Dimensions of Embodied Communication
-   **towards a typology of embodied communication**

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1.   Why and what?

A very basic reason for studying "embodied communication" is that the concept awakens hopes of greater descriptive and explanatory adequacy for theories of language and communication. Whether this hope is realistic, of course depends on what embodied communication is.

The concept of embodied communication can be analyzed as having three conceptual components that can be brought out by the words "embodiment", "body" and "communication".

Semantically, the phrase "embodied communication" expresses a reification of a 2-place dynamic relation "embody" between the two arguments "communication" and "body". This relational structure can be used both to further explicate the conceptual components and to suggest some possible typologies of "embodied communication".

Thus, an analysis can be based on all three elements, i.e. embodied communication can be analyzed and classified from the point of view of what types of bodies or aspects of bodies it involves, it can be classified from the point of view of what types of communication or aspects of communication are involved and finally from the point of view of what type of relation of embodiment (or aspects of such a relation) are considered.

In harmony with the above, he structure of the paper is as follows. In section 1, the concepts (or meanings) associated with the words "embody", "body" and "communication" are briefly examined. In section 2, this analysis is used to suggest some possible first typologies for "embodied communication". In section 3, the concept of communication is then examined a little more in depth, by bringing out several conceptual dimensions associated with communication and asking how these might be embodied. In section 4, this examination will be used to present a somewhat more refined communication based typology of "embodied communication". Section 5 concludes the paper.

1.1   Embodiment

Let us first briefly consider the three main concepts by examining how the words expressing the concepts are actually used. A glimpse of this can be had in a so-called concordance where a word can be seen as used in a particular context. Below is an example of part of a concordance for the word "embodied" taken from the British National Corpus.

Table 1 Concordance of the word "embody"

\# the power *embodied* in a railway train could never be embodied in art. \# a shell of nacre that **embodied** all its notions of the perfect \# sorrow was too vast to be *embodied* in music, or music too ethereal to uplift a mortal woe \# he soon discovered that virtue which Plato thirsted to see *embodied*. \# becoming more and more gross and *embodied*, as they emerge farther from the shadows of their antique origin \# after a hundred efforts, I have *embodied* something of my thoughts \# these verses which *embodied* the fashionable philosophy of the day \# political freedom and of natural justice *embodied* in that Declaration of Independence \# "and am I, therefore, called upon to no other than "philosophy and theology *embodied*.\# etc

When we examine the uses of "embodied" exemplified in the concordance, we see that "embody" seems to be used for relations that might also be expressed by words like "realize, "actualize", "exemplify" and "express".

Attempting to generalize over these uses, we might say that "embodiment" makes the intangible tangible and amenable to observation, consideration and investigation or perhaps that "embodiment" renders a phenomenon X possible to experience in concrete terms.

If we feel that this characterization of the meaning of "embodiment" is too wide or general, we can try to stipulate a more specific sense of "embodiment" (e.g. "embodiment" in the sense of being part of biological body) as the one we are interested in. An alternative method is to try to use qualifying terms like "physical" or "biological" to get more specific types of embodiment like "physical embodiment" or biological embodiment".

1.2 Body

Another way to capture the meaning of a term (and thus also the concept associated with the term) is to give a definition of the term. The following is a definition of the meaning of the term "body" in a wide sense

Body = def. any delimitable entity with extension and possibly content.

This definition, thus, excludes entities that have no extension. Examples of this are geometrical points but also mental entities if, they, in the Cartesian way, are defined as having no extension. To embody a mental entity, in this sense. is thus to add extension to the entity.

This definition of body captures many of the most basic concrete uses of the word "body", as in "physical body" and "biological body". It is less compatible with

abstract uses of "body" like in "body of knowledge", where unless the word "extension" is taken in a metaphorical non-physical sense, we perhaps have to conclude that "body of knowledge" implies something that is not purely mental, e.g. books, films or other media that serve as carriers of knowledge.

The definition also allows for a qualification of more particular senses of "body" such as

animal body = def. delimitable biological entity (with extension (content)) capable of self sustainment and reproduction.

This definition covers "living" and animal biological bodies where for "living bodies" but not for "dead bodies", it holds that they are capable of reproduction, autonomy and sustainment.

1.3 Embodiment and body

Limiting our analysis to the physical and biological sense of "body", we may now say that "embodiment" denotes a relation between a physical or biological body and some phenomenon X (the body B embodies X, or X is embodied in B) where this relation can be of at least four different types.

(i)   Actualization: X is "actualized" in the body
(ii)   Containment: X is in the body
(iii) Link: X is linked to the body
(iv) Property: X is a property (aspect) of the body

In addition to these four cases, we may also consider the reverse case, i.e. the case where a body B is embodied in X. Here a body B is being related to X (the body often being some sort of property of X). An example of this can be found in so called "embodied concepts" or "embodied meanings", i.e. concepts and meanings that have been shaped by the body, e.g. color words, words for spatial relations or words for so called "basic categories" (cf. Lakoff and Johnson, 1999). In such cases, the word meaning is claimed to be embodied, since a relation to the body constrains and shapes the meaning and in a sense becomes a property of the meaning.

1.4 Communication

In the widest sense, the word "communication" can be defined as follows.

Communication = def. the sharing of anything between two or more arbitrary entities

Note, that this definition is different from many classical definitions of "communication" (cf. Shannon and Weaver 1949), in that it defines "communication as primarily involving "sharing" rather than "transfer". The reason for this is that "sharing" unlike "transfer" recognizes the active participation of not only the "sender" but also of the "recipient" in communication. Another consequence is that the definition using "sharing" rather than "transfer" is less open for "transport uses" of the word "communication", as when one talks of "communication by car, train, boat or plane". The sender is conceptualized as an initiator of "sharing" rather than as

an initiator of "transfer" and the recipient is conceptualized as an activated cosharer rather than just as a passive recipient. In this way, this definition of communication lays the foundation of a "two-way" rather than a "one-way" concept of communication. In fact, perhaps it might be better to say that the definition opens for a "many-ways" concept of communication, since communication, not infrequently can involve more than 2 parties who might be more or less active. If they are less active, they might be described by labels such as "eavesdroppers" or "audience". Using the "sharing" perspective on communication, they will, however, not be regarded as merely passive, since perception and understanding of what is being communicated also requires their activity.

If we think that the sense of communication given above is too wide, we may, similarly to what was suggested for "body" above, qualify and specify the sense of communication we are interested in, for example, by specifying properties of the participants (senders and receivers) or the nature of what is shared. Thus, we might define "animal communication" as "sharing of information between at least two cognizant living organisms" or "human communication" as sharing of content (or information) between at least two human beings. If we want the definition to be more specific, we can define "human communication" as sharing of information involving at least two human beings in interaction with each other and with the context (environment). "Information" can then be further qualified as "content", "meaning" or "understanding", where all these three concepts have their own specific properties which, depending on circumstances, could be in focus for the analysis.

The process of communication and the communicators can also be further qualified with regard to properties such as awareness, intentionality, control and conventionalization. In other words, communication can exhibit degrees of awareness (from unaware – to aware), intentionality (from unintentional – to intentional), control (from controlled to uncontrolled) or conventionalization (from unconventionalized to conventionalized). We can thus speak of conscious (aware) and intentional communication as well as of unconscious and unintentional communication. Note here that reflection on whether "dead communication", in the sense of "communication of energy", is possible, strongly suggests that such qualities as "life", "consciousness" and "intentionality" create a qualitatively different sense of both "communication" and "embodied communication". In addition to the properties just discussed, there will therefore in a continued analysis be different kinds of causal processes and context involvement underlying these properties, which can also be further qualified.

The differences between the definitions and the various ways of determining the sense of "communication" will have consequences not only for what should be regarded as "communication", but also for what should be regarded as "embodied communication". One example of this can be seen in the discussion of what visually noticeable body movements should be regarded as communicative, i.e. as gestures. Should only those movements be regarded as communicative that are intended by the sender to be communicative (cf. Poggi, et al 2000) and Kendon 2004) or should all body movements that influence a recipient, regardless of whether sender or recipient are aware of this, be regarded as communicative (cf. Allwood 2002).

The definition of communication as "sharing of information" also opens for another important aspect of communication, namely that it usually takes place in joint social activities (e.g. cf Allwood 2000), where communication is seen as an instrument for the accomplishment of the activity (cf. Malinowski 1922). A further effect of this is that the definition opens up for a consideration of "modes of sharing in communication", i.e. communication can vary from being a case merely of coordination, to collaboration and cooperation (cf. Allwood 1976) and Allwood, Traum and Jokinen 2000) and even include modes of conflict and competition.

This turns out to have interesting consequences for the semantic and pragmatic analysis of the content of communication, where we now have to consider mechanisms which make possible various types and degrees of "shared content", "collaborative content", "coconstructed content", "cooperative content". A first suggestion could here be to say that sender and receiver are "activating similar content" in such a fashion that the activities of both parties are dependent on each other through interactive modes such as coordination, collaboration, coconstruction or cooperation in the service of a joint activity. As a kind of base line, it might here be worth noting that some sort of coordination is required, even when communication is conflictual or competitive, rather than collaborative or cooperative.

It might further be worth noting that viewing communication through the perspective of "sharing" changes the criterion for "successful communication". In the "transfer" based view of communication , this criterion amounted to saying that "successful communication" required that the content transferred by the sender was identical to the content received by the recipient, i.e. "identity of content". In the "sharing" view of communication, this criterion rather becomes "sufficient coordination of content for the purposes of the current joint activity", i.e. the contents activated in sender and receiver must be sufficiently coordinated to allow for continued communication and joint activity. The "sharing" perspective on communication might, thus, be seen as a way of developing and specifying the so called "cooperative principle" formulated by H. P. Grice "make your conversational contribution such as it is required, at the stage at which is occurs by the accepted purpose or direction of the talk exchange in which you are engaged", cf. Grice (1975).

1.5   Embodied Communication

Let us now use the definitions and analyses of the concepts of "embody", "body" and "communication", given above, to try to provide four alternatives regarding how to determine the concept of "embodied communication". Thus, we have "embodied communication" if

(i)   at least two bodies (biological or physical) **actualize** (provide occurrence in space-time) "information sharing". By being open to both biological and physical bodies, this definition includes communication involving machines, avatars or other virtual communicators.

(ii)   the "information sharing" between two bodies is a bodily process taking place **in their bodies**. This definition would be very compatible with a "monistic materialistic" outlook on embodied communication (cf Armstrong (1975 and 1978).

(iii) "the information sharing" (conceived of as something mental) is **linked to** a biological or physical body. The link could be causal and one-way as in epiphenomenalism or causal and two-way as in Cartesian dualism. It could also be a case of supervenience, (cf. Chalmers 2003) or be driven by God as in medieval "occasionalism" (cf. Malebranche 1993).

(iv) "information sharing" is a **property** (or **aspect**) of physical or biological bodies in contextually influenced interaction. This view would come close to a Spinoza inspired "aspectualist" or "parallel theory" inspired view of embodiment (cf. Spinoza 1989).

Finally, we might also in a kind of reversal of perspective, as suggested above, try to use the concept of "embodied communication" to shed light on phrases like "foot of the mountain" or "head of the organization", by saying that they are cases of shared meanings which are shaped, constrained or metaphorically inspired by the body

1.6 Embodied communication – some puzzles and issues

An initial puzzle in contemplating the meaning and concepts expressed by the phrase "embodied communication" is that the phrase implies that "embodied communication" is a special case of "communication". "Embodied communication" is a type of "communication", but might there also be types of "communication" which are not embodied? The problem is that it is not so easy to determine just what the nature of non-embodied communication would be. In fact, one suspects that the linguistic structure of the phrase is misleading and that communication perhaps always is embodied. Another puzzle that is related to the first might be expressed by the questions "What is being embodied?" and "What is the nature of the embodying relation". This might then lead to further questions like: "Should what is being embodied be something other than a body or can it be another type of body?" If "communication" is something different from a body, what is it? For example, is it something "possible" rather than "actual", something "mental" or something "social" to give three possibilities from traditional (philosophical) literature. If it is a type of body, what kind of body is it?

A third issue can be raised by comparing the notions of "embodied communication" and "embodied cognition". The notion of "embodied cognition" was created, e.g. cf. Lakoff and Johnson with a clear anti-dualist intention. Is this also true of "embodied communication"? if it is, the conceptual determinations of "embodiment" which allows for dualism (mainly the linking sense) would have to be rejected.

A fourth issue concerns the fact that many definitions and analyses of both "embodied cognition" and "embodied communication" tend to focus on the importance of a biological or physical body for cognition or communication and tend to defocus the important of interaction, activity and context. Can these phenomena be seen as aspects of embodiment or do they have to be seen as additional elements to be added to embodiment?

More generally, we may ask what are the properties and dimensions of human communication and how are they related to each other and to embodiment?

Specifically, we know that human communication has physical aspects (is embodied physically) through media of communication such as sound waves, light waves and molecules that trigger smell and taste. It also has biological aspects involving organs (brain, vocal tract, arms. hands, etc) of information of production and information reception and processing (brain, ears, eyes, etc). It also involves psychological aspects (planning, intention, perception, understanding etc), and social aspects (interaction, joint information and communication systems like language). In the case of the physical and biological aspects, they, in a sense, provide the embodiment directly while in the case of the psychological and social aspects, more of a discussion of what embodiment involves is required. For example, one may ask if human languages (and other systems of communication) are disembodied counterparts of embodied systems and, if this is the case, what the nature is both of the disembodied systems and of their embodied counterparts.

2.   A first suggestion for typologies of embodied communication

Using what has been said above, we are now in a position to suggest a first set of typologies of embodied communication. As suggested initially "embodied communication" may be classified from the point of view of each of its main conceptual components, body, communication and embodiment.

Body

From the perspective of the "body", the embodying substratum we may distinguish
(i)   physical embodied communication
(ii)   biologically embodied communication
(iii)   other types of embodied communication

All three types have several subtypes and as we shall see often occur in combination with each other, so that physical and biological embodiment become parts of a larger complex of embodiment. The category "other types of embodiment" covers a miscellaneous set of phenomena such as "abstract embodiment" and "metaphorical embodiment".

Communication
As we shall see, the concept of communication affords several types of classification. One kind of classification makes use of the type of relation that is seen as classifying communication (genus proximum).
Is communication
                -       a type of transfer (Shannon and Weaver 1949)
                -       a type of sharing (Allwood 2000)
                -       a type of resonance (St Clair and Busch 2000) or
                -       a type of contagion (Alajaji and Fuji, 1994)

Irrespective of which relation we use to classify communication, e.g. "transfer" or "sharing", we may, in a second step, ask how the relation is embodied.

As a result we get taxonomies such as the following

(i)   embodiment of communication as sharing
(ii)   embodiment of communication as transference
(iii)   embodiment of communication as resonance
(iv)   embodiment of communication as contagion

The differences between the physical and biological processes that are required to capture the four types of relation will bring out the differences in embodiment between the four perspectives. If the difference between the perspectives is compatible and complementary, rather than incompatible, we might even find that all or several different types of embodiment are needed for different aspects of communication.

Besides classifying communication from the point of view of the process or relation involved, we may, as already noted, also classify communication from the point of view of the information shared, the communicators involved or from the instruments employed in communication, etc. and for all of these features of communication, we may then also ask how they are embodied.

For further possibilities, see section 3 below, where we will discuss other features of communication which give rise to new possibilities of classifying communication and embodied communication.

Embodiment

Thirdly, we can classify "embodied communication" from the perspective of the relation of embodiment. If we define "communication" as "sharing of information", and "embodiment" as one of the four types distinguished above, we can characterize the "embodiment of communication" as

(i)   **actualizing** the sharing of information. (Actualize is taken in the sense of making something potential actual, for example, the potential of communication is actualized through neural activity, behavior and acoustic or optical energy.)

(ii)   activating processes **in** physical or biological bodies

(iii)   being **linked** to certain processes in physical or biological bodies

(iv)   focusing on certain **properties or aspects** of physical or biological bodies.

Formulated this way, it seems reasonable to claim that the four senses of embodiment discussed, in fact, are compatible. **Actualization** can take place by being **linked** to processes that are often taking place **in** physical or biological bodies. These linked processes can then, in turn, be seen as a **relational property** or **aspect** of the sharing of information. What this means is that the four senses of embodiment we have distinguished may be seen as the result of four different perspectives on an underlying relation and that the typology points our attention to the possibility of these different perspectives.

3.   Dimensions of Communication

3.1   *Requirements on a description of "embodied communication"*

Let us now try to approach the problem of determining the nature of "embodied communication" in a different way from that which has been discussed above. If we compare different scientific ways of investigating the notion of human "embodied communication", there are at least the following:

1.   Directly investigating the biological (mostly neural) and physical correlates of human communication.

2.   Modeling the biological and physical properties of human communication by building models of the body and the brain in a computer program

3.   Creating an artificial communicator that exhibits some of the properties and dimensions found in human communication

4.   Constructing an abstract functional model (often boxes and arrows) which is supposed to specify embodied processes leading to the properties and dimensions of human communication.

A presupposition of all the approaches is that there is reliable information on communication available, gained through tradition, experiments and naturalistic observation on what the basic properties, dimensions and functions of human communication are. It is these features that are to be shown to be embodied. They therefore also provide the basis for requirements on the adequacy of the biological, physical or functional models that are being proposed.

3.2.   *Activity Based Communication Analysis*
In the hope of increasing the adequacy of models of "embodied communication", we will therefore discuss a number of basic properties, dimensions and functions of human communication, the embodiment of which eventually should be part of a model of "embodied communication" and can be made use of in providing more fine grained typologies of communication and embodied communication.   The perspective underlying the discussion will be that of "Activity Based Communication Analysis" (ACA), cf. Allwood, 1976 and 2000. Communication (linguistic and other) in this perspective is seen as an instrument for human social activities, cf. Allwood, 1994.   Communicators, through their communicative and other instrumental actions participate in joint activities that can be characterized by the following 4 parameters influencing both communicative and non-communicative activity.

(i)   a joint purpose
(ii)   typical activity dependent roles
(iii)   typical artefacts and instruments of the activity
(iv)   typical social and natural environments of the activity

The parameters are sufficiently abstract to allow capturing factors that on a meso-social (mid range) level are influential in most human social activities.

The approach (ACA) also includes both general features of communication that are based on human nature and features that are based on macro-social factors like conventions specific to particular cultures, languages, social institutions or organizations. On the meso level (the activity level), the social role in a specific activity is connected with obligations and commitments which, given the purpose at hand drive the activity forward through the successive communicative and other contributions made by the participants in the activity. On the social micro level, these contributions are connected by the fact that each contribution has an evocative and a responsive function. The evocative function is aimed at evoking a response from the interactive partner and the responsive function of the partner's contribution gives this response. Consider the following short example of an exchange between A and B (example 1).

(i)   A: always sunny in Bielefeld
        B: (nodding) mm yeah it is (looking happy)

The evocative functions of A's utterance (communicative contribution) are to get B to continue (C), perceive (P), understand (U), evaluate and perhaps comply with the main evocative function (MEI) of the utterance which in this case, is to share A's expressed belief that it is sunny in Bielefeld. The responsive function of B's utterance is to multimodally signal (nod + mhm, yeah) willingness to continue, ability to perceive and understand as well as agreement with the MEI by reformulating it in brief pronominal form. Over and above the mentioned evocative and responsive functions, communicative contributions also have, for example,. expressive and referential functions. In example (i) the expressive function of A's utterance is to express a belief while the referential function is to implicitly refer to the meteorological situation in Bielefeld. The expressive function of B's contribution is the expression of the responsive CPU functions, mentioned above, combined with the expression of agreement and happiness.

The referential function of B's utterance is substantially the same as in A's utterance. The interplay of evocative and reactive/responsive functions are triggered by the expressive and referential functions of each contribution and are combined with role requirements to give rise to successive obligation and commitments. In the example under discussion, A's utterance is based on the obligations of considering B cognitively and ethically (cf. Allwood 1976) and on desiring a continuation. The utterance itself commits A to believe in the statement expressed by the utterance. This commitment would be cancelled if A were to show signs of non-seriousness or irony. Besides the commitments and obligations concerning A, A's utterance also generates two obligations for B, (i) to evaluate his/her own willingness/ability with regard to the evocative functions of A's utterance and (ii) to react/respond on the basis of the evaluation. Usually B's meeting of this latter requirement involves some sort of feedback combined with continued expression and coactivation of new information.

Even though the brief description given above has presented a somewhat simplified picture of what is involved in normal socially relevant communication, it should

make clear that the physical and biological embodiment of communication must be construed in such a fashion that it can be socially and interactively relevant. To be more specific, embodiment must make possible processes of communication that lead to:

1.   shared contact
2.   shared perception
3.   shared understood content/information (including emotions, implicatures, sensitive, among other things, to the influence of the theory of mind (TOM) of the participants (cf. Dennet (1983) or Frith and Frith (1999),
4.   Agreed on judgements (common ground)

These processes draw on a shared context/background of

(i)   a shared perceptual environment (both of a communicative and a non-communicative nature)
(ii) joint engagement in an activity (containing both communicative actions and other instrumental actions)
(ii) other information activated by the performed (communicative and other instrumental) actions

If we now turn to consequences regarding embodiment, this means that we should be able to give an "embodied" account of how language and communication lead to a jointly activated and constructed content, containing multimodal and multidimensional information, often using short one-word utterances and gestures, often relying on information being carried by instrumental actions that are not primarily communicative.

3.3   Communication as sharing of information

The sharing view of communication is fairly strongly supported by a number of earlier theoretical approaches, which are all more or less harmonious with the view that people become more similar to each other as they communicate. Examples of such theories are accommodation theories (cf. Tajfel 1974 and Giles and Smith 1979), alignment theories (cf. Pickering and Garrod 2004), coactivation theories (Allwood 2001), imitation theories (Tarde 1903), symbolic interaction (cf. Mead 1934), the motor theory of perception (Lieberman and Mattingly 1985, Galantucci & Fowler (in press)) and mirroring theories (Decety et al 1997, Rizzolatti and Arbib 1998, Arbib 2002, Gallese and Lakoff 2005).

The claims of these theories are to a varying extent compatible with each other and can be used to explain the fact that we become more alike both regarding external behavior (means of expression) and information processing (content) when we communicate. Examples of expressive behavioral phenomena that depending on theory have been claimed to become more alike include similar postures, similar gestures, similar pronunciation (accent, prosody etc.) and similar touch.

On the content side, the same theories are harmonious with or predict that we share cognitive, emotive, volitional and even physiological states (like fatigue or hunger) or social states (like a common social identity). When we communicate, we thus

become alike, not only through our external behavior but also through the information or content we share, leading to similar perceptions, understandings, beliefs, hopes, desires and eventually to intentions for action and actions.

Not only do we become alike, but we also become able to coordinate, i.e. able to take the other party into consideration and to let our own actions and behavior be based on this consideration. The coordination normally takes place, irrespective of whether our mode of interaction is conflictual, competitive or more collaborative. As Mead (1934) pointed out also two boxers have to take each other into consideration and coordinate their actions, if they are to be successful. From this very basic level of coordination, more complex communicative interaction, however, usually is developed and leads to phenomena like collaboration, coconstruction and cooperation.

Some of the theories mentioned above can be used to begin to provide an account of how sharing and coordination are embodied. Examples of this are the motor theory of perception (Lieberman and Mattingly 1985) and the mirror neuron theory (Arbib 2005, Gallese and Lakoff 2005), which both provide the idea that motor areas of the brain are involved not only in production of speech and action, but also in their recognitions and perception. Similar ideas concerning the production and perception of emotions by facial gestures have been put forth by Dimberg et al. 2002.

Mechanisms like the ones hypothesized for mirror neurons might then be part of the priming mechanisms needed to explain so called "alignment" (cf. Pickering and Garrod, 2004). The theory could also be used as support for "coactivation theory" (cf. Allwood 2001), which besides giving a role to motor areas of the brain in perception and other priming processes would also bring in the role of features of the shared context, i.e. shared perceptions, joint activity, shared beliefs, expectations etc. In a long term perspective, finding embodying mechanisms and processes for how such features influence communication remains a strong desideratum.

However, communication also involves non-sharing. The point of communication is to increase the information which is shared by decreasing the information which is not shared through an interplay between non-shared and shared information, This interplay drives dialog forward and involves interaction between non-shared information and three types of shared information, i.e. background information (common beliefs that can be assumed to be shared), communicated information (what is interactively offered for sharing, building on what has already been shared) and implied information (information that is implied – implicated or presupposed – by what is offered for sharing). An exciting goal will be to find mechanisms and processes embodying this interplay, e.g. the embodiment of presupposition and implicature.

Another interesting part of the interplay between shared and non-shared information in communication is played by our assumptions and beliefs about the minds of other people, often currently described as our "theory of mind" (cf. Premack 1988). Such beliefs do not only take into account the experience of becoming more similar to other people in communication but also the experience that there is non-shared information, i.e. our experience and beliefs that other people might have different perceptions, beliefs, emotions and desires than we do. Perhaps we might say that the

experience of increasing similarity in communication leads us to expect other people to have the same basic mental dimensions as ourselves, e.g. cognitive, emotive and volitional, but also to expect that there might be differences regarding the specific values of these dimensions.

The consequence is that processes of embodiment have to make room for the fact that we, in communication, simultaneously, are maintaining our own information processing and sharing part of this with another person, while at the same time maintaining assumptions or beliefs about the other person's information processing (theory of mind).

3.4   More features of communication

So giving an account of embodied communication will be a fairly complex matter. To get an idea of the complexity involved in the task, I will now briefly list 9 further features or properties of communication that eventually should also be part of an account of embodied communication.

1.   Multimodality

Communication is multimodal. On the production side, it involves at least gesture, speech, touch, smell and taste and on the reception side, at least vision, hearing, feeling, touch, smell and taste.

In line with what has been claimed above, these features of communication can also be used to typologize "embodied communication", so that we can speak of embodied gestural and visual communication, embodied speech, embodied auditive communication or embodied haptic, olefactory and gustatory communication.

It seems fairly clear that the embodiment of each of these types might be of a slightly different nature.

One of the issues raised by multimodality concerns how the modalities relate to each other both intrapersonally (How do my words relate to my prosody and gestures?) and interpersonally (How do my words, prosody and gestures relate to your words, prosody and gestures?). Concerning the embodiment of intrapersonal, multimodal distribution (or fission) of information, we need a theory that relates content with multimodal production. See McNeill (2000 and 2005) for an interesting theory of this type, claiming that content is always expressed multimodally.

Concerning the embodiment of interpersonal aspects of multimodal communication, we have above discussed several theories which although usually broader in scope would also be useful in understanding multimodal communication.

2.   Multiple types of content

Communication involves multiple types of (shared) content. For example, the content might have volitional, emotional or cognitive aspects and concern identity

(of the communicator), physiological states, emotions, moods, attitude (including beliefs, hopes and desires), joint action.

Since activating shared content could be said to be the main goal of communication, it is important that any account of embodiment includes processes and mechanisms for this. It is also fairly clear that these processes might be different for the embodiment of shared emotions and the embodiment of shared propositional content.

3.   *Multiple modes of representation*

Communication involves multiple modes of representation. Using the taxonomy of basic modes of representation developed by Charles Sanders Peirce (cf. Peirce 1931), we can see that communication often simultaneously involves indexical, iconic and symbolic information. Often an iconic gesture illustrates and emphasizes what is said verbally (symbolically), while the speaker's attitude to what is being said is indexically present in voice quality or facial gestures. A mother might say, for example, of her son **he is a big boy** simultaneously moving her vertical palms apart, iconically illustrating the word " big" while at the same time having a happy indexical smile. One of the issues connected with embodiment is therefore how symbolic, iconic and indexical representation is embodied and interrelated.

To illustrate, let us consider an example where we see a hand grasping an apple, while simultaneously we hear a voice saying "a hand is grasping an apple". Thus, we have complex information, which is given simultaneously in a perceptual indexical mode and symbolically in a verbal mode. Following the mirror-neuron approach to perception, we might now assume that motor cortical areas are involved in the visual indexical perception – but what is involved in the perception and understanding of the verbal symbolic utterance and how are indexical perception and symbolic understanding related?

Another phenomenon which might have consequences for the work to be done by theories of embodiment, is that there seem to be typical, even if not necessary, connections between specific modalities and specific models of representation. Thus, smell, taste and touch typically carry information indexically. Icons and symbols involving smell, taste and touch are possible (c f. perfume (sometimes iconic smell) and Braille (tactile symbolic for the blind)), but not very common. Icons are most common in the visual modality, while symbols occur both in the visual and auditory modality. A possible explanation is that vision affords richness of homomorphism and isomorphism (structural similarity) to a greater extent than other sensory modalities. If this is true, what implications does it have for the embodiment of icons? Symbols occur in both the visual (e.g deaf sign language) and auditory modality (spoken language) but is there a difference here so that visual symbols more often than auditory symbols have an iconic background? Can this be connected with the fact that, although humans can differentiate both auditory and visual stimuli very finely, only visual symbols afford rich homomorphic connections to what is being represented? Are such connections less possible auditorily, so that auditory symbols are more easily connected with abstract information?

4.   *Multiple degrees of awareness, processing, control and intentionality (agency)*

Communication is also a phenomenon that seems to afford multiple degrees of awareness, processing, control and intentionality both on the production (sending) side and on the recipient side. Even though what we are dealing with are probably continuous scales, it is often convenient to distinguish three levels on the production side (indicate, display and signal) and three levels on the recipient side (subconscious influence, perception and understanding). For both production and reception, these levels of processing operate on both factual information and emotional-attitudinal information as well as on conative (will and desire) information. On the recipient side, this has as one consequence that what is perceived or understood might also be believed, disbelieved, agreed or disagreed with (cf. Allwood 2001).

Finding embodying processes that allow for varying degrees of awareness, processing, control and intentionality together with processes that allow for differentiation and integration of factual, emotive and conative information will provide a major challenge. This challenge is not going to be made smaller by the fact the three semiotic modes of representation (symbol, icon and index) also in principle, allow for several levels of processing, even though there is a frequent and natural connection between indicated and indexical information, between displayed and iconic information and between signalled and symbolic information.

The levels of production and processing can in principle be crossrelated in any fashion. Thus, indicated information might merely influence me subconsciously. It might also be simultaneously perceived and understood by me, activate my emotions, attitudes and intentions for actions. The same kind of complex picture might also be true for displayed and signaled information.

A consequence of what just has been said is that it is natural to assume that the sharing of information which goes on in communication also can take place with multiple degrees of awareness, processing, control and intentionality (agency), so that we can share information, not only consciously but also subconsciously.

A model of how communication as interactive sharing may be combined with the idea that communication involves multiple levels of awareness was presented in Allwood, Grammer, Kopp & Ahlsén (2006).

INSERT FIGURE 1 HERE

The figure shows two communicators, A and B, communicating multimodally (vocal and gestural production combined with visual and auditory perception), on three levels of intentionality (indicate, display and signal) and three corresponding levels of recipient reaction. The information which is indicated is usually of an analog indexical nature, while the information which is signaled is usually of a digital symbolic kind. Displayed information is usually iconic. The figure also shows how the levels of intentionality and awareness can be connected with further types of processing. If we move from those that are least controlled to those that are most controlled these might be labeled mirroring, appraisal and evaluation. In general, it is assumed that the processes that are the least controlled are also the fastest and that

more aware, controlled and intentional processes are slower. Finally, the diagram shows how the mirroring, appraisal and evaluation can be related to still further processes triggering adaptation and feedback from one communicator to another.

If we continue our analysis, reflections on the relations between modes of representation and types of communicative intentionality can also be related to types of content. Even if all types of connection in principle are possible, factual content is typically symbolic and signaled, while emotional content more often is indicated or displayed.

We may also ask questions concerning the degree of control of the different modalities of communication. For example, it seems to be the case that speech is more controlled than gestures and touch which, in turn, are more controlled than smell or taste. If this impression is correct, we may ask if it is the result of cultural conventions and learning or the result of genetically embodied constraints on the extent to which we are able to control our different means of production.

Likewise, there may be degrees of control involved in the reception of information. We seem to be able to control vision (closing eyes, directing focus etc.) to a greater extent than hearing, which, in turn, can be more controlled than our haptic, olfactory and gustatory senses. Again, we may ask if such differences are the result of learned social conventions or part of our genetically embodied endowment.

A further issue that is related to what has just been discussed is the question of what modalities we are least aware of. Are they the same as those that are least controllable? A special phenomenon to take note of here is that we are sometimes acutely aware of something without being able to control it. For example, my accent indicates my geographical origin but I might not be able to control this. I might also be aware of my own smell or gestures, without being able to control them. In general, perhaps I am most aware of the information which is "signaled" by my words and perhaps this is also what I can most easily control.

5.   *Multiple degrees of rationality*

Communication also affords multiple degrees of rationality. Here we can imagine a number of phenomena running from causal efficiency (which can be unaware and uncontrolled) to conscious controlled and intentional strategies aimed at minimizing cost and effort and maximizing benefit. The embodiment of rationality in communication can probably thus not be limited to maxims of rational communication like the ones formulated in Grice (1975), since these all operate on a fairly high level of awareness and intentionality.

Rather the embodiment of rationality probably involves a grounding also in more basic causal mechanisms connected with functional efficiency and then extending to mechanisms which allow for rationality to be integrated with high levels of consciousness and intentionality.

6.   *Multiple causally mediated resources, enablements and constraints.*

In general, if we broaden our perspective on communication, we realize that it operates under very many simultaneous enablements and constraints. All of these have to be embodied in some fashion.

Some of the most important of these constraints are the following:

human nature, the natural environment, culture, language, social institution, organization, social activity, exchange type and individual beliefs and motives.

It is perhaps not overly negative to say that we do not really know how most of these constraints are embodied, nor how their influence and effect on communication is embodied.

7.   *Multiple degrees of interactivity and incrementality*

Another property of communication is that it can be more or less interactive. We often distinguish 1-way communication from 2-way or 3-way communication. The embodiment that is needed to support very interactive processes (like a lively argument) will likely be slightly different from the embodiment needed to support less interactive communication (like listening to a lecture) over the radio.

A striking feature of interactive communication is its incremental nature. Speech and gestures are both produced incrementally (step by step) and perceived and understood incrementally. We can produce single phonemes, morphemes and words, parts of phrases and also to a surprisingly high degree perceive, understand and interpret them incrementally.

This means that the processes which embody interactive production and reception of information must be capable of incrementality. But they must also be capable of withholding mechanisms to make room for short time memory effects, where we can keep information without making a decision on its contextual interpretation. Embodiment must take account of the fact that communication not only involves sharing on multiple levels of awareness, but that this sharing is also incremental, often involving short one word utterances as in the two following examples:

Example 1. Cooperative preparation for recording

C: a ok de e bra så
   (yes ok it is fine like that (so))
A: så
    (like this (so))
C: ja
   (yes)

In this example, C is behind a camera giving instructions to A concerning how to sit. The example involves a vocal deictic affirmation, followed by vocal-gestural specifying query (*så*) and a vocal confirmation (*ja*) and shows how vocal verbal

elements incrementally are integrated with informative (although not primarily communicative) body postures and movements.

Example 2 Cooperative relational description

A1: mm de e ett gränsfall teknologi då
      (mm it is a borderline case technology then)
B1: ett gränsfall ja
      (a borderline case yes)
A2: mellan
      (between)
B2: nature
      (nature)
A3; na kulturvetenskap och naturvetenskap
      (na cultural science and natural science)
B3: a
      (yes)

Example (2) is an excerpt out of a discussion between A and B on the status of technology. The incremental, interactive and coconstructive character of the discussion can perhaps be brought out by the following short hand description:

A1: statement that is an attempt at a conclusion
B1: repetition -> affirmative empathic feedback
A2: affirming implicit 3-place relation and querying implicit missing arguments
B2: supplements argument
A3: continues supplementation and specification of arguments
B3: affirms

8. Multiple degrees of mutually activated, constructed and shared information

As we can see from the two examples, the issue of multiple degrees of interactivity and incrementality can be related to the issue of degrees of sharing, coactivation and coconstruction.

However, it should also be noted that sharing of information is not necessarily dependent on interactivity since it seems possible to listen to a radio lecture and have a high degree of content sharing between lecturer and listeners, even though the content is not produced through interactive production. It also seems possible that certain types of lively interaction do not always result in a large amount of shared content. Thus, the embodied processes supporting coordinated interaction in some respects must be able to function independently of the processes embodying content sharing.

It is likely that the conceptual differences between "shared information", "shared content", and "shared understanding", should result in somewhat different types of embodiment. One way of trying to capture the difference is to say that both "understanding" and "content" imply "information. The relationship between "content" and "understanding" is less clear. This would mean that all "shared understanding" and all "shared content" is "shared information. It would also mean

that there are types of "shared information" that are not "shared content" or "shared understanding". This way of differentiating the concepts is of course slightly stipulative but perhaps examples of "shared information" which are not "shared content" or "shared understanding" can be found in the information shared between communicators in connection with action coordination on a low level of awareness. The relation between "content" and "understanding" seems to be one of overlap rather than implication since it seems possible to perceive "what is being said" without understanding it, (i.e. perceived content that is not understood.) and it also seems possible to understand what someone means without hearing all that is said.

9. Multiple degrees of cooperativity

Ideal cooperation can be defined (cf Allwood, 1976) as interaction having four subgoals
    (i)   cognitive consideration (coordination)
    (ii)   activity toward a shared goal (collaboration)
    (iii)   ethical consideration
    (iv)   trust

Using this analysis, we may now consider to what extent communication is cooperative. It can be claimed (cf. Allwood, 1976, 2000), that normal human communication necessarily at least involves contact and cognitive consideration (coordination, alignment and mutual accommodation are other very closely related concepts) as well as collaboration with the joint purpose of shared understood content. This gives us a kind of minimal characterization of rational, intentional communication. Since conflict and competition also mostly involve contact and cognitive consideration, i.e. (coordination) and not infrequently also joint understanding (you have to cognitively consider and sometimes understand your enemy to beat him/her), this indicates a (minimal) conceptual relationship between cooperation, conflict and competition. The final two criteria of cooperation, i.e. ethical consideration and trust, are not part of the minimal requirements for communication but are essential for any long term communication. It is not likely that communication that frequently is unethical, hurtful, distrustful (paranoid) and untrustworthy would be able to be the unparalleled instrument of social cohesion that it in fact is. This means that processes and mechanisms for the embodiment of ethical and trustful communication are also important and we may therefore ask whether the different types of cooperation and the differences between them can be captured in terms of embodiment, or whether perhaps the notion of embodiment only really makes sense on a more basic minimal level of communication (i.e. coordination).

3.5   From features to typology?

Perhaps, the nine features or dimensions of communication we have discussed could be summarized in the following manner.

Normal embodied communication involves at least two causally enabled/constrained rational motivated agents, who in service of a joint activity with varying degrees of control, intentionality and awareness (indicate, display and signal) use multimodal symbolic (mostly verbal), iconic and indexical means (both vocal and gestural) interactively, incrementally (synchronized no-line) to jointly activate, coconstruct

and share information (content and understanding) in a more or less coordinated, collaborative and cooperative way in the *service of a joint activity*.

The summary can now be used also to extract features for a typology of communication. All the features that have been used to characterize communication also need to be embodied in some way. We may thus ask what processes and mechanisms are needed for the causal enablements of and constraints on communication. For speech, this would, as far as we know, involve at least an account of how speech organs interact with acoustic energy and the physiological and neurological properties of hearing. We must then also find processes and mechanisms that make it possible for communication to be rational, motivated and intentional and mechanisms which relate rationality, motivation , intentionality to speech production, hearing and listening.

Understood in this way, the characterization of communication given above gives a list of properties and features that any effort to give an embodied account of communication eventually has to deal with. In this vein, we may speak of embodying all the ten dimensions above, i.e. multimodality, types of content, types of representation, types of external causal influences, degrees of awareness, processing, control and intentionality, rationality, interactivity, incrementality, sharedness and cooperativity.

As easily can be seen, there is, thus, no overwhelming risk that research on how communication is embodied will come to a halt tomorrow.

4   A simpler picture

The nine dimensions discussed above give a type of boundary conditions for the embodiment of communication. Alternatively, we might also choose to focus more narrowly on some of the more central features of communication. Doing this, we may distinguish two main types of communicative functions (cf. Allwood 2001)
   (i)   Main message (MM)
   (ii)   Communication management (CM)

The main message in communication is the main purpose for which the communicative contributions is made, e.g. a statement, a questions, a request etc. . Communication management is needed to support the actual production of contributions and the interactive sharing, activation and coconstruction of content and understanding. Communication management can be subdivided into (i) own communication management (OCM) and (ii) interactive communication management (ICM): Own communication management concerns features of communication that help communicators plan and produce their contributions, e.g. mechanisms for turnholding and change of what has been said. Interactive communication management concerns features of communication that support interaction, e.g. mechanisms for management of turns, feedback, sequencing, rhythm and spatial coordination.

Both of these two main functions of communication, i.e. the main message and communication management, are embodied by biological and psychological processes and mechanisms which still have to be more carefully understood. This is

even more true when we consider how the system of communication with its subsystems MM and CM are put to use in human social activities, where we need to find out how system and activities are embodied together.

In fact, it is likely that a fruitful agenda for the study of how communication is embodied is to start by studying the embodiment of the subsystems of interactive and own communication management, i. e. turntaking, feedback, sequencing, rhythm (cf. Allwood 2001) and the systems for change and choice (cf. Allwood et al. 1990).

The next point on the agenda would then involve turning to the main message (MM). Here issues of embodiment will probably be even more complex, involving determination of meaning through the operation of semantic-epistemic operations on context, making use of features of morphology and syntax (cf. Allwood 1999).

Even if an agenda of this type is premature, awareness of the fact that communication has the complex features discussed above may help to structure the research agenda and aid the choice of what features of communication it may be fruitful to find embodiments for.

5. Reflections and conclusions

In this paper, I have tried to give an overview of some of the properties of communication, in order to help us understand what a theory of embodied communication needs to include.

I have also provided a number of suggestions for how one or more typologies of human communication may be constructed.

Finally, I have pointed to some unresolved issues and areas of research, where we need more theory development and empirical data.

A main claim has been that it is possible to determine the concept of "embodied communication" in several ways. A basic reason for this is that each of its three principal components, i.e. "communication", "body" and "embodiment" can also be determined in several ways. In the widest sense, "embodied communication" only means "communication" made "tangible and graspable". Whatever interpretation we give of embodiment, an analysis of its role will be to help us describe, explain and understand the complex phenomenon of human communication. This means that an understanding of the properties and dimensions of human communication and how they are interrelated will be a presupposition for a successful study of embodied communication. Once described, these properties will also serve as criteria pointing to phenomena that the suggested processes of embodiment should account for.

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