types we have discussed in a modal logic language.

Shared belief and communicative intention are thus logically necessary components of the architecture of a communicating agent. Although adult communication will also have to include private beliefs and a more sophisticated concept of intention, we propose that these two basic components, appropriately reconsidered, are sufficient to explain infant communication.²

Sharedness is an agent's ability to construe her own mental states as mutually known to a partner. This is the starting point of communicative interaction, which may then be viewed as the progressive modification of the common background shared between the participants. Sharedness is made possible by the fundamental identity of all human beings' cognitive architecture, which allows us to recognize our conspecifics as having mental states qualitatively similar to ours and therefore to view them as plausible communicative partners (Tirassa 1997).

We hypothesize that a young child may communicate by resorting not to a full-fledged ToM, as implied by the relevant literature, but simply to the capability of sharing her mental states with her partners, provided that she is incapable of *not* sharing them. In a reversal of the classical approach, according to which the infant is unable to ascribe mental states to other individuals, we argue that she is unable not to consider her mental states shared with the partners. In this perspective, the egocentrism of the pre-ToM child may be interpreted not as the inability to view the conspecifics as endowed with mental states, but as the inability to understand that they do not necessarily share her own mental states. In her earliest stages of life, a child would then take all of her experiential states as shared with her partners. In our proposal, for an infant to share all of her mental states means that they are, in her own perspective, intrinsically public.

An adult's, or an elder child's, ability to share *not* all of her mental states (i.e., to understand that both her and her conspecifics have mental states private of their own) is instead made possible by the presence of a full-fledged ToM, i.e., by her ability to differentiate her mental states from those that may be ascribed to the partner. This may be a later acquisition in child development, possibly supported by increasingly complex social interactions with the caregivers.

As for *communicative intention*, Airenti, Bara & Colombetti (1993) define it as an agent's intention to add to — or, in general, to modify — the common background shared with the partner, i.e., as an individual's capability of acting in such a way that a partner may notice her actions and ascribe them a suitable communicative meaning.

Our proposal in this respect is that, if the child shares all her subjective reality with the partners, then every action she may perform is performed in the cognitive space she shares with them and has therefore a communicative meaning. An infant would simply entertain an undifferentiated type of intention, which would be neither strictly private nor strictly communicative, since the difference between the two would require her to be aware that some of her mental states are not actually shared.

To make an example: a hungry child would simply take it for granted that her caregivers share this mental state of hers, which would bring her to also take it for granted that her hunger will be satisfied. From the viewpoint of a strictly Gricean theory of communication, her cry would not be considered intentionally communicative, because this would require that she be able to draw an explicit distinction between the mental states she takes as private of her own, those she takes as private of the caregivers', and those she takes as shared with them. She can-

² We remind that we are only dealing here with the mental states involved in communication, and not with the various behavioral means that an agent may employ to make her communicative intentions manifest.

not therefore be said to entertain a fully communicative intention, according to the definition given above. However, she can take it for granted that every behavior of hers is public, i.e., shared with the caregivers: private and communicative behavior are simply one and the same thing.

Later on, with the full development of ToM, the infant would begin to recognize that both she and the other individuals have their own private mental states, qualitatively similar but not necessarily identical to those of their partners. This will enable her to realize that only some of an agent's mental states may actually be shared with another individual. This will be the beginning of intentional communication in a fully Gricean definition: as ToM develops, communication will become one of the means available to a certain end, and not a plain state of the world.

Still later, this capability will become explicit, more similar to a *theory* in the literal acceptance of the term; this will allow the elder child to reason upon and to try to affect the others' mental states in a more sophisticated, adult-like way, and therefore to deal, e.g., with wrong beliefs and their revision, deceits (involving a crucial difference between an agent's public and private mental states), and so on.

Communication and innatism

Explicit ToM becomes manifest around the fourth birthday; Clements & Perner (1994) have found evidence of an implicit ToM appearing around the third. Most researchers agree that these abilities do not start from scratch, but find their precursors, or prerequisites, in earlier cognitive capabilities, like gaze monitoring and joint attention (Baron-Cohen 1995). In any case, there is strong evidence that a child younger than 3 or 4 is incapable of differentiating her own mental states from those that can be ascribed to other individuals. This implies that she is unable to communicate in a fully Gricean way; unless one is willing to assert that she does not communicate at all, this leaves open two possibilities.

In principle, two individuals belonging to the same species may interact in two ways: *ethological*, i.e., affecting each other's behavior by way of a fully codified repertoire of behaviors; or *psychological*, i.e., affecting each other's mental states by way of intentional communication. These two types of interaction are found in different species, emerge in different phylogenetic stages, and are irreducible to each other; the latter, but not the former, requires certain specific mental states, only typical of the highly complex cognitive systems of socially sophisticated species like ours.

An explanation of infant communication based on an ethological perspective would pose serious problems. As a first thing, it is not parsimonious, from a scientific standpoint, to have to formulate two completely different theories for communication in the adult and in the infant.

The greatest difficulties, however, would come from the attempt to understand the transition from the ethological theory supposedly used by the infant to the psychological one used by the elder child and the adult. A first possibility is that the ethological theory would simply vanish, leaving room for the psychological one; this, however, seems rather implausible and even hard to understand.

A second, more interesting, possibility would be to postulate an evolution of the ethological theory into the psychological one. We argue, however, that this will not work either. How could an infant learn that the caregivers are endowed with mental states, starting from an ethological theory? Such knowledge cannot come from the simple observation of their behavior, because an organism's mental states — or even the simple fact that that organism does actually entertain mental states — cannot be inferred from the plain observation of that organism's behavior (Searle 1992; Turing 1950; Watson 1913). Ethological and psychological theories are intrinsically different, and the latter cannot be derived from the former, nor from their local or global falsification. This is, in practice, a reformulation of what is known in linguistics as the argument from the "poverty of the stimulus".

There is, in other words, a circular problem with the ethological stance: if an infant had no idea that the caregivers are endowed with mental states, she would have no way to make such discovery starting from the observation of their behavior. The only way to interact with other human agents *qua* human agents is by viewing them as intentional from the beginning.

Recognizing conspecifics as plausible communicative partners cannot be a matter of learning; nor can it be learned that they possess mental states or that these states can be more or less different from ours. Therefore, the capacity of entertaining shared beliefs and communicative intentions have to be innate and species-typical in order to justify the very existence of human communication. This does not mean that these mental states are present at birth: our point is that they result from the evolution of earlier, undifferentiated states of sharedness and intention. Both these earlier mental states and the patterns of their development into adult-like states (which will include the ability to differentiate between private and shared beliefs, and between private and communicative intentions) have to be innate. The full development of the earlier states into the later ones, of course, may well require appropriate interactions with the social environment. Our point here is thus that the child cannot *learn* that there exist other beings, similar to her, with whom she may communicate: this knowledge has to be part of her innate competence. Only this allows for the creation and modification of a common background with the caregivers.

Conclusions

We have proposed that there exist primitive components of human cognitive architecture, necessary for intentional communication as it has been defined since Grice (1957), arguing that they have to be innate in order to allow for the very existence of communication. These components are sharedness and communicative intention (plus, of course, an appropriate set of input/output channels like language or gesture).

These components have to be somehow present in the infant, if she has to be viewed as part of the human communicative collectivity (which is also the only way to guarantee that she will learn what she has to learn from her social environment). There is, however, evidence that they cannot be present in the same sophisticated form they take in the elder child and the adult: something simpler is therefore needed to explain infant communication.

We have argued that our version of undifferentiated sharedness and intention are the necessary and sufficient components of an infant's communicative competence. A key point of this argument is that this requires a very early, innate capability of recognizing agency, i.e., of viewing certain entities of the world as agents endowed with mental states, and certain events of the world as brought about by agents rather than by physical necessity.

Acknowledgments. This research has been funded by the National Research Council of Italy (CNR), Coordinate Project on *Planning and plan recognition in communication*, 95.04019.CT11, 96.01787.CT11, and 97.00161.CT11.

References

- Airenti, G. (in press) Dialogue in a developmental perspective. In: *Proceedings of the 6th Congress of the International Association for Dialogue Analysis, 1996*. Tübingen: Niemeyer.
- Airenti, G., Bara, B.G., Colombetti, M. (1993) Conversation and behavior games in the pragmatics of dialogue. *Cognitive Science* 17: 197-256.
- Allen, J.F., Perrault, C.R. (1980) Analyzing intention in utterances. *Artificial Intelligence* 15: 143-178.
- Austin, J.L. (1962) *How to do things with words*. London: Oxford University Press. 2nd ed. revised by J.O. Ormson & M. Sbisà, 1975.
- Baron-Cohen, S. (1995) *Mindblindness. An essay on autism and Theory of Mind*. Cambridge, MA: MIT Press.
- Clark, H.H. (1992) *Arenas of language use*. Chicago, IL: University of Chicago Press.
- Clark, H.H. (1996) *Using language*. Cambridge: Cambridge University Press.
- Clements, W.A., Perner, J. (1994) Implicit understanding of belief. *Cognitive Development* 9: 377-395.
- Cohen, P.R., Morgan, J., Pollack, M.E., eds. (1990) *Intentions in communication*. Cambridge, MA: MIT Press.

- Cohen, P.R., Perrault, C.R. (1979) Elements of a plan-based theory of speech acts. *Cognitive Science* 3: 177-212.
- Colombetti, M. (1993) Formal semantics for mutual belief. *Artificial Intelligence* 62: 341-353.
- Colombetti, M. (1998) A modal logic of intentional communication. *Mathematical Social Sciences*, in press.
- Grice, H.P. (1957) Meaning. *The Philosophical Review* 67: 377-388
- Grice, H.P. (1989) *Studies in the way of words*. Cambridge, MA, and London: Harvard University Press.
- Leslie, A.M. (1994) ToMM, ToBy, and Agency: core architecture and domain specificity. In: *Mapping the mind. Domain specificity in cognition and culture*, eds. L.A. Hirschfeld & S.A. Gelman. Cambridge: Cambridge University Press.
- Perner, J. (1991) *Understanding the representational mind*. Cambridge, MA: MIT Press.
- Premack, D. (1990) The infant's theory of self-propelled objects. *Cognition* 36: 1-16.
- Premack, D., Woodruff, G. (1978) Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences* 1: 515-526.
- Schiffer, S.R. (1972) *Meaning*. Oxford: Oxford University Press.
- Searle, J.R. (1969) *Speech acts: an essay in the philosophy of language*. London: Cambridge University Press.
- Searle, J.R. (1979) *Expression and meaning*. Cambridge: Cambridge University Press.
- Searle, J.R. (1992) *The rediscovery of the mind*. Cambridge, MA: MIT Press.
- Sperber, D., Wilson, D. (1986) *Relevance. Communication and cognition*. Oxford: Blackwell. 2nd ed. 1995.
- Strawson, P.F. (1964) Intention and convention in speech acts. *The Philosophical Review* 73: 439-460.
- Tirassa, M. (1997) Mental states in communication. *Proceedings of the 2nd European Conference on Cognitive Science*, Manchester, UK.
- Tirassa, M. (in preparation) Cognitive pragmatics and the architecture of the mind.
- Turing, A.M. (1950) Computing machinery and intelligence. *Mind* 59: 433-460.
- Watson J.B. 1913. Psychology as the behaviorist views it. *Psychological Review* 20: 158-177.