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Cognitive Science Dept. Lund University, Sweden.

Paper One

Evolving Social Constraints on Individual Conceptual Representations

Abstract: The paper deals with how constraints on conceptual representations evolve through processes of knowledge sharing. We describe pragmatic settings of referential communication and provide a model of how names, nouns and adjectives emerge through a process of abstraction. In situations of referential communication, the contrast class – the set that intended referents must be distinguished from – is important for determining the degree of specification of referential utterances. Two processing strategies involving contrast classes are proposed that are connected to the nominal and adjectival levels of abstraction. Certain cognitive representational skills are needed to be able to assess a contrast class in a communicative situation. We propose three communicative strategies that correspond to different assessments of the relevant contrast class.

1. Introduction

1.1. Objective

The aim of this paper is to apply *intersubjective* considerations to concept formation, in contrast to traditional theories, which mainly focus on individual aspects. We shall argue that the development of concept representation is partly determined by *communication* between individuals. In this context, linguistic communica-

Together with Peter Gärdenfors.

tion will be seen as a co-evolution between individual cognitive structures and socially generated mechanisms. Hence, influences are to be found in both directions.[1]

Our theoretical framework is not only taken from linguistics, but rather from a broader cognitive science perspective. In particular, we will be concerned both with what language represents and with how it is expressed. We will bring together three areas of cognitive science to show their interdependence: (1) the evolution of the building-blocks of language and what they represent; (2) the choice of building-blocks for referential communication; and (3) the cognitive prerequisites for being able to adapt to other people's representations.

To give an inkling of how these areas are interconnected, consider the following scenario: "I" want "you" to fetch a ball, a drink, a towel or something else to me where I am sitting in the sun beside the pool. If I want you to get a ball, I simply ask you to get a ball. But if the house is filled with balls in all colors, I need a means to single out the ball I want by a more specific linguistic expression, *if this distinction is important*. We shall study the relation between the real-world distinctions that we have a need for and the corresponding expressions that evolve in language.

There is also a relation between the structure of the *current context* and the expressions used. For example, if it is time for my daily swimming hour and you see that I have a towel that is soaking wet, I may ask you "Get me a dry one, please." Hopefully you won't get me a Martini, or any other thing that is dry but not a towel. Thus, in a particular context, I only have to distinguish in my language to a point where I reduce uncertainty in that context.

In this paper we concentrate on referential communication as a paradigm case, rather than communication in general (Hanks 1990). One argument for this limitation is that communicating about objects (and persons) to achieve coordination of actions is likely to have been important in a primitive linguistic community.[2]

1. This area is excellently reviewed by Chiu, Krauss & Lau (to appear).

One of the advantages of studying referential communication is that reasonably delimited communicated situations can be investigated. We hypothesize that the outcome of communication in such situations can promote evolution of language on a larger scale.[3]

1.2. Freyd's (1983) model of shareability

The starting point of our analysis will be a theoretical scenario proposed by Freyd (1983). The main theme of her paper is that knowledge, because it is shared in a language community, imposes *constraints* on individual cognitive representations. She argues that the structural properties of individuals' knowledge domains have evolved because "they provide for the most efficient sharing of concepts," and proposes that a dimensional structure with a small number of values on each dimension will be especially "shareable."

According to Freyd, the description of an object will result in a distortion of the hearer's representation compared to the speaker's, as in figure 1 (overleaf). For example, let us say that a car C is similar to (but not identical with) the shape of another car A and that the color of C is similar to (but not identical with) that of a tomato B. Then the speaker's description of C will most naturally be based on the shape of A and the color of B.

This shareability process is continually ongoing: the interplay between individual and social structures is in eternal co-evolution. The effects are magnified when communication takes place between many individuals. Freyd hypothesizes that the mechanism

2. However, there are some problems with using referential communication as a paradigm case for language and language evolution in general. While referential communication concentrates on the perceptually salient properties – what is sometimes called the *identification procedure*, the conceptual core can be argued to consist of *nonobvious*, *functional* properties. See Paper Two, Smith & Medin (1981), Gelman & Coley (1991) for discussion.

3. Linguistic evolution is much faster than biological. As Deacon (1997:ch. 4) points out, language can be seen as evolving once per generation.

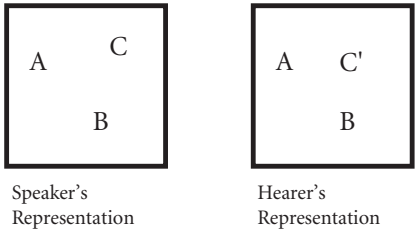

Figure 1. After Freyd (1983).

will, over time, create a *grid* of fairly stabilized and discrete values on a few dimensions, as in figure 2.

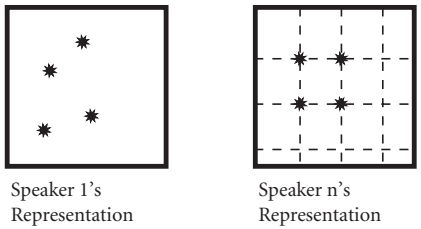

Figure 2. After Freyd (1983).

Freyd's approach is suggestive: using previously known landmarks to communicate about other objects makes the mental representation of the new objects more similar to the representations of the old ones. However, her approach assumes that the *dimensions* are given in advance. As a consequence, her account leaves several questions unanswered: First, what is the cognitive origin of the dimensions? And second, how do speakers choose which dimension to use when communicating?

We want to insert Freyd's approach into a broader evolutionary setting where we distinguish between three levels of abstraction in referential communication. As we will see, dimensional structures only emerge on a rather high level of abstraction. On the other

hand, the kind of adjustment of mental representations described in Freyd's model will facilitate the processes of abstraction that we shall describe in the following section.

2. Three levels of abstraction: from object to cluster to dimension

2.1. Names and nouns

We will start from the assumption that each object that is perceived or communicated about is represented cognitively as a point in a multi-dimensional space. The dimensions of this space correspond to various qualities of the objects. In Gärdenfors (in preparation) it is called a *conceptual space*. Different individuals may structure their spaces differently, so there is no immediate way of comparing them.

The properties of the objects may be changing, which means that the points representing them move around in the conceptual space as indicated in figure 3. Furthermore, objects come into existence and disappear, which means that points come and go in the representing space.

Figure 3. Points move around in the conceptual space.

Now suppose the two individuals in a communicative dyad each have their own set of points in their private conceptual space. Also assume that the paradigmatic communicative situation is one where the speaker wants to use language to make the hearer identify a particular object.

At the lowest level of abstraction, this communicative task is achieved by *names*. A name picks out a particular object in the con-

ceptual space. In figure 4, this identification is represented by encircling the representation of an object. If both participants associate the same name with the same object (independently of differences in how they are represented cognitively), then the hearer can identify the object that the speaker intends.

Figure 4. A name singles out a unique referent.

However, this communicative mechanism only works when both speakers are *acquainted with* the named object and have associated the same name with it. Furthermore, the mechanism is dependent on a *stable context* in the sense that entities exist in the presence of the speaker and the hearer long enough for a name to be established (by deixis or some similar pragmatic mechanism).

In an evolutionary setting, there are two kinds of entities which remain relatively stable and identifiable within a community, namely *people* and *places*. Thus one can speculate that the first stages of language contained names for people and places together with words denoting *relations* between such entities (Dunbar 1997; Hewitt & MacLarnon 1998; Worden 1996). Such a communicative system would be a *protolanguage* in the sense of Bickerton (1990).

Now, how can objects which are not suitable for naming be identified? To answer this, we must enter the second level of abstraction within the set of points in a conceptual space. A fundamental fact about the world around us is that it is *not random*. Properties of objects tend to go together. Our minds seem predisposed to detect such covariations (Holland, et al. 1986; Paper Four).

A likely explanation of our capacity to detection covariation is that our perceptions of natural objects show covariations along several dimensions and, as a result of evolutionary pressures, we have developed a competence to detect such covariations. In the concep-

tual spaces, covariations show up as *clusters* of points. Such a cluster is marked by a circle in figure 5.

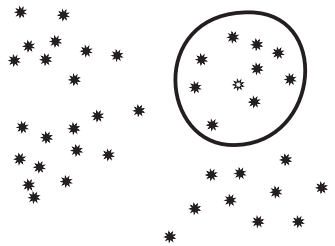

Figure 5. A noun corresponds to a cluster of covarying properties.

A crucial feature of clusters is that, unlike single objects, they will remain stable even when objects change their properties somewhat or when new objects come into existence or old ones disappear. Thus, clusters are much more reliable as references of words than are single objects. Furthermore, even if two individuals are not acquainted with the same objects within a cluster, their representations of the cluster may still be sufficiently similar to be matched. For this to happen, it is sufficient that we interact with the same kinds of objects and have shared socio-cultural practices.

The prime linguistic tool for referring to a cluster is a *noun*. Rather than referring to the entire cluster, a noun refers to an object that functions as a stand-in for the cluster. This stand-in object, marked by a white star in figure 5, can be identified as the *prototype* of the cluster (see for example Rosch 1978). This mechanism explains why nouns (noun phrases) have basically the same grammatical function as names. By using a noun, the speaker indicates that she is talking about one of the elements in the cluster, by default a prototypical element, which is often sufficient for the hearer to identify an appropriate object in the context (see section 3.2).

The prototype need not be any of the objects anybody has encountered. It is represented as a central point in the cluster associat-

ed with a noun, but no existing object need be located there. Nevertheless, since different regions of the space correspond to different properties, the prototypical object will, by default, be assigned a number of properties. For example, a bird is normally small, sings, flies and builds nests in the trees. Such properties form the *expectations* generated by the mentioning of a noun (see Gärdenfors 1994; 1995).

Among the objects represented in the conceptual space of an individual, there may be several layers of clusters, depending on how finely one wants to partition the space. However, there tends to be a privileged way of clustering the objects which will generate the *basic categories* in the sense of prototype theory (see for example Rosch 1978). This is the set of clusters that provides the most "economic" way of partitioning the world. What is "economic" depends, among other things, on the practices of the members of the community. Economy goes hand in hand with learnability: the basic categories are also those that are first learned by children.

2.2. Adjectives and dimensions

Basic-level nouns partition the conceptual space only in a rather coarse way. Using nouns presumes that the communicators are *acquainted with the same clusters*, which is a much less severe assumption than that they are acquainted with the same individuals. However, in some communicative contexts even this presumption delimits the communicative capacities. One example of such a context is when the speaker and hearer face a class of objects that all fall under the same noun and the speaker needs to identify one of the objects in the class, but has no name for it. This is where the third level of abstraction becomes necessary.

A fundamental strategy to distinguish objects *within* a category that has been determined by covarying properties is to identify a feature that does *not* covary with other propeties of the category. We see this as the basic mechanism for generating the *dimensions* of communication. For example, the color of object often does not

covary with other properties.[4] In figure 6, the color dimension is indicated by different shades of gray.

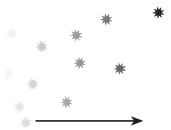

Figure 6. Adjectives single out dimensions.

Dimensions that are singled out by this process will be expressed by *adjectives* in natural language (see also Givón 1984). For example, to identify a particular block among a set of toy blocks, one can say "the red block" (color dimension) or "the big block" (size dimension). In identification tasks, adjectives are normally only used in combination with nouns, as will be seen in section 3.2.

This mechanism provides a rationale for Freyd's model that was presented in section 1.2. Social interactions will generate a need for representations where the dimensional structure is represented by a small number of values on each dimension.[5] In this way, the combinations of values on different dimensions generate a *grid* over the conceptual space as was argued by Freyd (compare figure 2). When communicating about objects, the grid, with its corresponding combinations of adjectives, will generate a class of communicable references. Meanings outside this class cannot be easily shared in communication since they are not directly codable.

Our thesis that adjectives are more abstract tools for communication than are names and nouns is supported by data from child language, as is witnessed by the following quotation from Smith (1989:159):

4. It is something of a misnomer to call color a dimension, since it is three-dimensional and can be broken down into the dimensions hue, saturation and brightness.

5. As a matter of fact, dimensional adjectives often come in pairs: heavy – light, tall – short, etc.

> Among the first words acquired by children are the names for basic categories – categories such as *dog* and *chair*, which seem well organized by overall similarities. Words that refer to superordinate categories (e.g. *animal*) are not well organized by global similarity, and the words that refer to dimensional relations themselves (e.g., *red* or *tall*) appear to be understood relatively late.

It should also be noted that representational availability of a dimension normally precedes explicit awareness of the dimension. This means that even if a dimension is exploited in linguistic communication, the communicators are often not able to refer to the dimension itself, which would presume an even higher level of abstraction than the three levels discussed in this section. In support of this position, one can mention that children learn to use color words before they can engage in abstract talk of color in general. A related phenomenon from child language is that adjectives that denote contrasts within one dimension are often used for other dimensions as well. Thus, three- and four-year-olds confuse "high" with "tall," "big" with "bright," etc. (Carey 1985).

3. Communicating reference in a context

The processes of abstraction described above leave us with a set of linguistic tools that we can combine when referring to objects: names, nouns and adjectives. We argued that these different levels have emerged in a cultural context as a response to communicative needs in situations of referential communication.

So far, our aim has been to formulate one aspect of a theory of why different words come into being in terms of the three levels of abstraction. However, it is not possible to consider the processes of referential abstraction isolated from the *context* of referring expressions. This section is devoted to a closer examination of such communicative situations. We will investigate how the context influences which expressions are used in referential communication.

3.1. Contrast classes

For our purposes, an important distinction is that between the *represented* world, which contains all possible objects (real or merely imagined), and the *contextually given* world, which consists of the objects present to (either of) the communicators. The contextually given world typically contains all objects that can be perceived, but it may also contain objects that have recently been talked about or objects that are part of the mutually represented conceptual spaces of the communicators. In this sense, context is partially determined by the *expectations* of the participants (Olson 1970). A particular instance of such expectations, namely the world of the other, will be discussed in section 4.

The key question now is how the contextually given world is determined in a communicative situation. Olson (1970) formulated a highly influential theory of referential semantics, where he showed how the meanings of words partially depend on a perceptually given or inferred set of alternatives from which the intended object has to be distinguished. This set we will call the *contrast class*.[6]

Olson calls his theory *cognitive*, which must be understood in relation to the dominant theories at that time, which were largely behavioristic. Thus, it is cognitive in the sense that it focuses on mental processes connected to perceived or inferred alternatives, but on the other hand it takes for granted the designation of words, as in the following quotation, where the connection between the word "smooth" and the property of being smooth is unproblematic. This assumption is made in most branches of linguistics, philosophy and psychology.

> Thus, if there were two balls in the visual field, one rough and the other smooth, it would be entirely appropriate to say, "Give

6. This construct has received different names in the literature. See for example Broström (1994), Gärdenfors (in preparation) and Rommetveit (1985). Other names in the literature: *domaine notionnel*, (Culioli 1990), *context of confusable alternatives* (Harnad 1987), *nonreferent array* (Krauss & Fussell 1990) or *Referenzbereich* (Pechmann 1984). It seems also related to the *focal set* of Cheng & Holyoak (1996).

me the smooth one." If there were several objects in the visual field, but only one – the ball, the intended referent – was smooth, it would be appropriate to say, "Give me the smooth thing." (Olson 1970:263)

3.2. Overspecification in referential communication tasks

To see the effects of different contrast classes, let us first look at some of the studies of referential communication. Figure 7 is a typical illustration from an experimental study (Pechmann 1984), where the task for the subject was to single out the object marked with a star for an imaginary listener who saw the same image, but without the star. A persistent finding in such tasks is that subjects *overspecify* their referential expressions, i.e. they provide more information than would ideally be needed to assure communicative success.

Figure 7. A typical experimental stimulus from a referential communication task. From Levelt (1989), after Pechmann (1984).

This point can be better illustrated by the contrast class given in figure 8.

In this situation, one can distinguish between three levels of answers:

"The bird"	Appropriate utterance
"The black bird"	Overspecification
"The black one"	Underspecification

Figure 8. Modified from Pechmann (1984).

From an abstract logical point of view, "bird" will refer to the necessary and sufficient feature to identify the object marked by a star. However, the typical description given by the subjects is "the black bird," which is an overspecification.

Olson (1970:266) notes the phenomenon of overspecification:

> First, speakers tend to use a degree of redundancy, perhaps for the benefit of the listener – a subject that warrants further study. Second, speakers tend to use a familiar noun even if it contains more information than may be required. As Brown (1958) pointed out, things tend to be called by a name that corresponds to the most frequent and useful level for differentiating objects. Thus, speakers frequently call a cat a "cat," even if for informative purposes "animal" would be sufficient. Third, the level to which an utterance is differentiated depends on the intent of the speaker. No utterance ever differentiates an intended referent from all possible alternatives but only from those among which the speaker infers that the listener must choose in the present context, for the purpose of that particular "language game." It appears to be the case that the speaker makes minimal assumptions about the range of alternatives to be differentiated.

3.3. Communicative efficiency in an evolutionary framework

From an evolutionary point of view, the phenomenon of overspecification raises the question of what can be the adaptive advan-

tages of overspecifying reference. A simple answer would be that talk is cheap in relation to the cost of misunderstanding so that, in general, communication benefits from overspecification. However, we believe that a deeper answer can be given by more carefully considering the standard of comparison with respect to which the degree of specification is assessed. The need for such a criterion arises when one wants to determine whether participants actually minimize their effort in communication.

Pechmann (1984) uses a specification standard that is based on the notion of *discriminating feature*.[7] Each feature of the intended object is examined with respect to its discriminating value, and if subjects mention features that are not discriminating, then the utterance is classified as overspecified. This "classical view" of referential communication can be reformulated as follows: Given a contrast class, some dimensions are more informative than others. The informativeness of a dimension is inversely correlated with the degree of covariation with other properties of the objects in the reference class. When identifying an object, the speaker communicates about the most informative dimension(s).[8]

It should be noted that this view takes for granted that the relevant features are easily picked up by the subjects, and that features denoted by words like "bird" and "white" are treated on a par with each other.

In an evolutionary framework, the approaches of Pechmann and Olson presented above deserve some comments. Most early studies measured communicative efficiency in relation *only to the speaker*. Clark & Wilkes-Gibbs (1986) criticize the approach of Olson and propose not to measure effort minimization for the speaker only, but that the speaker and listener together can be said to *collaboratively* minimize their efforts – if the speaker doesn't carefully choose referential expressions, the listener will ask for clarification and the

7. The argument in this section also holds for the theory of Olson (1970).
8. For the relationship between features and dimensions, see Schyns, Goldstone & Thibaut (1998).

two will together arrive at an identification of the correct alternative.

This latter approach is much more attractive from an evolutionary point of view, since the outcome is related to the *communicative dyad*, rather than to the speaker alone. It is of course very risky to speculate about the unit of selection in a communicative setting like this, but we hypothesize that happy outcomes of referential communication on the local level can promote the evolution of referential communication also on a global cultural level.

3.4. Contrast class and word meaning

The analysis of overspecification given here also provides an interesting connection with word meaning, discussed in Olson (1970). The central idea in his model is that different uses of the same word correspond to different conceptual representations depending on what "nonreferents" the referent is contrasted against. A square that is only contrasted against a triangle will only "mean" four-sided. An example of this is the adjectival use of "square" meaning "not round," as in "Take the square pillow." Table 1 presents an example of Olson's analysis.

	Utterance	*Event*	*Alternative*	*Meaning*
Case 1	This is a square			Ambiguous
Case 2	This is a square			4-sided
Case 3	This is a square			Straight-edged
Case 4	This is a square			Straight-edged 4-sided Symmetric

Table 1. Meaning depends on context. After Olson (1970).

Olson hypothesizes that subjects can directly learn the distinguishing features of the intended referent. Since the meaning of "square" is dependent on what alternatives are available, this clearly shows the context-dependence of meaning.[9]

However, even if "square" is only contrasted against "triangle," as in the first example in the table above, there are several features that distinguish the square from the triangle, for example "not pointed," "larger area" and "4-or-more-sided." Only with reference to the underlying *cultural practices*, it is possible to determine which features will be relevant. In its mathematical context, square is singled out in contrast to the other geometrical constructs that exhibit interesting regularities from this special point of view.

Furthermore, we want to connect to the three levels of abstraction proposed in the preceding section. Depending on the contrast class, different processing strategies are suitable. If we want to distinguish a towel in the context of a ball and a bottle of sun lotion, the meaning of towel will be "the feature" that distinguishes towel from the two other. However, there are several features that will provide this distinction. Olson's solution would be to pick the most salient feature, or a feature that has proven useful in other situations, or simply a feature at random.

However, a difference between this example and the "square" example above is that there are *many clustering features* that distinguish the elements of the contrast class, and we propose that this characterizes many natural situations of categorization.

For a situation with many clustering features, we propose a strategy of cognitive processing that we call *nominal categorization*, as opposed to *adjectival categorization* where only one feature is abstracted. Nominal categorization has the following characteristics:

¶ The named instances present in the context are regarded by the hearer as *typical* of the concept. The first instance denoted by a noun will be considered to be a prototype of the noun (see section 2.1). It is the *configuration* of stimuli that is regarded as important rather than the distinguishing power of a few features. Nevertheless, many of the salient features will be defeasible in different contexts.

9. Olson's analysis is related to a central semantic area that is called *meaning potential* or *depth of intention*. This area is almost neglected in the literature. See Næss (1953) and Rommetveit (1974; 1985).

¶ It is, in fact, a *less abstract* processing strategy than abstracting one feature at a time. A pragmatic explanation of this could be that the *interaction* with objects always takes place on the basis of many dimensions at a time (Paper Four).

When viewed as an instance of nominal categorization, "towel" will get a conceptual representation that consists of a whole cluster of dimensions, partially overlapping the representations of "ball" and "bottle." This can also be argued to be the case in prelinguistic categorization in nonhuman animals.

The distinction between nominal and adjectival categorization provides a bridge between the holistic and analytic theories of categorization discussed in, for example, Smith & Medin (1981).[10]

3.5. Contrast classes and higher-order categories

In the quotation above, Olson stated that when referring to a smooth ball in the context of several nonsmooth things, the appropriate utterance would be "Give me the smooth thing." This is correct from an information-processing perspective, where "thing" is supposed to be any generic entity, like "object," endowed with only the properties common to all "things" (most often mass and 3D extension).

However, humans and animals do not interact with generic things, and superordinate concepts like "furniture," "animal," "object" or "thing" are not part of the nominal abstraction level discussed in section 2.1, but rather belong to a higher level of abstraction. As was argued in section 2.2, basic-level words are the appropriate starting points for referential expressions.[11]

A different reason for why "object" or "thing" would not be a natural alternative in a context where "bird" or another basic-level

10. Gärdenfors (in preparation) uses the word "concept" in another sense, and makes the distinction between *concepts*, based on several dimensions, and *properties*, based on one dimension. This distinction corresponds to the one between nominal and adjectival categorization.

11. Harnad (1987) treats the contrast class itself as a potential higher-order category, of the same kind as "furniture" and "animal."

word would be regarded as an overspecification is the nonmonotonicity effects that occur in concept combinations as argued in Gärdenfors (in preparation). For example, a red wig is not a red object. Thus it would be misplaced to talk about a red object when wanting to identify a red wig.

4. Three strategies of communication

When two persons meet, their conceptual grids and the corresponding linguistic labels will only partially overlap. An amplified situation of this kind occurs when you go to a place where a language or dialect is spoken that is mutually intelligible in most cases, like going from Sweden to Denmark. You can continue speaking Swedish, but certain expressions are likely to cause misunderstandings. The importance of this is dependent on the stakes of communication. If you are sitting on a bench in a park feeding pigeons, the motivation to learn from these misunderstandings is perhaps not as strong as if the outcome of an important task depends on the success of communication.

The discussion in the previous section was based on a contrast class presumed by the speaker and the listener in their communication. Hence, we took it provisionally for granted that it was possible to identify a relevant contrast class. However, in many communicative situations, there are reasons to question the prerequisites for being able to infer a contrast class at all. The key problem is to what extent it is possible to form expectations about the conceptual representation of the other. And if the presumed contrast classes of the communicators mismatch, communication is likely to break down.

The purpose of this section is to distinguish three strategies of communication, based on three different levels of how the speaker anticipates the listener's conceptual representation. The first and most primitive strategy is that the speaker acts as if the grid of the listener is *identical* to her own. We call this the "first-person strategy."

The second, more advanced, strategy involves the speaker anticipating the structure of the listener's conceptual grid. In other words, the speaker tries to imagine what the *listener's* representations look like. Since this strategy focuses on the listener, we call this the "second-person strategy."

We will give an illustration of the differences between the two strategies by borrowing data from Krauss & Glucksberg (1977).[12] They tested adults and children (4;4 – 5;3 years old) in a referential communication task. The subjects were asked to describe six nonsense figures (like the one in figure 9) for a listener on the other side of an opaque screen, who was to assign the correct number to copies of the same figures.

Figure 9. Some of the figures used by Krauss & Glucksberg (1977).

When describing for example the fifth picture in figure 9, adults produced utterances like "This one looks something like a horse's head," and they made very few errors in these tasks. The children, on the other hand, used short, idiosyncratic expressions like "another Daddy's shirt," "bird," "dress hold," "dress," or "knife."

Two dimensions of communication seem to come into play here. The first is the uniqueness of the referring expression, which is violated by children when using, for example, the expression "another Daddy's shirt," uttered after having called an earlier figure "Daddy's shirt." To use the same expression for two figures in adult communication would indicate some *similarity* between the figures. Furthermore, the essence of a referential communication task is to generate expressions that single out every object in relation to all the others, so producing the same expressions for two objects means that the children had misunderstood their role in some sense.

12. See Andersson (1994) for more examples of conceptual negotiations.

The second dimension concerns the possibility of running the process backwards, producing a kind of absolute, self-sustaining meaning. This process can be uncovered by letting somebody else generate a figure on the basis of one of the given expressions and see if the new figure is similar to the original one. This approach also makes the new subjects independent of the contrast class of the original experiment, when the variation of figures in the test is sufficiently large.

In order to test this method, we devised a simple experiment, where we took the output from Krauss & Glucksberg's test and asked three subjects to produce schematic drawings on the basis of the descriptions produced in their experiment.

One set of descriptions of these figures that was produced in their experiment was the following:

1. Looks like a motor from a motorboat. It has a thing hanging down with two teeth.
2. It looks like two worms or snakes looking at each other. The bottom part looks like the rocker from a rocking chair.
3. It's a zigzag with lines going in all different directions.
4. It's like a spaceman's helmet; it's got two things going up the sides
5. This one looks something like a horse's head.
6. It's an upside-down cup. It's got two triangles, one on top of the other.

The drawings that were produced by our three subjects on the basis of these descriptions are found in figure 10.

There is a surprising similarity between the four sets of drawings, especially columns two and five, but also one, three and four. We take this as indicating that the subjects giving the original descriptions have abstracted from the contrast class of the original experiment, and produced generic descriptions.

This means that we have in fact three different levels of anticipation, which could be interpreted as corresponding to three different (subconscious) interpretations of what the task is all about, or three cognitive processing strategies.

Figure 10. Drawings produced by three subjects from descriptions of the original drawings.

Using the first-person strategy, which was the one used by the children, it is impossible to solve the task. Apparently, the kids were communicating in some sense, but they used what Krauss & Glucksberg (1977) called *nonsocial* speech.

The second-person strategy, which is taken for granted in most of the referential communication tasks discussed in section 3, corresponds to somehow computing a contrast class that is common to the speaker and the listener and being referentially economical in the referring expressions.

What we will call the third-person strategy, finally, corresponds to generating a *generic* contrast class such that the object is ideally recognizable in whatever context it occurs. We have given evidence for an even stronger hypothesis than this, in the context of Krauss & Glucksberg's experiment, namely that it is possible to reproduce the original drawings from the descriptions alone.

To rephrase the three strategies in the terminology of Freyd (1983), the speaker using a first-person strategy will not modify his conceptual grid in advance, but the outcome of the communication will determine whether another expression will be needed. A person using the second-person strategy will adjust his grid in anticipation, to avoid breakdowns in the communication. In this strategy, communication is still dependent on the context of use.

The third-person strategy means that the speaker takes the perspective of an imaginary conceptual grid that is shared within a community. The resulting word meaning is more context-independent than the meanings resulting from the other strategies.

Relative context independence is a clear advantage in settings where the feedback from the listener is reduced. Thus, the third-person strategy is likely to be closely associated with cultures of *written* language. Olson (1988) associates this with a shift in how to express lack of understanding. "What do *you* mean?" becomes "What does *it* mean?"[13]

It is not necessary for the whole community to share the same perspective. Speakers with second-person perspective will be able to communicate with people with first-person perspective. In support of this, when Krauss & Glucksberg (1977) tested the children on the adults' descriptions, they found that the children were able to assign the correct order to the drawings based on the descriptions that the adults provided.

5. Conclusion

In conclusion, we would like to give a very brief summary of the main points in the paper.

¶ We took a starting point in Freyd's (1983) model of shareability. We questioned some of her assumptions and provided a framework for discussing shareability in a pragmatic setting that can be supposed to mirror some aspects of the evolution of referring expressions.

¶ In section 2, we showed how the tools of referential communication evolve through a process of three levels of abstraction. Names point to a unique referent in a conceptual space. Nouns correspond to a cluster of points in the space, represented by a prototype. They represent several covarying dimensions. Adjectives, finally, represent a single dimension in the conceptual space.

13. Also compare the discussion of epistemic modals in Paper Three, and the reasoning capabilities discussed in Luria (1974/1976).

¶ In section 3, we reviewed some studies of referential communication, and examined the overspecification results, and the claim that the *meaning* of words depends on the current contrast class. We found that two processing strategies can apply, that are basically parallel to the nominal and adjectival level of abstraction in section 2.1.

¶ Section 4 presented three communicative strategies based on different levels of anticipation of the other's conceptual representation. We proposed the *first-person strategy* where the speaker treats the listener as if her grid was identical to the speaker's own. The *second-person strategy* lets the speaker take into consideration the current contrast class, and adapt the linguistic distinctions to the context. The *third-person strategy*, finally, takes the perspective of a generic contrast class. Some empirical evidence was provided to support the argument that the adults in Krauss & Glucksberg's (1977) study used this strategy. We also believe going from first-person strategy to third-person strategy to be the evolutionary ordering of the strategies.

¶ Applied to the model of Freyd (1983), these levels of perspective taking can be said to correspond to different levels of anticipation of the representational distortions that the sharing of knowledge imposes.

¶ The changes in representational skills that we model do not have to concern the population as a whole. A person with second-person perspective will be able to communicate with a person with first-person perspective, and the same is true for persons with third-person perspective. This makes the evolutionary scenario more plausible than if "backward compatibility" were not preserved.

¶ Thus, a study of the evolution of language must consider settings where happy communicative outcomes can be hypothesized to promote evolution on a global level. The communicative practices that are taken as primary will influence the theories of evolution of language. Language has evolved to fill certain needs in specific contexts. From these contexts, evolution has proceeded through

processes of abstraction and decontextualization. However, this kind of evolution is not automatic in any sense, but connected to certain cognitive representational achievements, some of which we have described.

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