The Public Journal of Semiotics

Volume III June 2011 No. 1

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ISSN 1918-9907

A Peircean approach to pictorial documents

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[Logic] is in short The Philosophy of Representation (CP 1.539)

Abstract

The paper summarizes six chapters of a book introducing Peircean visual semiotics to non-specialists. The book has an epistemological bent, and is intended as an empiricist response to Saussurean rationalism, locked away as it is in the universe of Thirdness. Inevitably, in reducing two hundred and thirty pages to twenty-four, the paper has been shorn of the majority of the original examples, quotations and summaries, the relations between the various chapters (here sections) are not developed in detail and the general presentation is perforce allusive: for example, the dynamic object, surely one of Peirce's most potent yet least understood concepts, has been simplified in what is, after all, an introductory text; similarly, acquaintance with his system of categories has largely been taken for granted. Finally, Simonides of Ceos' epigram stating that a poem is a talking painting and a painting a mute poem gives the book its title and a major leitmotiv, namely the way we obtain information from pictorial documents.

Most semioticians are by now familiar with the fact that Peirce considered his semiotics as a species of logic, and the idea that the interpretation of signs, beautiful or otherwise, should fall to a discipline as abstract as logic has caused concern and dismay among theorists of the sign interested in language, literature and pictorial artifacts. However, as a proto-cognitive scientist concerned with the nature and acquisition of scientifically valid knowledge, Peirce not only set his research within mathematics and phenomenology, but was also attentive to the way the rules and theorems of science were to be represented. He thus dignified this aspect of scientific inquiry with the status of a philosophy: his semiotics, therefore, as we know it, turns out to be but the first of three separate branches of logic, branches which he considered collectively as the "philosophy of representation".

What follows, then, is an attempt to give the flavor of this particular conception of philosophy as it applies to pictorial documents. It is a summary of a recent book which deals specifically with this form of logic: a visual semiotics, in other words (Jappy 2010). Isolating this particular aspect of the general theory will possibly irk the specialist, but as the book in question was published in French, it seemed that non-francophone semioticians might be interested in an English version of the major points of the research.

The article deals in turn with the three divisions of the 1903 classification of signs, plus what can be considered one of the core elements of his philosophy of representation, namely the relation between the sign and the medium through which it is communicated; but first a section on certain important non-mimetic considerations and, quite obviously, the definition of the Peircean sign. References to Peirce's definitions, etc., employ the customary presentation of paragraphs from the *Collected Papers* (e.g. CP 2.277) or to page numbers in volume two of the *Essential Peirce* (e.g. EP2 477).

Non-mimetic considerations

This section introduces some of the important general "pre-semiotic" properties of images to which reference will subsequently be made. They have theoretical as well as methodological implications, and are prerequisites for a semiotics of pictorial data. We begin with some very basic differences between image and text, namely their respective "dimensionalities", a theoretical construct first introduced in the 18th century; these are followed by the communication channels that pictorial media exploit, and, finally, by an important distinction between frame and window.

Bodies and actions

One of the first modern, semiotically-oriented, discussions of the differences in dimension that distinguish text and image is to be found in the 18th century study *Laocoön* (Lessing 1766 [1984]). Although the thematic basis of the theory of aesthetics that Lessing develops in this work is a three-dimensional statue, his principal concern is with the way the two dimensions of painting and the single dimension of poetry motivate by a "suitable relation" each art form's representational potential. Drawing on Aristotle's theory of imitative creation, he formulates these distinctions "from first principles" in a well-known passage at the beginning of chapter sixteen. Substituting "text" for "poetry" and "image" for "painting", the upshot, in Lessing's view, is that the one-dimensional line of language units composing texts makes for inherently dynamic, progressive representations of actions, while the two-dimensional still image is a space on which bodies extend in a static "flat". These distinctions can conveniently be illustrated by Plate 1, a frame from a mid-twentieth century British comic strip, combining text and pictorial "bodies" in the cropped representations of two adolescents, a pair of spectacles and a wig.

Plate 1: A frozen transition

Several paragraphs later Lessing also suggests that bodies, not only in the most general sense, but also in the particular case of human bodies, change over time as a result of actions in series. However, he notes, the state of a body, e.g. a human face and its expression, is, at any

given moment, the result of some prior action, and no doubt will be the cause of some subsequent change of face and facial expression.

Channels of communication

In its complete form the comic-strip is multimodal. Nevertheless, its dominant mode of representation is pictorial, or, more technically, iconic, while the information we derive from the vignette as we interpret it is conveyed, not by two, but by at least three distinct communication channels. The first channel is the pictorial, nonverbal channel, the nature of the information which it provides being the subject of a later discussion. This channel, composed basically of lines, forms and, generally, colors, occupies the surface of the image, and this particular example illustrates the way any still image can be interpreted as a sort of frozen transition between prior and subsequent events in the strip.

The second channel is, of course, the verbal. This is the information channel with which we are most familiar, not only in its written form but also through conversation and oral discourse generally, and it is, of course, the channel without which we could barely survive. This verbal channel obviously has an ancillary role to play in the understanding of comic strips and films, etc., in that such sequences of images contain dialogue, but in no way does the verbal channel constitute the dominant mode that it would assume in a poem or a work of fiction, for example.

A third, circumstantial, source of information is supplied by the communication channel conveying well known mass media conventions, such as the placing of authorial intrusion in oblong boxes in the top left corner of selected frames, a position from which the western eye has been accustomed to scan any two-dimensional document. Were this a traditional Japanese *manga* or a comic-strip drawn by an Arab graphic artist, this top—left to bottom—right orientation would, like the verbal material it contains, be oriented in the opposite direction. There are, in addition, pictorial conventions—varieties of "balloons"—to indicate speech, thoughts, telephone conversations, etc., a jagged halo here to suggest surprise, a general left-to-right orientation of characters indicating which character initiates dialogue and action.

Frame and window

Now if the two-dimensional structure of the image makes available a flat surface on which to inscribe various types of "bodies", as Lessing has it, it also offers the possibility of closure by means of a frame—not simply a frame in the traditional sense, but a frame as described by Meyer Schapiro in a remarkable discussion of field and vehicle in pictorial signs in one of the founding texts of a general visual semiotics. The frame around a painting, he suggests, is "like a window frame through which is seen a space behind the glass. The frame belongs, then, to the space of the observer rather than the illusory, three-dimensional world disclosed within and behind", (Schapiro 1994: 7). While comic-strips are not at all at issue in his essay, Schapiro is nevertheless drawing attention to the fact that when we interpret a picture, or a vignette such as Plate 1, we, the observers, unconsciously enter the three-dimensional world of the protagonists, no less than when we become involved in, and are moved by, a telefilm on TV or a film at the cinema. Over and above its theoretical implications, Schapiro's far-reaching remark suggests a methodology for a semiotics of pictorial representations.

Firstly, it should never be forgotten that the "space behind the glass", e.g. the three-dimensional world in which the protagonists of the frame are enacting their teenage drama, is

a world apart, and should be kept so in any semiotic study of images. This is the mute world of the purely pictorial with its specific range of signs. Secondly, we must take into account that the frame itself, as Schapiro suggests, belongs to the space of the observer, but above all to the space of the graphic artist who, for various reasons, produced the comic-strip in the first place. His is the world or space of the third communication channel, and his lines of conduit, so to speak, are delimited by the frame. This means, of course, that the succession of events which includes the one depicted on Plate 1 is determined by two agencies: the graphic artist, whose moral purpose we can divine from the plot ("Be sure your sins will find you out") and the more local determinations of the characters as they go about their adolescent intercourse "behind the glass". We note, at this point, that the verbal material in the strip belongs on both sides of the frame: it grounds the dialogue of the protagonists and is the vehicle for the author-artist's contextual cues in the third communication channel.

It follows, then, from a non-mimetic point of view, that a visual semiotics concerns itself not only with the first and last of the communication channels mentioned above, but also, separately, with the frame and the "contents" of the window: in short, with, what is left in a (still) image once all the verbal material has been excised.

Sign and sign action

This section briefly introduces the basic constituents of the theory of sign action, or semiosis, a logical relation holding between three correlates developed by Peirce at the beginning of the 20th century (CP 2.233). These correlates are the sign itself, the "cause" of the sign, named the dynamic object, and, finally, the effect that the sign produces on the person interpreting it, namely the interpretant.

Semiosis

This is how Peirce defined the sign and its relation to the other two correlates in 1908:

> I define a Sign as anything which is so determined by something else, called its Object, and so determines an effect upon a person, which effect I call its Interpretant, that the latter is thereby mediately determined by the former. My insertion of "upon a person" is a sop to Cerberus, because I despair of making my own broader conception understood (CP 8.343)

The influence on his conception of semiosis of the three categories can clearly be seen in the following militaristic example of semiosis that Peirce himself offers:

> Suppose, for example, an officer of a squad or company of infantry gives the word of command, "Ground arms!" This order is, of course, a sign. That thing which causes a sign as such is called the object (according to the usage of speech, the "real", but more accurately, the existent object) represented by the sign: the sign is determined to some species of correspondence with that object. In the present case the object the command represents is the will of the officer that the butts of the muskets be brought down to the ground. (CP 5.473)

We note the three-term structure of the order given to the squad of soldiers and, just as importantly, the fact that while the order itself belongs to the world of actuality and existence (Secondness), the object belongs to the altogether more general realm of volition and thought (Thirdness). Note, too, that the example also makes the important point that in the course of

semiosis, the sign is in some way "determined to some species of correspondence" with its object. In other words, the nature of the object determines the structure of the sign (structure being a case of Firstness); alternatively, we could say that whatever structure a sign displays, it inherits it in some way from its object. A simple linguistic example shows how this might be the case: the example of semiosis above contains an order, and this determines the distinctly injunctive structure of the sign. If, on the other hand, the colonel had wanted to communicate information to the orderly, the syntax of the sentence would have had the completely different form of a declarative.

Returning to the pictorial example on Plate 1, it should be obvious that the effect, or interpretant, of the sign formed by the expression on the girl's face, her verbal outburst and the removal of the wig and glasses, is the character called Terry's reaction: a reaction which our experience of the world has taught us to recognize, and which is here communicated via the three communication channels identified above, namely the recognizable expression of surprise on his face, the exclamation of the proper noun "Pat!", and the cartoon artist's "surprise" signal effected by the jagged halo round his head and shoulders suggesting a recoiling movement. Since he registers surprise at Pat's removing the wig and glasses, it follows that this plus her angry outburst correspond to the complex sign which triggers his reaction. What caused her to remove her wig and spectacles is the object of this particular sign, and obviously originates in the previous vignette. These, then, constitute, in the protagonists' world at least, the object of the sign visible in the image.

The functioning of semiosis can be illustrated schematically by means of Figure 1, where the arrows indicate the direction of determination—the semiotic "determination flow", so to speak—from the object to the interpretant via the sign. The broken line between the object and the interpretant indicates the impermissible immediate relation between object and interpretant (i.e. a relation not mediated by the sign), the sort of relation which might hold in some outlandish theory of telepathy. On the other hand, the solid horizontal line separating the sign from both object and interpretant illustrates the fact that the sign, e.g. the order given to the soldiers, belongs to the existential world of the troughs and crests of the air waves of speech, for example, while the object and interpretant belong to the phenomenologically more complex and general world of thought and desire. This latter feature of sign action, namely, differences of complexity concerning the object and the interpretant on the one hand and the sign itself on the other—a consequence of Peirce's three-way categorical distinctions—is more properly seen as a function of the ecology of signs, and will be dealt with in greater detail below.

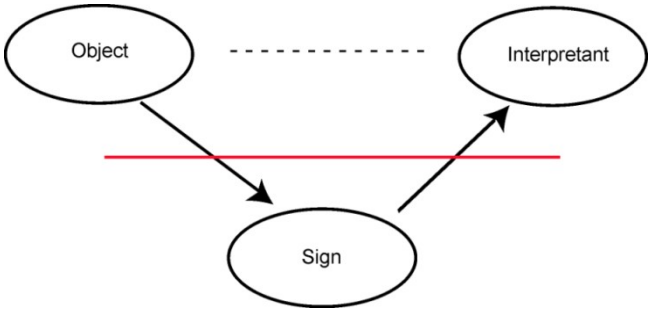


Figure 1: Sign action

Two objects

Obviously, at one level the particular arrangement of lines and shapes on Plate 1 composes a sign representing a lovers' tiff: we recognize the purely graphic elements of the sign as representing as its objects expressions and postures of anger and surprise. In other words, anger and surprise are the determinants of this particular configuration of lines and forms, etc. However, at another level, if these particular facial features are there at all it is necessarily as a consequence of the moral purpose of the author-artist who chose to put them there in the first place (more properly stated, they are the consequence of the relationship between this particular ontology or universe of existence playing out behind the glass and the artist's more or less momentary state of mind: see CP 8.178). It follows, then, that the process of "determination by an object" in images (and in verbal communication, too) is extremely complex and must exist on at least two levels. At one level, behind the glass, as Schapiro puts it, we enter a denoted world of causes and effects represented by the visible objects on the page; on another level, on our side of the frame, we are part of the space of the author-artist who drew them there in the first place. And thus it is that in the comic-strip, as in any other pictorial sign—in any sign, in fact—there seem to be two distinct types of objects engaged in this complex semiotic activity, those constituting the participants in the represented adolescent world of mistrust and deceit, the other belonging to the space of the author-artist and to ours, the readers.

This potentially misleading situation was resolved in 1904 when Peirce reasoned that semiosis involved in fact not one but two distinct types of object: firstly, the less visible object responsible not only for the sign on Plate 1 but for all the others in the strip, too, namely, the intentions of the artist; and secondly, the object that we infer and identify by experience as the face of an angry young woman confronting a surprised young man (each represented by a specific configuration of lines). The first type of object he termed the "dynamic" object, which is the object **outside** the sign; that is, the object which instigates a sign in the first place and determines it to be what and such as it is. The second he called the "immediate" object, the object **within** the sign, the "trace", so to speak, of the first object as it occurs in this particular vignette, namely the two adolescents, the spectacles and the wig, etc.

We note, finally, that these two objects correspond conveniently with Schapiro's distinction between frame and window: the dynamic object belongs to the space of the frame, while the immediate object is formed from the visible world of the protagonists behind the glass. Thus, while the immediate objects of any (figurative) painting or photograph, for example, are what we see in the image, the dynamic object has to be inferred collaterally from the hints left more or less consciously by the artist, photographer, cinematographer, etc.

How shall the sign be called?

The first of Peirce's 1903 divisions identifies the three major subclasses of signs we are likely to encounter in our everyday affairs. In an illuminating passage in "Pragmatism", a text from 1907, he writes of the subclasses in question as being, respectively, "of the nature of a significant quality, or something that once uttered is gone forever, or an enduring pattern like our sole definite article" (EP2 403). Although less well known, this division, which he had earlier divided into **qualisign**, **sinsign** and **legisign**, is no less pertinent to the analysis of images than the better known second division distinguishing between icons, indices and

symbols: furthermore, the signs we find in images of all types, and indeed the images themselves, correspond no less to this three-way distinction than the more familiar verbal examples Peirce gives.

As Schapiro's perspicuous observation urges us to, in dealing with pictorial documents, we must be careful to distinguish between the sign itself and its "contents", and nowhere is this more evident than in the first division. To see just how this applies, consider how the following photographic representation of jubilant soccer fans compares with the teenagers from Plate 1 above:

Plate 2: Rival soccer fans

Clearly, the photograph of the soccer fans and the sketch of the teenage lovers in Plate 1 are *in themselves* "singular" signs, in the sense that they are singular events, that is, one-off signs, the material making of which, like Peirce's once-uttered sign, is over and gone forever. They are infinitely reproducible but can never be repeated in exactly the same way anywhere else or at any other time, and are in no way part of a system or "enduring pattern". This is because as "frames" they are the individual creations of the existential spaces of the photographer and the graphic artist: photographs and sketches are thus sinsigns. On the other hand, signs like those exhibited *within the space of the protagonists* in either illustration, both the verbal and the nonverbal—gesture, expression, etc., specificity of appearance—are general and systematic to the extent that they can be used with the same "meaning" in diverse combinations in an infinite variety of situations, and are clearly more complex in that their interpretation is governed by general rules which we learn from childhood, and as such transcend individuality. They are, therefore, signs which in a certain manner are law-governed: mass media conventions—cropping, framing techniques, etc.—and the various systems of nonverbal communication signs exhibited by these examples are all, no less than verbal signs, types of legisign, and, although less complex and less easily articulated, require careful identification.

Nonverbal communication legisigns

For convenience, in describing such nonverbal legisign systems it is useful to adopt the classifications proposed by certain social psychologists, whose research bears upon the ways in which human verbal communication is embodied in, and abetted by, precisely these various nonverbal sign systems in real life, of which we have two pictorial representations here. The exact typology of nonverbal communication (NVC) systems varies from author to author. Noted early research in the field was conducted by the American anthropologist, Edward Hall,

whose work on "proxemics", i.e. the study of the signification of distances maintained between humans as they interact, was taken up and systematized as a form of "body language" by the French lexicologist and semiologist, Pierre Guiraud (e.g. 1980). An excellent but relatively dated selection of articles on the semiotic aspects of real life (i.e. not necessarily represented pictorially) "somatic" nonverbal communication is to be found in Kendon (1980). Of special interest is Kendon's introductory essay. However, for the sake of simplicity and consistency, I adopt here the typology of the social psychologist, Michael Argyle (1972, 1988).

In his work, Argyle postulates a certain number of (generally culturally variable) nonverbal signals, which are, in effect, behavioral legisign systems, and several of these figure prominently in the photograph and vignette examined above. Some of the more visually salient of these are often scalar signals, precisely the sort likely to be reproduced as signs in pictorial media. Remember, once more, that social psychologists, ethnologists and anthropologists, like many semioticians, study such legisign systems in real life human interactions, whereas visual semiotics tends to examine and classify such signs as they are represented pictorially at one remove from reality in confrontations, for example, behind the semiotic "window". On Plate 2 above we find, among other NVC legisign signals: proximity (Hall's proxemics), facial expression, "war paint" on the face, gesture, posture, orientation, and perhaps most notably at a soccer match, appearance, which is a potent way for the protagonists to send out information about themselves. To these must be added, of course, the numerous mass media conventions encountered in image-making of all kinds.

We note, at this point, that there remains one subclass of sign still to be described, one that is such that it cannot be illustrated in isolation *qua* sign, and is the least complex within the current division. Such signs are the qualitative components to be found in the material sinsigns "higher up the scale", so to speak, and as such are, in themselves, pure potentialities. These are what enable us to identify the particular expressions of the two teenage lovers, and the attitudes of the soccer fans and their lone opponent: they generally occur in clusters of qualities, thereby enabling us to interpret them as surprise and guilt in one or jubilant, menacing behavior in the other. Simplifying considerably, we might say that these qualities or properties constitute the lines, shapes and colors of which all pictorial signs are composed, and we only perceive them to the extent that they *inhere* in such signs and make it possible to discriminate between them. They are simply abstract qualities, qualities in limitless diversity which function as signs, the very stuff, for example, of wine tasting, perfume confection and piano-tuning and, as here, image-making. Such are the qualisigns.

Finally, there are two important aspects of the classification that must be borne in mind. Firstly, implicit in this first division, but explicitly stated elsewhere (see below), is the fact that the subclass lower down the scale is involved in the subclass above. All sinsigns have a semiotic identity guaranteed by their specific set of qualisigns. Secondly, the legisigns themselves are general and immaterial, and so cannot be perceived as such, whence the horizontal line separating the sign from its object and interpretant on Figure 1 above: they are materialized and appear to us through the existent nature of the medium as a special class of sinsign which Peirce named **replicas**. Legisigns, both verbal and, as in Plates 1 and 3, nonverbal, govern innumerable instances; these, the replicas, are characterized by their specific clusters of qualisigns enabling us to identify them when we encounter them both in

texts and images *and* in the infinite variety of encounters we make in real life. Just how the representation of these replicas differs in a line drawing and a photograph (Plates 1 and 3, respectively) is a topic to which we now turn.

Modes of representation

"A sign", wrote Peirce in 1911, "is either an **icon**, an **index** or a **symbol**" (CP 2.304), and we attend now to this particular facet of signs, namely, the three modes of representation which constitute the second criterion for their classification. It concerns the three principal ways in which a sign can represent its object; or, what amounts to the same thing from a different point of view, it concerns the nature of the relation holding between the sign and the object which causes it to exist in the first place. First established by Peirce in 1867, the three-way distinction between icon, index and symbol is by far the best known and most widely canvassed, even figuring paradoxically in the theoretical arsenal of competing semiotic theories and in most accounts of visual culture; within it, the concept of the icon, based as it is on the relation of resemblance, is probably the single most controversial subclass established by Peirce. This division constitutes the second in the triadic system of 1903, following the distinction between qualisigns, sinsigns and legisigns examined above, and preceding the "informational" division to be examined in the final section below.

From the point of view of a visual semiotics, the icon is probably the most interesting mode of representation, for as the name suggests, iconic signs are composed of "significant qualities", Firstnesses therefore, and it is not immediately evident how they can acquire the Thirdness status of symbols. Initially, Peirce called such signs "likenesses", but later adopted the universally known, but much contested, "icon". In a way, this is unfortunate as the term, from a Greek word for "image", suggests that this subclass deals simply with types of picture, whereas the *qualitative* nature of the icon is valid not only for vision but also for smell, touch, taste and hearing: for example, the notes of music we hear in the concert hall are no less iconic, in the strictly Peircean sense, than a painting of Marlborough Castle—they simply involve a different set of significant qualities.

In what follows the three subclasses are described in order of increasing complexity and, to give the reader the flavor of Peirce's original formulations, the most important definitions are introduced as the argument develops. Given the controversial nature of this particular division, and in view of the importance the concept of the icon has in a discussion of visual semiotics, we begin with a number of general considerations which should lead to a better understanding of why Peirce associated the relations of resemblance, physical contact and convention with, respectively, icon, index and symbol.

Herewith another highly important definition of the sign, dating from 1906:

> I use the word "*Sign*" in the widest sense for any medium for the communication or extension of a Form (or feature). Being medium, it is determined by something, called its Object, and determines something, called its Interpretant [....] In order that a Form may be extended or communicated, it is necessary that it should have been really embodied in a Subject independently of the communication; and it is necessary that there should be another subject in which the same form is embodied only as a consequence of the communication. (EP2 477)

In this passage from a letter to Lady Victoria Welby, Peirce is expounding on an important aspect of the nature of the relations holding between the sign and object, and in particular, on the formal consequences of the determination of the sign by the object, a principle already encountered in Peirce's militaristic illustration of semiosis discussed above. The interesting point, for it constitutes one of the major theorems of linguistic iconicity theory, is that in determining the sign to existence, the object imparts or communicates part of its form to that sign: in an older sense of the term, we might say that the object *informs* the sign, whence the concept of "information". For obvious reasons this principle is particularly evident in the case of the least complex of the present group, the icon.

The icon

Plate 1, the vignette examined above minus the verbal elements, is offered as a typical example of the icon. The relation between the sign and what it represents is necessarily qualitative, since the former is composed simply of black lines and shapes: for us to be able to identify as teenagers the persons represented, both object and sign must have at least these qualities in common; and the nature of the relation between the two is one of resemblance, since, for Peirce, any two entities can be said to resemble each other if they share at least one quality. Such a sign can offer no proof of the existence of the protagonists, its immediate objects: as the reader can see for himself, they simply look like teenagers. The fact that we recognize them as such is simply a matter of experience, and has nothing to do with the sign itself: even a child would recognize it as representing two quarrelling youngsters for the simple reason that this is what they look like. From our experience, "the cognitive resultant of our past lives", we construct inferentially a composite image from the lines and shapes on the page.

Plate 1, then, is an example of an icon, a sign which is said to be "motivated", that is, determined in its very shape by part of the structure of the object that it represents in the way described in the definition given above (EP2 477). The following is Peirce's painstakingly-formulated definition:

> An Icon is a sign which refers to the Object that it denotes merely by virtue of characters of its own, and which it possesses, just the same, whether any such Object actually exists or not. It is true that unless there really is such an Object, the Icon does not act as a sign; but this has nothing to do with its character as a sign. Anything whatever, be it quality, existent individual, or law, is an Icon of anything, in so far as it is like that thing and used as a sign of it. (CP 2.247)

By definition, then, an icon is a sign that signifies by virtue of the fact that it shares at least one "character" or quality with the object that determines it (though such a simple sign, it must be said, would have very little practical interest, should it exist). In other words, when the sign and its object simply share common qualities or properties such as lines and shapes, etc., as in the sketch above, then the sign is an icon of that object, and its characteristic representative quality is to be such as it is, independently of both object and interpretant. To the extent, then, that an entity has at least one quality it is fit to function as a sign, though it cannot do so until it conforms to some object and has determined in turn an interpretant.

The index

Here is how Peirce defined the index in 1903, in a passage following the definition of the icon given above:

> An Index is a sign which refers to the Object that it denotes by virtue of being really affected by that Object. It cannot, therefore, be a Qualisign, because qualities are whatever they are independently of anything else. In so far as the Index is affected by the Object, it necessarily has some Quality in common with the Object, and it is in respect to these that it refers to the Object. *It does, therefore, involve a sort of Icon, although an Icon of a peculiar kind; and it is not the mere resemblance of its Object, even in these respects which makes it a sign, but it is the actual modification of it by the Object*. (CP 2.248; emphasis added)

The semiotic structure, or constitution, of the index thus necessarily involves two elements—sign and object: in other words, this constitution is dyadic. In addition to the definition it offers of the index, the passage makes a further important point: by virtue of the principle of implication underwritten by the relations holding between his three categories, Peirce is able to justify theoretically just why it is that an index such as a photograph is *interpretable* at all. The physical contact between object and film is, in itself, only temporarily observable (if at all, though in the case of film the actors and technicians, etc., all witness the indexical nature of the filming process). Nevertheless, the "impact" of the object on the film is such that it leaves a complex but visible mark or trace which contains information of a sort concerning the "model" that brought it into being. In other words, just as any Secondness requires qualities of Firstness to give it its specific identity, so too the index has an icon "nested" within it, an icon without which we should not be able to identify the perceptible immediate object of the sign or the external object it represents.

Whereas in the case of the icon the existence of the object was not a prerequisite for its own particular representative quality—it was simply required to possess at least one quality—the index is defined precisely by the fact that the object is necessarily involved in the dyadic structure of its semiotic constitution: the interpretant, therefore, does not enter into the picture, though indices obviously do not function as such until they actually determine an interpretant.

Consider, as an example, Plate 2 above, the photograph of the soccer fans. Since, in Peirce's words, the sign is really (i.e. existentially, physically) "affected by its object", he frequently proposed the photograph as an excellent illustration of the index, if only for the simple reason that it is not possible, or wasn't in the days of argentic photography, to take a photograph of a non-existent object, a condition which clearly shows the relation between sign and object to be existential. This means that an index can only relate to an individual object, or, as in the example or in the case of a group portrait as in a school photo, to a group of individuals, to a group of "particulars". Such a sign is deictic, i.e. has a pointing, designating function inasmuch as it relates to, and is only understandable in relation to, a unique individual (or group of individuals), to a unique time and to a unique place: 'The index asserts nothing; it only says "There!" It takes hold of our eyes, as it were, and forcibly directs them to a particular object, and there it stops' (CP 3.361).

Peirce furthermore makes the very important point that since the actual physical contact (a contact which we don't normally witness) between sign and object is what makes the sign indexical, in order for us to recognize the person whose photograph it is, the index must

incorporate an icon. Putting this implication principle back to front, he states: "A photograph, for example, not only excites an image, has an appearance, but, owing to its optical connection with the object, is evidence that that appearance corresponds to a reality" (CP 4.447). In the present case, this "image" or "appearance", namely the iconic material in the photograph, is a very much more detailed composition of lines, shapes and colors than the sketch on Plate 1, but is nothing more, nevertheless, than the **iconic** set of traces of the shapes and colors reflected by the jubilant fans and their hapless rival.

In similar fashion, a footprint in the sand, an index, will indicate that some animal or other has walked in the area, but the actual shape of the footprint, its iconic content, will enable us to determine whether it was made by a crab, a bird or, as Robinson Crusoe discovered, a human being. It thus follows that an index, too, is a motivated sign.

Finally we note that while the vignette on Plate 1 as a whole is an iconic sinsign, it nevertheless represents, behind the glass, iconic replicas of the relatively simple NVC legisigns described above: expression, orientation, proximity, appearance, etc. The photograph on Plate 2 also contains the representation of similar replicas of NVC legisigns. These, too, are iconic—they constitute the visible material of the sign, and it is not because the photograph is indexical that the status of what we see in it should also be indexical: to be perceived and interpreted at all they require the qualitative contribution of the icon. On the other hand, what we see as iconic material would, in the actual confrontation, be experienced by the protagonists as very real indices of two warring soccer tribes. This is the case too in cinematography: (with the exception of animation), the material production of the film is indexical but what we see on the screen is purely iconic.

The symbol

Finally, the most complex relation of all holding between a sign and its object is one that transcends individuality and represents a very general object. In this case, since no individuals are involved, only classes, the sign has to be learned (its object can't be seen in the way that an individual can, and has to be inferred), and functions therefore by convention, by "agreement" among the sign users. This means that such signs call for the active participation of the user/interpreter—anyone who doesn't already know what the word *legisign* means is not likely to understand it when they first come across it, unless the meaning can be inferred from the context. Common nouns, verbs, adjective and adverbs are all linguistic examples of symbols adduced by Peirce, while proper nouns, demonstratives, personal and relative pronouns, etc., are all examples of a sub-category of indexical legisigns he termed **hyposemes**. However, as mentioned above, it is an interesting question within a purely visual semiotics how predominantly qualitative nonverbal signs like icons might acquire the complex status of symbolhood.

To begin with, this is how Peirce defines the symbol:

> A Symbol is a sign which refers to the Object that it denotes by virtue of a law, usually an association of general ideas, which operates to cause the Symbol to be interpreted as referring to that Object. It is thus itself a general type or law, that is, is a Legisign. As such it acts through a Replica. Not only is it general itself, but the Object to which it refers is of a general nature. Now, that which is general has its being in the instances which it will determine. There must, therefore, be existent instances of what the

> Symbol denotes, although we must here understand by "existent," existent in the possibly imaginary universe to which the Symbol refers. *The Symbol will indirectly, through the association or other law, be affected by those instances; and thus the Symbol will involve a sort of Index, although an Index of a peculiar kind*…. (CP 2. 249; emphasis added)

As mentioned before, the semiotic constitution, or structure, of the symbol, unlike that of the index, necessarily involves the "participation" of the interpretant—it is genuinely triadic: in practical terms this means that we have to know in advance what the object of the sign is in order to interpret it. When this is not the case, we have to learn it, whereas we are normally able to recognize the elements in a photograph or a painting. However, applying the implication principle by which the more complex subclasses involve the less complex, Peirce is explaining in the definition above that a symbol contains a sort of index, albeit of a "peculiar kind". We already know that an index incorporates an icon, which means that by transitivity a symbol contains some form of iconic material (were this not so, remember, we should be unable to perceive it—the symbol itself is perfectly general, while an index is instantaneous, and only the iconic traces in the sign are perceivable).

How, then, might an icon attain to symbolhood? Religious art abounds with examples, as evidenced by the numerous studies explaining the "hidden", i.e. symbolic, meanings of objects to be found in religious imagery: Hall (1983) is a good example. We learn, for example, that peacocks, which are to be found in much early religious imagery were placed there not for their esthetic value, but because their flesh was held by legend not to be subject to decomposition or putrefaction. In this way peacocks were not simply pictorially flamboyant birds but the symbols of everlasting life. Consider, as a further example, Van Eyck's *Arnolfini Portrait*, 1434, hanging in the National Gallery, London, which illustrates the principle perfectly. As a painting, the whole image is a sinsign by division one and an icon by the present one: it is an existent object composed of iconic material which we interpret to be a man and a woman holding hands, a dog carefully placed between them at their feet, a bed, a mirror, a pair of discarded clogs and a chandelier, etc. Although the meaning of the painting is disputed, it is thought to represent the wedding ceremony uniting the banker Giovanni Arnolfini and his wife. While it is impossible to establish definitively just what each carefully chosen object in the image actually represents, the dog is an interesting case of symbolism in the Peircean sense. At one level, it is simply a dog, possibly one in the house already or even a gift from husband to wife. However, it has also been interpreted as symbolizing fidelity between the two, an important feature of Christian marital doctrine.

The important point is that although an icon by definition, the painting contains pictorial symbols. They are instantiated in the objects the artist has elected to include: these are the indices of a "peculiar kind". What makes them symbols is the fact that this individual dog, for example, has been interpreted to represent something considerably more complex, namely a concept. All concepts are legisigns; they are general and have to be learned, and if it weren't for the various interpretations of the painting by art historians our understanding of the semiotic status of the dog would be all the poorer. Furthermore, the fact that interpretations of the painting and the meaning of the elements it contains are the object of disputes among art historians is evidence, too, of the symbolic status of the elements of the world behind the glass: they are almost universally deemed to mean more than their face value.

However, there are less conventional cases of the symbolization of basically iconic material. Consider what might be termed "dysfunctional symbolization", the attribution to a painting, work of art or religious artifact of values not necessarily to be found in the elements in the representation itself; this is the case with most forms of iconoclasm, the destruction of paintings and sculptures by psyches disturbed by folly or fanaticism. There are numerous examples of art works which have suffered from attacks by knife or hammer: Ad Reinhardt's giant black paintings, Leonardo's *Mona Lisa*, and Michelangelo's *Pietà* are but three well known examples. Yet another form of iconoclastic re-symbolization occurs in the way certain artists appropriate paintings, etc. from earlier traditions in order to re-work them by investing them with new values, satirical or otherwise, e.g. Duchamp's treatment of the *Mona Lisa*, and Plate 5, below.

Ecosemiotics

With this section we enter the heart of the Peircean contribution to the semiotics of pictorial documents. It is at this point that the relation between his three categories and the principles of semiotics they govern is evidenced most spectacularly as the basis of an ecology of signs: no sign occurs in a vacuum, and as we saw above, in the practical process of human communication all signs have to be conveyed through, and by means of, an existential medium. This, after all, is the justification for Peirce having posited the category of replicas of legisigns (a Nominalist wouldn't have bothered). The replicas of speech, to take a simple example, carry through the air we breathe as a wave-like succession of peaks and troughs, while those we write, as Lessing, for one, was careful to emphasize, are a linear sequence of inscriptions on a page (but now also on the computer screen or some other equally visible medium). Were this medium not existential in nature, we should be unable to hear, see, feel or smell signs, nor should we be able to expunge them from a writing pad or a blackboard, for example. Most importantly of all, communication would be the prerogative of a happy band of telepaths.

It therefore seems not unreasonable to expect that the medium in which the sign is conveyed should have some bearing upon the form it presents, and that an ecology of signs, that is, a study of the relation between the sign, the medium through which it is transmitted, and the complexity of the object represented, should yield interesting information concerning the nature and determinations of that structure. It is within the context of this often neglected relation between sign and medium that we take up and extend the theme of the mode of representation of their objects by signs begun in the previous section. The main thrust of this section is, therefore, a preoccupation with a sign's iconicity, that is, its semiotic *form*, not simply because the study of the formal characteristics of signs is, as we shall see, determined in crucial ways by the relation between sign and medium, but also because such medium-induced variations in form can be shown, for example, to be the major invariant element within the long history of discussions of metaphor and allegory in both image and text.

The hypoicons

We recall, first, that the object of a sign of human origin is nearly always going to be general (thoughts, volition, etc.), while the medium will be air (in the case of speech) or paper or a blackboard (if the sign is written), for example. These latter are cases of singularity, in other

words, Peirce's Secondness. Thus in the case of Peirce's definition of semiosis, the object and interpretant are, in practice, more complex than the medium through which the sign is transmitted (as shown by the horizontal red line on Figure 1). His theory of the categories makes it possible to analyze these complex relations between medium, sign and object, the defining text of which is celebrated in paragraphs 2.276-7 of the *Collected Papers* in which he introduces the concept of the hypoicon.

> 2.276. ...But a sign may be iconic, that is, may represent its object mainly by its similarity, no matter what its mode of being. If a substantive be wanted, an iconic representamen may be termed a hypoicon. Any material image, as a painting, is largely conventional in its mode of representation; but in itself, without legend or label it may be called a *hypoicon.*

This relatively simple statement means that Plate 1 is, like any painting without a caption, a hypoicon, which, of course, doesn't preclude such pictorial signs from representing the complexity of legisigns. However, by applying the familiar three-way categorial analysis to the subclass of icons, Peirce distinguishes three distinct cases in the following terse definition:

> 2.277. Hypoicons may be roughly divided according to the mode of Firstness of which they partake. Those which partake of simple qualities... are *images*; those which represent the relations, mainly dyadic, or so regarded, of the parts of one thing by analogous relations in their own parts, are *diagrams*; those which represent the representative character of a representamen by representing a parallelism in something else, are *metaphors.*

Thus the categories of Firstness, Secondness and Thirdness determine three hypoiconic "situations":

- The case where the object is simply qualitative and therefore less complex than the medium through which the sign is transmitted.
- The case where the complexity of both object and sign corresponds to that of the medium.
- The case where the object represented by the sign is more complex than the medium (the object is general, the sign and medium are existential singularities).

In the first case, then, we say that the sign is an *image*, in the second a *diagram*, and in the third that the sign is a case of *metaphor.* We can illustrate these fundamental distinctions captured by Peirce's definition as they apply to a single theme, namely representations of the human face, by Plates 3, 4 and 5. In the two more complex cases, each illustration is accompanied by an explanatory diagram based upon Figure 1. The first is a black and white, cropped version of the cover illustration of volume two of Aubrey Beardsley's *Yellow Book* (1894); the second is a diagram of the human skull taken from *Gray's Anatomy*, while the third is a poster designed to stimulate church attendance in Britain at the end of the last century. Note that all the objects represented are to be found behind the semiotic window.

Plate 3: Image

Plate 3 is a woodcut featuring among other things a stylized representation of a young woman's face, and Beardsley's principal concern is to organize these features in accordance with his particular esthetic preoccupations, e.g. the large expanses of black and yellow, the deliberate flattening of space and the rejection of perspective, as well as the deliberate placing of esthetic values above the representation of real live human features, etc. The actual relation between the eyes, nose and mouth are in this way of no scientific importance, and physiological accuracy was obviously not the artist's prime concern.

This is clearly not the case with Plate 4, which obviously targets surgeons, doctors and medical students: its primary purposes are to inform and to instruct, and physiological accuracy in this case is paramount, with the relations between the various parts of the skull scaled exactly in proportion and meticulously identified and labeled. Although it contains verbal legisigns of various kinds identifying the different parts of the skull (*frontal, supraorbital foramen*, etc., legisigns which obviously present no problems of comprehension to the experienced specialist), the mode of representation involved is inescapably iconic: in addition to these recognizable language signs the diagram is composed of lines forming relations within it which are intended to correspond term for term with relations among the parts of a human skull. In other words, as the definition states, for the sign to function correctly the dyadic or compound dyadic relations represented between the components in the diagrammatic representation have to correspond point by point, so to speak, to the relations between the components of the object represented. We don't know for certain that they do, but the sign represents itself to be representing them faithfully as doing so. This second representation, then, is an example of Peirce's *diagram,* an "icon of relations" (CP 4.418).

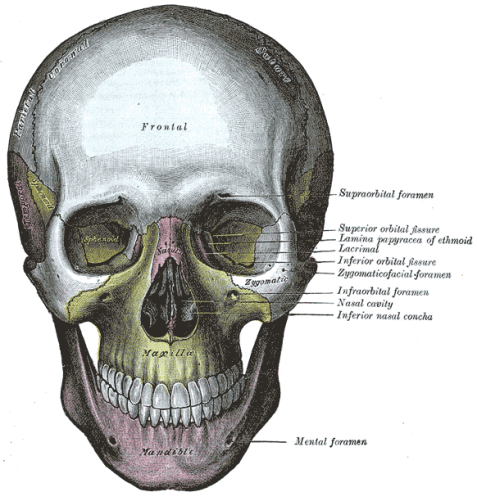


Plate 4: Diagram

The accompanying diagram, Figure 2, shows the community of dyadic structure of both object and sign, and the transmission of such a sign through the existential Secondness of the medium is such that the sign can represent the structure of the object unhindered. This has been considerably simplified on the explanatory diagram, where the multiple dyadic relations between the parts of the skull and their representation have been reduced to two on Plate 4: for example, the spatial relation holding between the nasal cavity and the inferior nasal concha has been reduced to the single dyad **a—b** in the object represented, determining the analogous dyad **a'—b'** in its spatial representation in the sign. Note that, as in the case of the index, the structure of a diagrammatic sign is determined by the structure of the object and that the interpretant is not involved in that structural determination (though the interpretant is obviously involved in the semiosis).

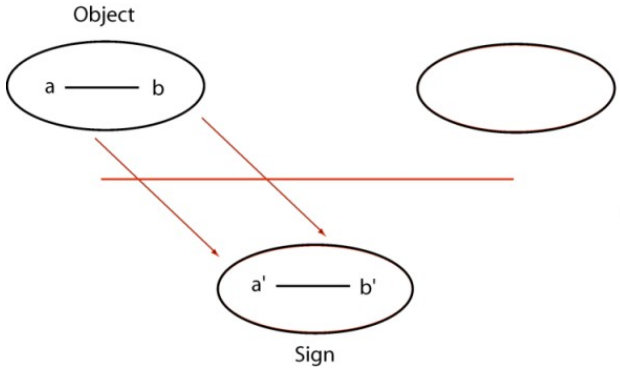


Figure 2: The semiotic constitution of the diagram

The purpose of the chimera on Plate 5, on the other hand, is of a different order, and there is clearly no scientific accuracy intended. This (originally multimodal) document entitled "(Meek Mild) Jesus: no wimp in a nightie" is offered as an example of pictorial metaphor. It was published in poster form as part of a campaign financed by the Church Advertising Network in Britain in preparation for Easter 1999, in an attempt to revamp the image of Christ and to revitalize church attendance at the time. It is, of course, yet another appropriation of the famous photograph of Che Guevara taken in 1960 by Alberto Korda, the idea being to replace the traditional docile image of a man prepared to turn the other cheek to his enemies and tormentors (whence the term "wimp", the "nightie" in question being an uncomplimentary reference to the ample robe Jesus is always represented as wearing) by a more aggressive and revolutionary one.

Plate 5: Metaphor

The interest of the poster is the way the features of two distinct but parallel ideologies, Marxist and Christian, are metaphorically integrated in a single image. What makes such an incongruous parallelism possible is the fact that both men were considered martyrs, and died for causes involving oppressors from home and abroad (Bolivians and American Army Special Forces on the one hand, and Jews and Romans on the other). The image of Christ is being targeted using the knowledge we are assumed to have of Che Guevara and the photograph as a basis for the comparison. The red background is common to both men—blood and revolution. Thus, just three nonverbal features of expression and appearance—replicas of NVC legisigns—and the framing convention governing the slightly low-angled shot are sufficient for an efficient interpretation of the message.

The diagram on Figure 3 displays the parallelism in the object that the sign has to transmit through the existential medium, and its reconstruction in the interpetant if it is to be successfully interpreted by the congregation targeted. Within the parallelism the relation **a—b—c** belongs to the unproblematic "base" domain (the terminology is not Peirce's, but that of Lakoff and Johnson 1981) assumed to be known to all, and representing, respectively, the beret, the facial expression and the low-angled shot from the Che Guevara photograph. The structure **a'—b'—c'**, on the other hand, is the problematic domain targeted by the metaphor, here the revitalizing of the image of Christ. Within the parallelism, **a** and **a'**, **b** and **b'**, **c** and **c'** are counterparts, that is, they correspond to each other within their respective domains: **a** and **a'** are respectively the beret and the crown of thorns, **b** and **b'**, the faces and expressions of Che Guevara and Christ, respectively, while **c** and **c'** can be supposed to be the framing techniques adopted by, respectively, the photographer and conventional artistic representations of Christ. The simplified structure of the resultant sign represents a reduction of the original two-tiered parallel to a "line" associating Christ's crown of thorns (**a'**), Che Guevara's face and moustache (**b**) and the particularity of the photographer's choice of frame (**c**).

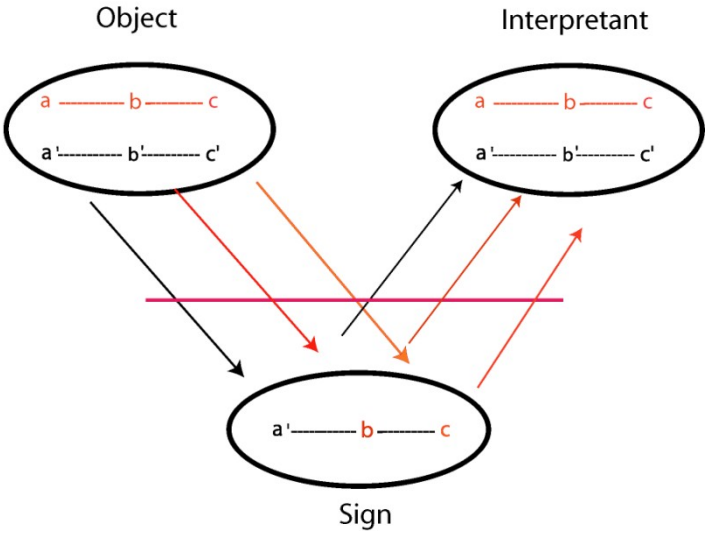


Figure 3: The semiotic constitution of metaphor

It is thus characteristic of metaphorical signs, firstly, that they should be underspecified with respect to the parallelism they have to convey—the existential structure of the medium prevents the transmission of the two-tiered totality of the original objet, and this parallelism has to be inferred at the interpretation stage; and secondly, that such signs always, at least when first encountered, appear incongruous—the incomplete blending of elements from two distinct domains of experience produces the sort of chimera shown on Plate 5. This is no less true of linguistic metaphor than of the nonverbal type discussed here. In this way, Peirce's category theory offers a neat explanation of how the medium crucially determines the structure of signs of this type, whether verbal or pictorial.

Finally, the diagram below illustrates in linear fashion this constricting "funnel" effect of the Secondness of the medium on the complexity of the object being represented: the parallelism in the object has been reduced unavoidably to a single "line" in the sign, with a consequent loss of information, and an incongruity within the sign itself.

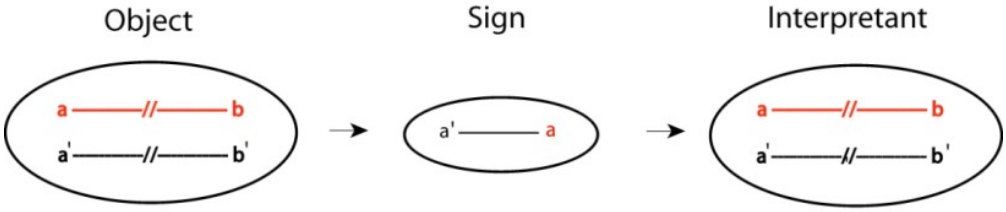


Figure 4: The funnel effect of Secondness on the structure of the sign

Within the object, the vector **a—b** represents elements from the base domain, the unproblematic area of experience assumed to be common to both speaker and listener; the vector **a'—b',** on the other hand, represents the problematic domain being "assessed" in the target domain. Thus in the sentence *Achilles is a lion*, the lion, renowned as the king of the jungle, i.e. adjudged by legend to be the most fearsome beast in the animal world, is the base, while Achilles and his value in relation to other human warriors is the target. The sign in this case contains the relation **a'—a**, that is, the element *Achilles* from the target domain, here represented for simplicity as **a'**, plus *lion*, here **a**, from the base, while the other elements of the parallelism, namely the other animals (**b**) and the other human warriors (**b'**) have perforce been omitted from the sign.

Beyond metaphor

Finally, the hypoiconic structure of allegory and personification, here an illustration from an emblem book, is more complex than the case of metaphor examined above, although this is not immediately apparent. Emblems were typically composed of a motto, an image or *pictura*, and a text in verse and/or an epigram. In this case, the *pictura* has been extracted from Andrea Alciato's 16th century *Book of Emblems*, and represents the emblem *Vigilantia et custodia*. In appearance it seems to be far simpler than the skull from *Gray's Anatomy*, being composed of easily recognizable facing cockerels perched on bronze bells at the top of twin towers, one in the dark, the other in the light, together with two lions guarding the entrance to a temple. We are tempted to think that even a young child could successfully interpret such an image.

Wakefulness and watchfulness

The crowing cock - because it gives signs of the coming Dawn and recalls toiling hands to a new day's labor; the bronze bell - because it calls the wakeful mind to higher things: each is fashioned on sacred towers. And here's a lion - but because this guardian sleeps with open eyes, it's therefore placed before the temple doors.

Plate 10: Alciato's emblem 16

However, as the experienced adult knows, following a long tradition of fables and bestiaries from Æsop and Jean de La Fontaine to James Thurber and Art Spiegelman, the animals are intended to represent human qualities, here wakefulness and watchfulness (and if he doesn't, the epigram is there to help). In other words, this picture represents an object far more complex than itself, a parallelism, in fact drawn between two pairs of animals and two commendable human qualities. The structure of the picture then is that of Peirce's *metaphor*, but the contents of the sign are even more underspecified than in the canonical case of metaphor. This situation we can diagram using the funnel schema from above:

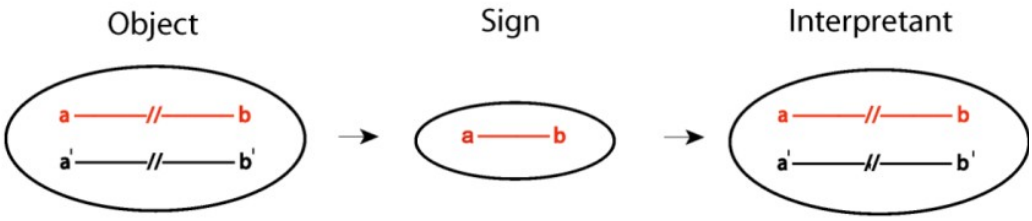


Figure 5: The hypoiconic structure of allegory

If we compare this schema with Figure 4 we see that the *pictura* itself contains only elements from the base domain, namely pairs of lions and cockerels. The two human qualities being targeted have to be inferred from our collateral experience of the genre. This (much simplified) would be the case, too, in the graphic novel *Maus*, where the vector **a—b** would stand for the well-known relation holding between cats and mice, while **a'—b'** would represent their respective counterparts in the target, namely the Nazis and the Polish Jews.

However, within the sign on Figure 5, as in the novel, the base relation between cats and mice is the only one to be fully represented, leaving the target to be inferred by the reader. In this way, fabulists and allegorist the world over, have, through the ages, appropriated and re-worked the structure of metaphor as Peirce identifies it in paragraph 2.277.

Image and information

Information

The final trichotomy of the 1903 classification discriminates between the three ways in which signs afford information about their objects, and is no less important to a visual semiotics than the others. Now Peirce states that the "only way of directly communicating an idea is by means of an icon" (CP 2.278), which raises the interesting question as to how icons, in particular pictorial icons, actually do this since, as seen above, they are composed principally of qualities. We note, to begin with, that outside computer science with its bits and bytes the term "information" is usually understood to mean some descriptive proposition, assertion or statement enabling us to describe some system. For example, a proposition such as *Collioure has an interesting church*, composed of the subject *Collioure* and the predicate *has an interesting church*, enables us to describe if only in part the "system" Collioure. Note that, in addition to the traditional formula of Subject + Predicate, Peirce defines the proposition as being composed of an index, which indicates what the proposition is about and establishes a universe of existence or ontology, and an icon from which information about the index can be obtained. The problem for a visual semiotics at this point, then, is a) to determine just what sort of information can be obtained from images of all sorts, and b) to what extent images can function propositionally.

The hypoicons once more

Plate 6: "Air" from the *Orbis pictus*

One way of obtaining information from images is illustrated by the fundamental differences between Plates 6 and 7. The first is an illustration from Comenius's *Orbis sensualium pictus,* an innovative 17th century pedagogical aid composed of chapters of images and associated "nomenclatures", and constructed on the Aristotelian principle, explicitly stated in the work's Introduction, that there can be nothing in the "understanding" that isn't first in the senses, the idea being that the visible world is either there before the child's eyes, or recognizable from past experience in the form of a mental image already in his mind, and that associating the

known image-content with the as yet unlearned word can lead to the extension of a child's vocabulary. Each chapter is composed of a woodcut illustrating one of the one hundred and fifty themes, with, on the facing page a list of terms in Latin. The second, Plate 7, is a cut-away diagram of a diesel pump. Both display an arrangement of distinct parts, each of which is identified with a number.

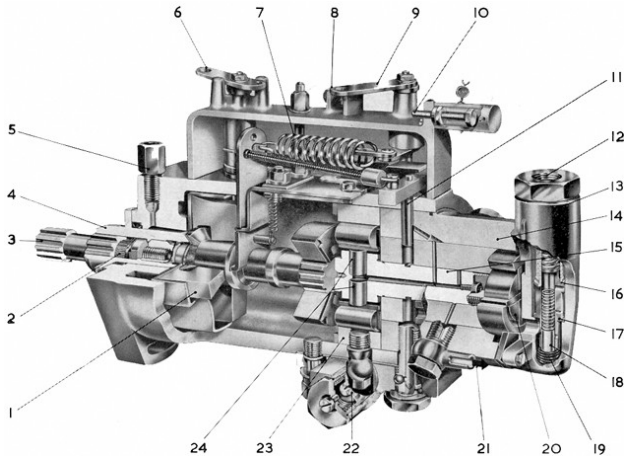


Plate 7: Cutaway diagram of a diesel pump

However, there the similarity ends, for while it would theoretically be possible to rearrange certain items on Plate 6, e.g. by placing the trees behind the house, without destroying its purpose, such a rearrangement would be totally impossible in the case of the pump. The explanation is simple: while both illustrations are iconic, Plate 6 is an **image** in the technical Peircean sense, composed simply of relatively unordered qualities (the wind must be directed at the trees, of course), Plate 7 is structured as a **diagram**, in the Peircean sense here too, in that relations between parts in the object, namely the pump, strictly determine analogous relations visible in the sign. This is, of course, the principle behind geometrical diagrams and the wordless instructions on how to install electrical and other appliances in the home; it is also, of course, the principle illustrated by the diagram from *Gray's Anatomy.* While such signs don't actually tell us anything as a proposition would, they nevertheless afford valuable, viable information.

Propositional imagery

However, there is more to the problem than the essential differences holding between imagic and diagrammatic icons. Indeed, more important for present considerations is the fact that, for Peirce, the whole notion of information was a function of a sign's capacity to indicate the existence of its object. For example, given the phenomenological status of the index as described earlier, in a proposition such as the one given above, *Collioure,* a proper noun, is the readily identifiable subject of the proposition: it is represented to the interpretant to be the index of some object *existing* independently of the sign within a specific ontology. This may or not be so, but the utterance represents this to be the case, and for this reason such a sign, with its "double" syntax (i.e. composed of two elements, namely a subject and a predicate) is subject to the principle of contradiction: it is either true or false. In such cases, Peirce identifies the sign as "dicent", i.e. a sign that actually *tells* us something.

Moving to pictorial data, a captionless photograph of the entity Collioure is "dicent" to the extent that, as an index, it displays and thus guarantees the existence at some unspecified

moment of such an object (or purports to, even in the case of digitally modified images). This cannot be the case with an icon, which is composed simply of qualities (aided in the case of diagrams by indices of a special sort), and so an icon, the object of which is necessarily whatever happens to resemble it—an "imaginary object" is one of Peirce's terms—can only denote the possibility, not the existence, of its object and cannot *ipso facto* convey information. In other words, they have an informative potential but, as a consequence of their qualitative status, they cannot *tell* us anything. With this in mind we turn to illustrations of the sign-types defined by this third trichotomy within which, in order of increasing complexity, Peirce distinguishes between **rhemes**, **dicent signs** and **arguments**, which differ essentially in the peculiar syntax connecting them to the object represented.

Rhemes

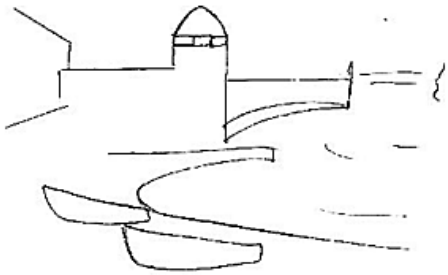


Plate 8: A Catalan fishing port

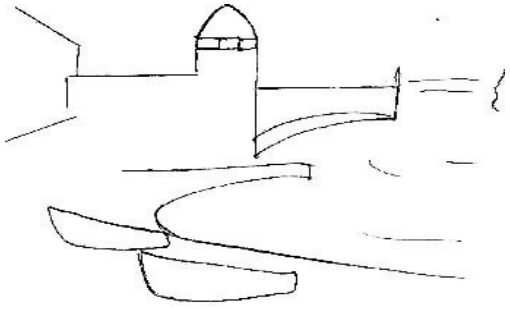
Of the several examples from this section, Plate 8, a sketch of a fishing village beloved of Matisse and the Fauves has the lowest informational value. Composed simply of lines and shapes, it is both a singular sign and an icon. Since there is no *physical* connection between the port and its pictorial representation, as there would be if it had been a photograph, it is in no way indexical, it has a simple syntax (only the sign is involved), it cannot form a proposition and therefore does not enable us to describe any system. Peirce called such signs **rhemes**—simple, substitutive signs. The sketch is a rheme, as is the expression above —*has an interesting church*. Nevertheless, although they do not constitute propositions, information of the sort mentioned in the discussion of Plates 6 and 7 can be obtained from such signs.

Plate 9: The church at Collioure

Plate 9, the photograph of the church in the same Catalan fishing village, is necessarily an index, since it stands in an existential relation to this part of the town (someone took the photograph at a particular time). It is also visibly iconic since we can, from the lines, forms

and colors composing it, recognize it as something like a church or a lighthouse, even if we've never seen the entity in question (it is also iconic by virtue of the implication principle associating all indices with some form of incorporated icon).

Nevertheless, the syntax of this particular sign is no less double than a proposition associating a subject and a predicate such as *Collioure has an interesting church*: the index is the fact that a photographer took the photograph at a particular date, and the whole image "tells" us that "there exists (or existed) something like this", the "like this" being, of course, the iconic material visible in the plate. In other words, such a sign, while still dicent, is less informative in that the index is not as clearly identifiable as the subject is in a linguistic proposition: we simply understand that the physical connection between the port and the film did in fact take place at some unspecified and unspecifiable time, but the port itself is not identified by name.



Collioure

Plate 10: A sketch of the port of Collioure plus caption

However, Plate 10, which is a sketch of the said church *plus* a caption beneath, is, unlike Plate 8, a double sign—a sort of proposition, therefore, by virtue of its characteristic "double" syntax. The caption is composed of a proper noun (*Collioure*), which is a type of index, plus an icon formed by the sketch (identical to the one on Plate 8). Thus the association of the index and the icon "informs" us that the existent entity Collioure is somehow like the lines, etc., on the sketch. Moreover, although composed of the simple qualities of a line drawing, as a consequence of the presence of the legisign *Collioure*, Plate 10 is semiotically more complex than the photograph on Plate 9.

Finally, returning briefly to some of the previous examples, we see that the NVC legisigns on Plates 1 and 2 are necessarily rhematic: being iconic and having therefore a "simple" syntax, they lack the dyadic, existential requirement that would enable them to yield viable information. Similarly, the Van Eyck dog and the peacock are both rhematic symbols for the same reason: their syntax, too, is simple.

Argument

Finally, the argument, the "triple, or rationally persuasive sign", the most complex of all subclasses, and the means of discovery of new information, is customarily linguistic in nature, as only language signs readily admit of the sort of complex articulation generally required by overt ratiocination. However, owing perhaps to changes of attitude towards the notion of mental images and to advances in digital technology, Peirce's enthusiasm for diagramming the reasoning process—he wrote of his Existential Graphs that they were "My Chef d'œuvre"—seems to have been vindicated by a recent renewal of interest in both diagrammatic and heterogeneous, or multi-modal logics, that is, logics which combine visual information and

symbolization. However, to assess the Graphs in relation to the present problematic would require a whole book, not an article, and the interested reader can find a very full account of this aspect of Peirce's preoccupation with the iconic, and a sympathetic, easily readable introduction to Peirce's three systems of graphs in Shin (2002) and its references.

Conclusion

What may have surprised the reader of the foregoing lines is the absence of any sort of recipe concerning the purpose of pictorial signs: the semiotic system described above is a logic, an empty formalism, while the purpose to which a sign may be put is the province of rhetoric. This is because for Peirce this particular semiotics and rhetoric were the two polar branches of his philosophy of representation: the first he described as a "speculative grammar", that is, a theoretical syntax whose purpose is not to stipulate what a given sign does or does not mean, but rather the conditions a) in which some entity can function as a sign, b) how any such sign is able to signify, and c) to what extent it can afford information. As a scientist formed in the laboratory he was keenly aware of the need for scientific accuracy in the acquisition and subsequent representation of knowledge. His speculative grammar was the first step in this undertaking, and the present article is an attempt to show how the discipline required of such a task might apply to pictorial data. "Speculative rhetoric", on the other hand, the final, most specialized branch of the philosophy of representation, "is the doctrine of the general conditions of the reference of symbols and other signs to the interpretants which they aim to determine", (CP 2.93). In other words, within a Peircean perspective, semiotics and rhetoric are distinct branches of a veritable philosophy in which semiotics provides the doctrine of rhetoric with its theoretical "syntactical" prerequisites. Although Peirce has provided semioticians with considerable material concerning the semiotics, there is far less available for his theory for speculative rhetoric. It is to be hoped that the foregoing will stimulate interest in this largely uncharted research undertaking.

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Content Analysis and the Measurement of Meaning: The Visualization of Frames in Collections of Messages

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Abstract

A step-to-step introduction is provided on how to generate a semantic map from a collection of messages (full texts, paragraphs or statements) using freely available software and/or SPSS for the relevant statistics and the visualization. The techniques are discussed in the various theoretical contexts of (i) linguistics (e.g., Latent Semantic Analysis), (ii) sociocybernetics and social systems theory (e.g., the communication of meaning), and (iii) communication studies (e.g., framing and agenda-setting). We distinguish between the communication of information in the network space (social network analysis) and the communication of meaning in the vector space. The vector space can be considered as the space in which the network of relations spans an architecture; words then are not only related, but also positioned. These positions are *expected* rather than observed and therefore one can communicate meaning.

1. Introduction

The study of latent dimensions in a corpus of electronic messages has been part of the research agenda from different disciplinary perspectives. In linguistics, for example, these efforts have been focused under the label of "latent semantic analysis" (LSA; Landauer *et al*., 1998); in communication studies, "framing" is a leading theoretical concept for studying the latent meanings of observable messages in their contexts (e.g., Scheuffele, 1999); and in social-systems theory and socio-cybernetics, codes of communication which can be symbolically generalized (Parsons, 1963a and b; 1968; Luhmann, 1995 and 2002; Leydesdorff, 2007) are expected to operate latently or virtually as "a duality of structure" (Giddens, 1984; Leydesdorff, 2010). These efforts have in common that the analyst shifts his/her attention from the communication of information in observable networks to the communication of meaning in latent dimensions.

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Latent dimensions can be operationalized as the "eigenvectors" of a matrix representing the network under study. Eigenvectors, however, operate in a vector space that can be considered as the architecture spanned by the variables (vectors) in observable networks. Statistical techniques for analyzing latent dimensions such as factor analysis and multi-dimensional scaling (MDS) are well-known to the social scientist—and where further developed for the purpose of analyzing communication (Lazarsfeld & Henry, 1968)—but the current enthusiasm for network analysis and graph theory has tended to push aside these older techniques in favour of a focus on observable networks and their structures. Spring-embedded algorithms that operate on networks such as Kamada & Kawai (1989) or Fruchterman & Reingold (1991) are integrated in software packages freely available at the internet such as Pajek and Gephi. These newer visualization capacities far outreach the traditional ones such as MDS.[2]

In this introduction, we show how one can use these newer visualization techniques with the older factor-analytic approach for distinguishing main dimensions in order to visualize the communication of meaning as different from the communication of information. The communication of information can be considered as the domain of social network analysis and its semantic pendant in co-word analysis (Callon *et al*., 1983; 1986). Words and co-words, however, cannot map the development of the sciences (Leydesdorff, 1997). The architectures of the discourse have first to be analyzed and can then also be visualized. Using an example, we walk the user through the different steps which lead to a so-called Pajek-file which can be made input to a variety of visualization programs (e.g., VOSViewer and Gephi)[3].

In other words, we provide a step-by-step introduction that enables the user to generate and optimize network visualizations in the vector space, that is, the space in which meaning is communicated as different from the communication of information in the network. Meaning can be generated when informations are related at a systems level. In cybernetics, one often invokes an "observer" to this end (Edelman, 1989; Von Foerster, 1982), but a discourse can also be considered as a relevant system of reference. Note that meaning is provided in terms of expectations and can be informed and updated by observations. The various bits of informations can be positioned in a vector space in addition to being related or not in terms of network links (Burt, 1982). The absence of relations can then be as informative as their presence (Burt, 1995; Granovetter, 1973).

The software for the visualization and animation of the vector space uses the cosine values of the angles between the vectors (variables) of word occurrences in distributions. We explain below how the word-document matrix can additionally be used as input to the factor analysis; for example, in SPSS. Unlike "single value decomposition" (SVD) which has been the preferred method in latent semantic analysis, factor analysis is available in most social-science statistics programs. We developed software so that one can move from a set of textual messages (either short messages or full texts) to these different software packages and take it further from there.

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[2]VosViewer, a visualization program available at http://www.vosviewer.com, reads Pajek files as input, but uses an algorithm akin to MDS (Van Eck *et al*., 2010).

[3] Gephi is a visualization program freely available at http://gephi.org.

2. The framing concept

The concept of framing was introduced by Goffman (1974). He explained that messages in the mass media are "framed" by journalists, which means that a description is provided from a certain perspective and with a specific interpretation. McCombs (1997) described framing as "the selection of a restricted number of thematically related attributes for inclusion on the media agenda when a particular object is discussed" (pp. 297-298). Van Gorp (2007) indicated that this process of selection is inevitable, as journalists are unable to provide an objective image of reality. McQuail (2005, at p. 379) agreed on this inevitability, which results in the inclusion of a specific way of thinking into the process of communication. Entman (1993) also argues that this process of selection can either be conscious or unconscious. A certain way of thinking is transmitted through the text. As Entman (1993, at p. 52) argued:

> Framing essentially involves selection and salience. To frame is to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem, definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described. (p. 52)

A fact never has a meaning in itself, but it is formed by the frame in which it is used (Gamson, 1989). This latent meaning is implied by focusing on certain facts and by ignoring others. Frames appear in four different locations in the communication process: at the sender, within the text itself, with the receiver, and within culture (Entman, 1993).

When studying frames through the methods described below, we focus on the frames that are embedded within the texts. These frames are often powerful, as changing a specific frame by a source might be interpreted by relevant audiences as inconsistent or unreliable (since dissonant). Textual frames are formed, among other things, by the use of certain key words and their relations. The relations among keywords provide the basis for thismethodology.

Matthes and Kohring (2008) distinguished five methodological approaches to the measurement of media frames. First,in the qualitative *Hermeneutic approach*, frames are identified by providing an interpretative account of media texts linking up frames with broader cultural elements. Secondly in the *Linguistic approach,*one analyzes the selection, placement, and structure of specific words and sentences in a media text. A third model is provided by the *Manual holistic approach*. Frames are generated through a qualitative analysis of texts, after which they are coded in a manual quantitative content analysis. In the *Deductive approach*, fourthly, frames are theoretically derived from the literature and then coded in a standard content analysis. Lastly, the authors identify a fifth and methodological approach:the *Computer-assisted approach*.An example of this latter approach is elaborated in this study. In this approach, frame mapping can be used as a method of finding particular words that occur together. As frames then are generated by computer programs, instead of being "discovered" by the researcher(s), this method has the advantage of being a more objective tool for frame extraction than the other methods.

3. The dynamics of frames

Through the research methods described in this study, one is able to study differences or changes in frames within different discourses, not only statically, but also dynamically. Danowski (2007) studied changes in frames from the perspective of language. He indicated that frames relate to the way that facts are characterized, which is based on cultural and social backgrounds. This is consistent with the vision of Scheufele (1999), who stated that the influence of media on the public mainly works through transferring the importance of specific aspects about a certain issue. Framing is considered by Danowski (2007, 2009) as a way of shaping the process of agenda setting. He also states that framing is mainly applied to provide a positive or negative view on an issue. Unlike Entman (1993), Danowski (2007) argued that frames change relatively rapidly in the media. Discourse in the public domain would have a charactermore versatile and volatile than scholarly discourse. This contrast makes it interesting to study changing frames within specific discourses.

Our research method provides also a way of studying these possible differences in the dynamics. The existing network visualization and analysis program Visone was further developed for this purpose with a dynamic extension (at http://www.leydesdorff.net/visone). The network files for the different years can be assembled with a routine mtrx2paj.exe which is available with some instruction from http://www.leydesdorff.net/visone/lesson8.htm. An in-between file (named "pajek.net") can be harvested and also be read by other network animators such as SoNIA: Social Network Image Animator or PajekToSVGAnim.Exe (Leydesdorff *et al*., 2008). In this study, however, we limit ourselves to the multi-variate decomposition of a semantic network in a static design (including comparative statics). An example of the potential of the dynamic extension to Visone showing heterogeneous networks in terms of their textual representations ("actants") can be found at http://www.leydesdorff.net/callon/animation/ which was made for a *Liber Amicorum* at the occasion of the 65th birthday of Michel Callon (Leydesdorff, 2010b).

When analyzing frames, one can make a distinction between restricted and elaborated discourses (Bernstein, 1971; Coser, 1975). Graff (2002) indicates that this distiction is mostly related to the audience of the communication. In restricted discourse, one single and specific meaning is constructed and reproduced. This is, for example,important in scholarly communication, when the audience in a particular field of studies has specific knowledge about the topics of communication. In elaborated discourse, communication is aimed at a wider audience. In this case, multiple meanings are created and translated into one another. The visualization of the frames in the collection of messages to be analyzed can reveal a more elaborated versus a more restricted type of discourse(Leydesdorff & Hellsten, 2005).

4. Using semantic maps for the study of frames

The research method presented in this section deals with content analysis of collections of messages. In addition to manual content analysis (Krippendorff, 1980; Krippendorff & Bock,

2009), one can use computer programs to generate semantic maps on the basis of large sets of messages. A properly normalized semantic map can be helpful in detecting latent dimensions in sets of texts. By using statistical techniques, it is possible to analyze the structure in semantic networks and to color them accordingly.

Content can be contained in a set of documents, a sample of sentences, or any other textual units of analysis. In our design, the textual units of analysis will be considered as the cases, and the words in these messages—after proper filtering of the stopwords—as the variables. Thus, we operate with matrices. Matrices which contain words as the variables in the columns and textual units of analysis as cases in the rows (following the convention of SPSS) are called word/document matrices. In co-word analysis and social network analysis, one often proceeds to the symmetrical co-occurrence matrix, but this latter matrix contains less information than the asymmetrical word/document matrix (Leydesdorff & Vaughan, 2006).

When visualizing a word/document matrix, a network appears, containing the interrelationships among the words and the textual units. In order to generate this network, one needs to go through various stages using different programs. In this section we explain how to generate, analyze, and visualize semantic maps from a collection of messages using the various programs available athttp://www.leydesdorff.net/indicators and standard software such as SPSS and Pajek.

4.1. Generating the word/document occurrence matrix

In order to generate the word/document occurrences matrix, one first needs to save a set of messages in such a format that the various programs to be used below are able to use them as input files. If the messages are short (less than 1000 characters), we can save them as separate lines in a single file using Notepad or another text editor.[4] This file has to be called "text.txt". In this case one can use the program Ti.exe (available at http://www.leydesdorff.net/software/ti) that analyzes title-like phrases. If the messages are longer, the messages need to be saved as separate text-files, named text1.txt, text2.txt, etc.[5] These files can be read by the program FullText.exe (at http://www.leydesdorff.net/software/fulltext/).

4.1.1. Frequency List

The text-file text.txt can directly serve as input for the program Frequency List (FrqList.exe at http://www.leydesdorff.net/software/ti). This program produces a word frequency list from the file text.txt, needed for assessing which words the analyst wishes to include in the word/document occurrences matrix. As a rule of thumb, more than 75 words are difficult to

[4] If one uses Word or WordPad, one should be careful to save the file as a so-called DOS plain text file. When prompted by Word, choose the option to add CR/LF to each line. (CR/LF is an old indication of Carriage returns and Line feeds, like using a typewriter.)

[5] Sometimes, Windows adds the extension .txt automatically. One should take care not to save the files with twice the extension ".txt.txt". The programs assume only a single ".txt" and will otherwise lead to an error.

visualize on a single map, and more than 255 variables may be difficult to analyze because of systems limitations in SPSS and Excel 2003.

Together with the text-file, one can use a standard list of stopwords in order to remove the irrelevant words directly from the frequency list. It can be useful to check the frequency list manually, to remove potentially remaining stopwords. If we begin with long texts in different files (text1.txt, text2.txt, … etc.),[6] these files have first to be combined into a single file text.txt that can be read by FrqList, for the purpose of obtaining a cumulative word frequency list across these files.[7] The use of FrqList is otherwise strictly analogous.

To be able to run FrqList, one needs to install the program in a single folder with the Text-file with all the messages (text.txt) and the list of stopwords, as shown in Figure 1.

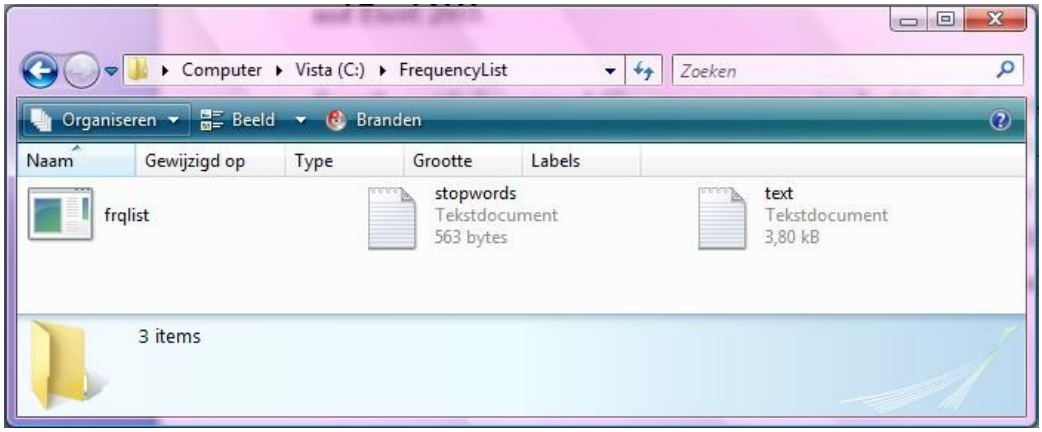

Figure 1 Example of using FrqList

After running, the program FrqList produces a frequency list: the combined word frequency list is made available as WRDFRQ.txt in the same folder, as can be seen in Figure 2. This file can be read into Excel in a next step so that, for example, the single occurrences of words can be discarded from further analysis.

[6] Sample files text1.txt, text2.txt, text3.txt, text4.txt can be found at http://www.leydesdorff.net/software/fulltext/text1.txt , etc.

[7] One can combine these files in Notepad or alternatively by opening a DOS box. In the DOS box, use "cd" for changing to the folder which contains the files and type: "copy text*.txt text.txt".

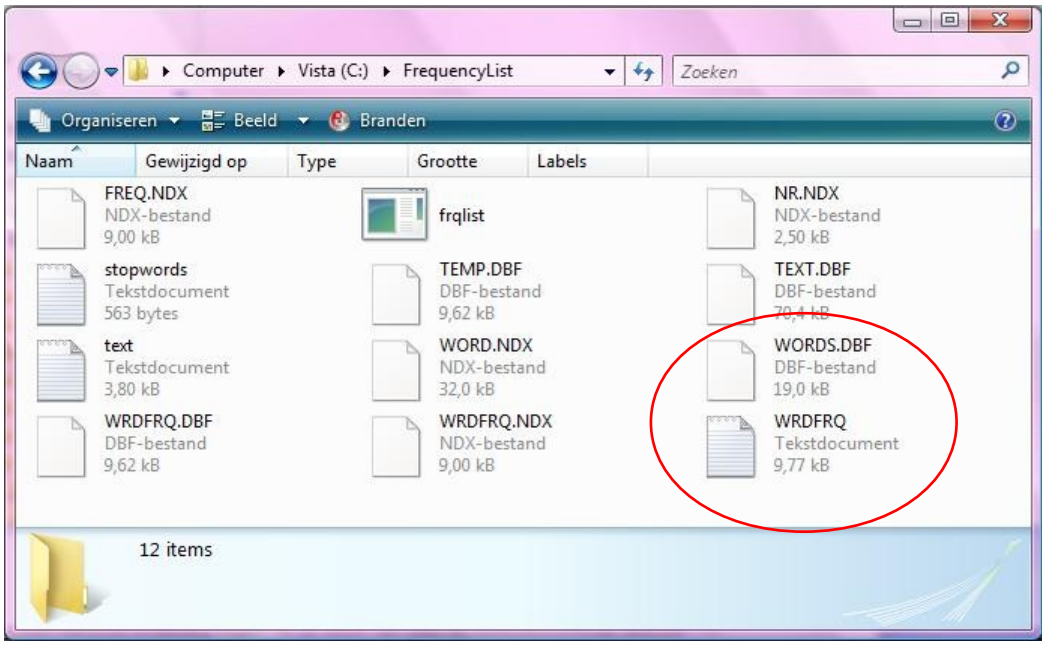

Figure 2 Output FrqList

4.1.2. Full Text

The next step is to import the frequency list—one can use wrdfrq.dbf or wrdfrq.txt—into an Excel file in order to separate the words from the frequencies as numerical values. At this stage, the list of words may be too long to use efficiently. To be able to visually interpret the data at a later stage, it can be advised to use a maximum of approximately 75 words. The first 75 words from the frequency list (without the frequencies) need to be saved as a Text-file by the name of words.txt. (Use Notepad for saving or obey the conventions for a plain DOS text as above.) This file "words.txt" can serve as input for the programs Ti.exe or FullText.exe.

One can use ti.exe for the case that the texts are short (< 1000 characters) and organized as separate lines in a single file text.txt, but fulltext.exe is used in the case of a series of longer text files named text1.txt, text2.txt, text3.txt, …, etc. Both programs need in addition to the information in the textual units, an input file named words.txt (in the same folder) with the information about the words to be included as variables. Prepare this file carefully using the instructions about removing stopwords and making selections specified above. You may wish to run FrqList.exe a second time with a manually revised file stopword.txt. (Save this file as a DOS file!)

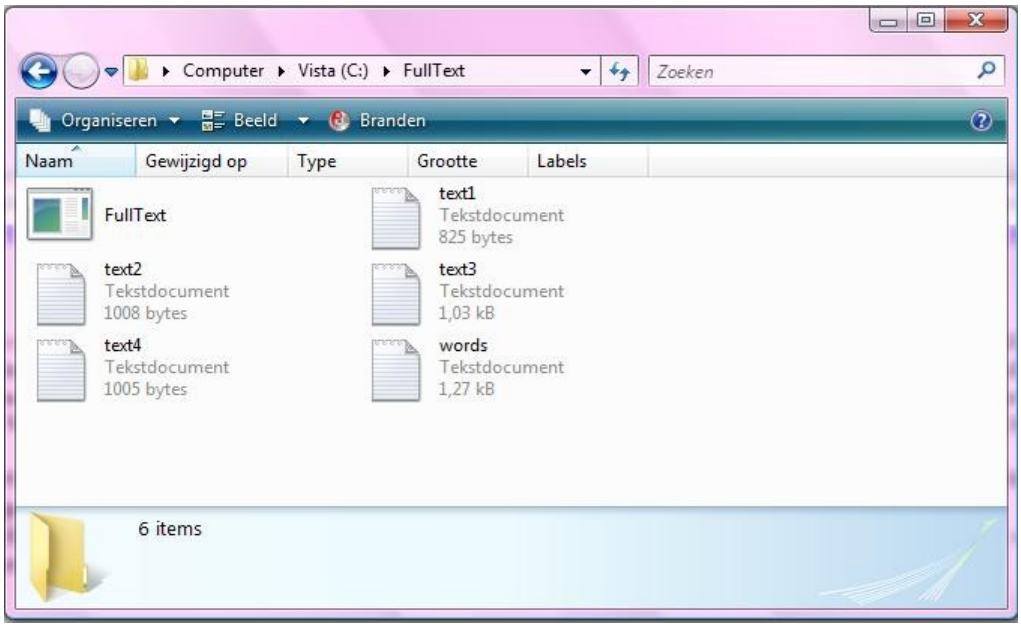

Figure 3 Example FullText

As can be seen in Figure 3, the separately saved messages (text1.txt, text2.txt, etc.), together with the file words.txt, form the input for FullText. (Analogously, for Ti.exe one needs the files text.txt and words.txt.) The program produces data files, which can be used as input for the statistical program SPSS and the network visualization program Pajek. By installing the program FullText in the same folder containing the saved messages and words.text, the program can be run. The output of FullText can also be found in this same folder, as can be seen in Figure 4.

Prior to running FullText, the program demands to insert the file name ("words") and the number of texts. After running FullText (or Ti.exe), one can use the files matrix.txt[8] and labels.sps to statistically analyze the word/document occurrence matrix by using SPSS. (The file matrix.txt contains the data and can be read by SPSS. The file labels.sps is an SPSS syntax file for labelling the variables with names.) In order to generate a visualization of the semantic map, one can use the file cosine.dat as input to Pajek. How to use these files for Pajek and SPSS will be discussed in the next paragraphs.

[8] Matrix.txt contains the same information as matrix.dbf. Matrix.dbf can directly be used with more than 256 variables in Excel 2007 and higher, but not in lower versions. In SPSS this depends on the version.

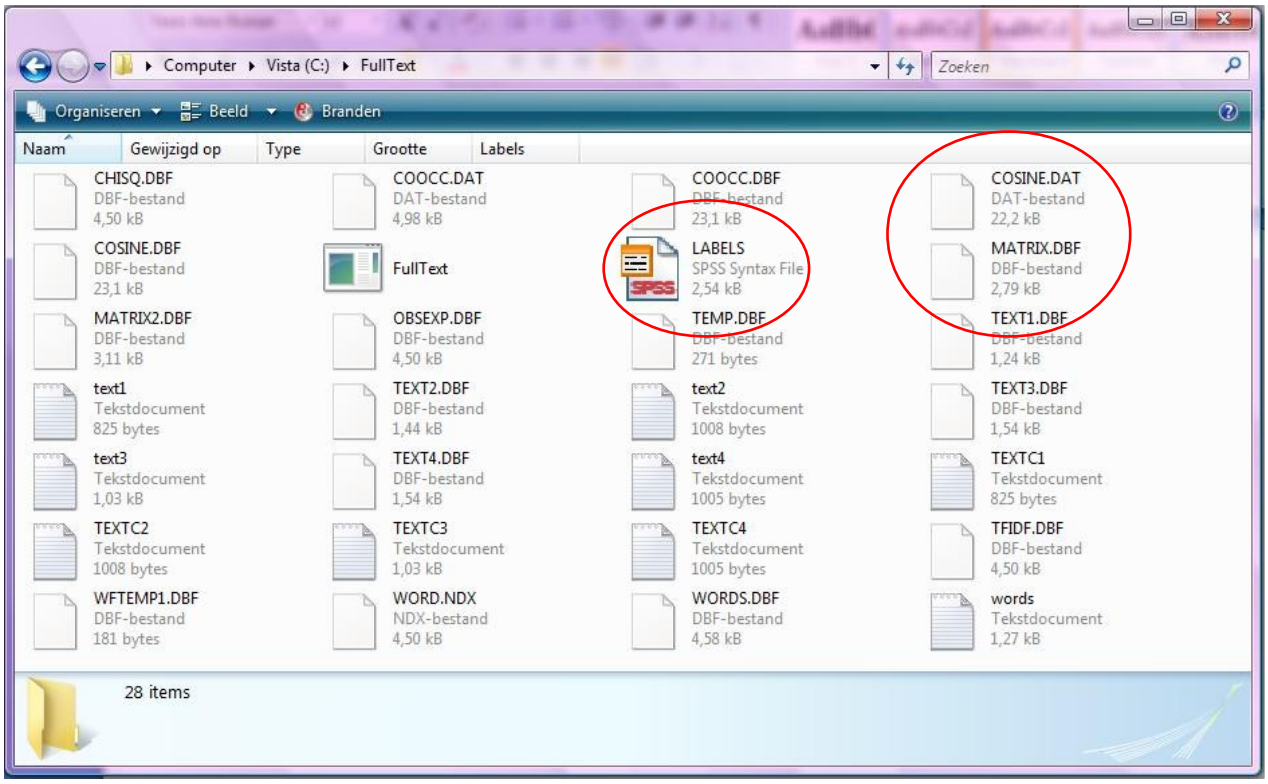

Figure 4 Output FullText

4.2. Analyzing the word/document occurrence matrix

As noted, the file matrix.txt can be read by SPSS. To label the variables with names, choose "File – Open – Syntax" in order to read the file labels.sps. Choose "Run – All". As can be seen in the syntax file, FullText has deleted the "s" at the end of the words. The aim is to remove the plural forms, but this may have no use when analyzing a word/document occurrence matrix. By comparing to the original words in the file WRDFRQ.txt (which was generated by FrqList) the labels in the variable view of SPSS can be manually adapted. This is only necessary if one wants to use the words as labels; for example, in a table of the SPSS output. When visualizing the word/document occurrence matrix, as we explain below, the words can be adapted for use in Pajek at a later stage.

4.2.1. Factor analysis

In order to analyze the word/document occurrence matrix in terms of its latent structure, one may wish to conduct a factor analysis in SPSS. The factor analysis can demonstrate which words belong to which components. Prior to the factor analysis one has to calculate the variance of the variables (the words from the matrix). Words with a variance of zero cannot be used in a factor analysis and therefore need to be left out of the process. (The variance can be computed in SPSS by choosing "Analyze – Descriptive Statistics – Descriptives", then selecting all the words into the right column and then ticking "Variance" under "Options".)

The next step is analyzing the data by means of a factor analysis. Choose "Analyze – Data Reduction – Factor" in SPSS. This step is visualized in Figure 5. Select all the variables in the left column, except the ones with a variance of zero, and select them to the right column. Then, under "Extraction", tick "Scree plot" and undo "Unrotated factor solution". Then, under "Rotation", tick "Varimax" and "Loading plot(s)" and finally, under "Options", tick "Sorted by size" and "Suppress absolute values lower than", which is by default set at larger than .10.

Under Extraction it is additionally possible to manually choose the number of factors. When the output of the factor analysis produces too many factors, it may be advised to manually set the number of factors on, for example, six. More than six factors may be difficult to visualize and interpret through Pajek at a later stage.

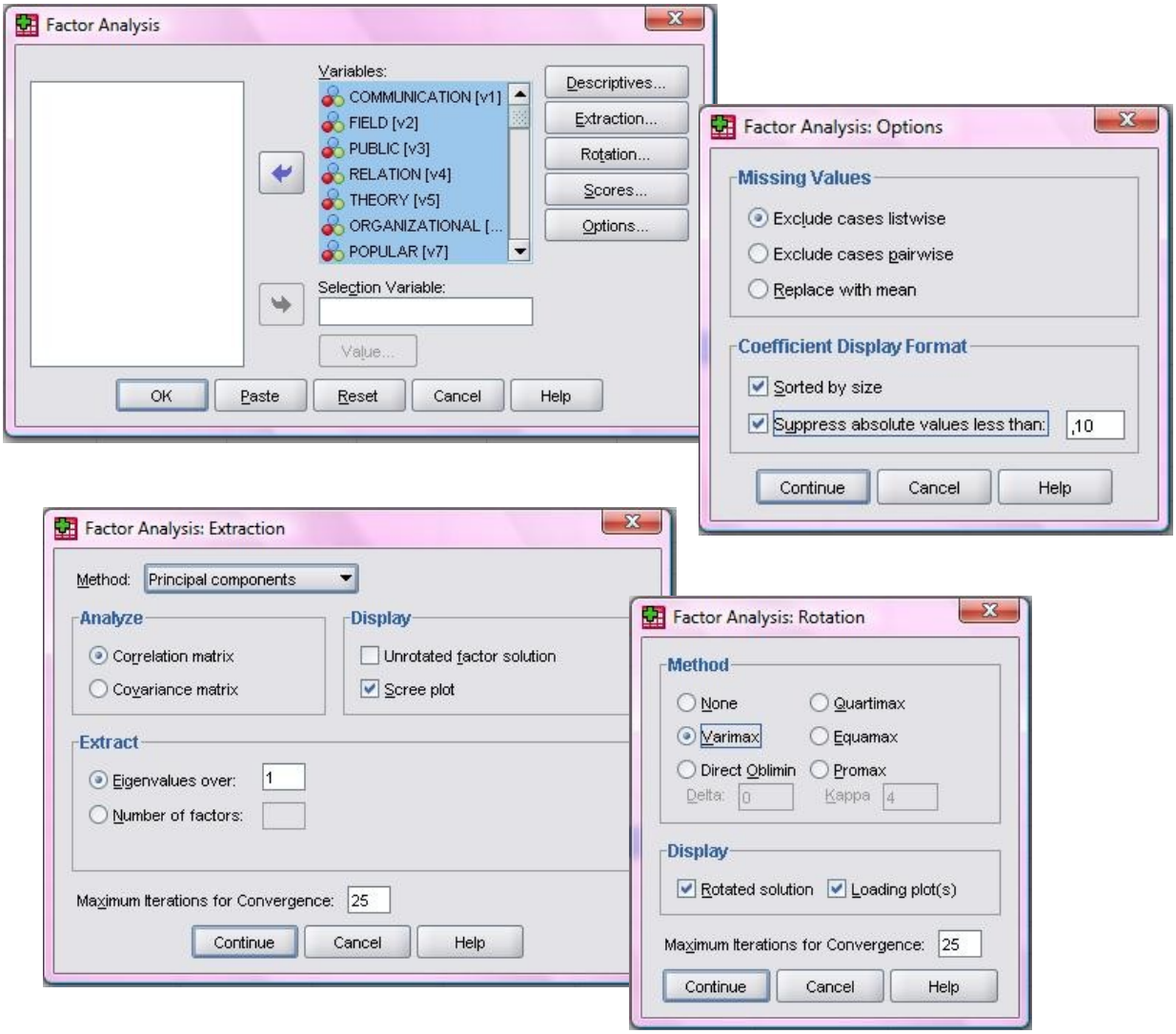

Figure 5 Factor Analysis in SPSS

The options are now set in order to conduct a factor analysis. SPSS produces several tables and figures in the output. The most relevant for our purpose is the Rotated Component Matrix. This matrix shows the number of components (factors) and the loading of the different words

on the components. At this stage, one can arrange the words under the different components, which can be used when visualizing the word/document occurrence matrix in the next stage. In Figure 6 an example of a few words are visualized with the arrangement under de different components. The various components can be considered as representations of different frames used in these texts. In the example in Figure 6, the texts are built around three different frames. How to use the output to visualize the word/document occurrence matrix will be discussed in the next section.

Rotated Component Matrix[a]

	Component		
	1	2	3
RESEARCH	**,875**	,436	-,209
FIELD	**,780**	,256	,572
WITHIN	**,568**	-,674	-,472
WELL	**,568**	-,674	-,472
LEVEL	**,332**		-,940
COMMUNICATION	-,147	**,968**	,202
APPLIED	,533	**,843**	
AREA	,483	**,841**	,243
PUBLIC	,345	**,766**	,542
THEORETIC	,345	**,766**	,542
RELATION	,345	**,766**	,542
TOOLS	,345	**,766**	,542
CONCEPTUAL	,345	**,766**	,542
DEVELOPED	,585	**,734**	-,344
CONCLUDES	-,332		**,940**
YEARS	,579		**,811**
ACROSS	,579		**,811**
APPLY	,579		**,811**
BASED	,579		**,811**
TRENDS	,579		**,811**
VISUAL	,324	-,860	**,395**
STUDIES	-,343	-,852	**,395**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Figure 6 Output Factor Analysis in SPSS (an example with a limited number of words/variables)

In addition to the positive factor loading, one may also wish to take into account that "level" has a negative loading (-.94) on Factor 3.

4.2.2. Cronbach's alpha

Prior to the visualization of the matrix, one may wish to conduct a reliability analysis, by calculating Cronbach's alpha (α) for each frame (component). This measure controls after the factor analysis whether the frames form a reliable scale. First, one can determine which words belong to which frames by using the output of the factor analysis in SPSS, like the example in Figure 6.

The next step is the calculation of Cronbach's alpha in SPSS, by choosing "Analyze – Scale – Reliability Analysis". Select the words from the first frame into the right column and run the reliability analysis by choosing "OK". Figure 7 shows the output of this analysis with Cronbach's alpha for the example from Figure 6, using the second frame which was composed of nine items (that is, words as variables).

Reliability Statistics

Cronbach's Alpha	N of Items
,949	9

Figure 7 Output reliability analysis (Cronbach's α) in SPSS

In the example in Figure 7, Cronbach's Alpha has a value of .95. In order to guarantee the internal consistency of the scale, Cronbach's Alpha needs to have a minimal value of .65.

4.3. Visualizing the word/document occurrence matrix

In this section we explain how to visualize the word/document occurrence matrix by using Pajek[9] and the output of the factor analysis in SPSS. In order to visualize the output of FullText, one is advised to use the file cosine.dat, which was generated by FullText (see chapter 2).[10] In the first part of this section the drawing of the figure is discussed. After that we explain how the visualization can be informed by the output of the factor analysis in SPSS. The final part of this section discusses the layout of the figure and how this can be changed.

Choose "File – Network – Read" to open the file cosine.dat in Pajek. To create a partitioned figure, one can choose "Net – Partitions – Core – All". To draw the Figure, choose "Draw – Draw partition". One can change the layout of the figure by choosing "Layout – Energy – Kamada-Kawai – Free". In this stage, one has created a figure which shows the different components with different colors, as can be seen in Figure 8. However, the algorithm used in Pajek for attributing the colors is different from the results of the factor analysis. We will change this below.

[9]The latest version of Pajek can be downloaded at http://vlado.fmf.uni-lj.si/pub/networks/pajek/ .

[10]The cosine-normalized matrix can be compared to the Pearson correlation matrix which is used for the factor analysis, but without the normalization to the mean. Word-frequency distributions are usually not normally distributed and therefore this normalization to the mean is not considered useful for the visualization. The results of the factor analysis inform us about the latent dimensions which are made visible by the visualization as good as possible. Note that visualization is not an analytical technique.

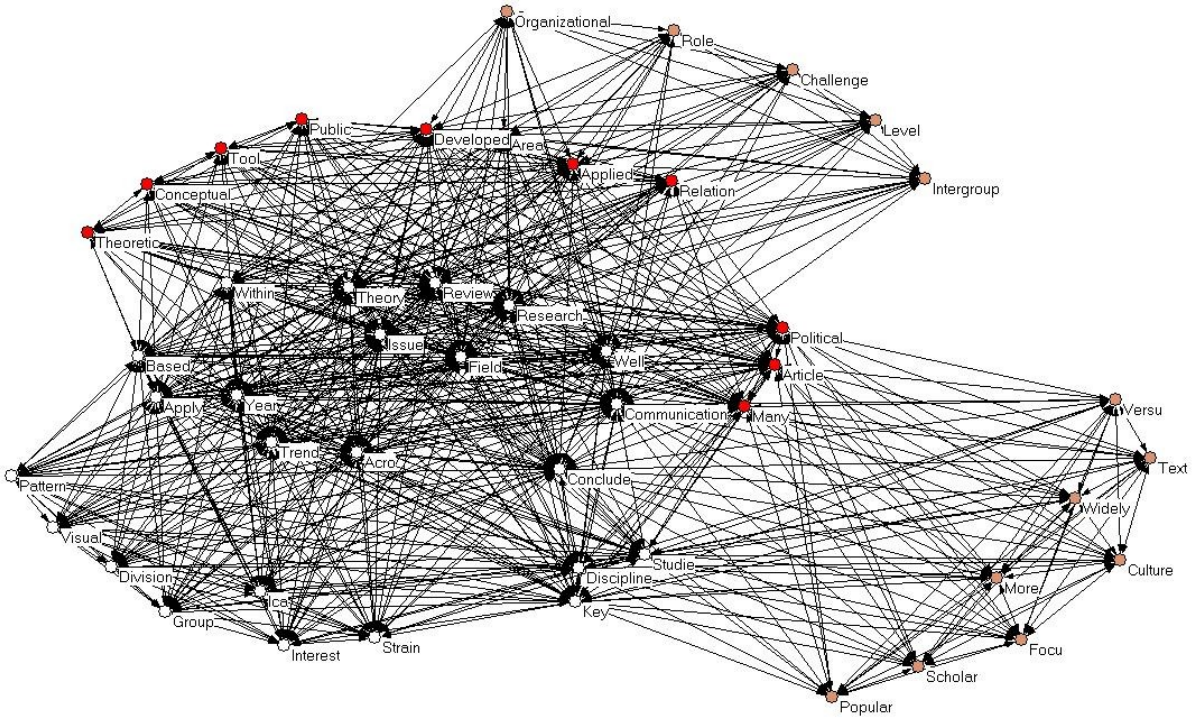

Figure 8 Standard Pajek figure with different components

As noted above and shown again in Figure 8, FullText automatically removes an "s" at the end of a word. Also in Pajek it is possible to put back the "s", in case of an incorrect removal. To do so, close the Figure and choose "File – Partition – Edit" in Pajek. In this window one can change the words manually. After closing the window and drawing the partitionedfigure again, the words are changed.[11]

The next step in visualizing the word/document occurrence matrix is the adjustment of the figure to the output of the factor analysis in SPSS, as discussed in the previous chapter. After the factor analysis in SPSS, each word was assigned to a specific frame. In the example, there were three different frames made visible in the output (Figure 6). In spite of the fact that Figure 8 also shows three frames in Pajek, there are differences between these frames and the frames from SPSS. These differences are being caused by the fact that Pajek uses the cosine matrix while SPSS uses the correlation matrix and performs an orthogonal rotation.

The visualization as shown in Figure 8 can be adjusted to the output of the factor analysis in SPSS. This adjustment can be done in the same way as the changing of the words in the previous section. By choosing "File – Partition – Edit", the frames can be reclassified by assigning the same numbers to words in the same frame.[12] After adjusting the figure from Figure 8 to the factor analysis in SPSS, a new figure can be drawn, which is shown in Figure 9.

[11] Alternatively, one can change the words in the input file cosine.dat using an text editor such as Notepad.
[12] In the Draw screen, Shift-Left click a vertex to increase its partition cluster number by one, Alt-Left click a vertex to decrease it by one.

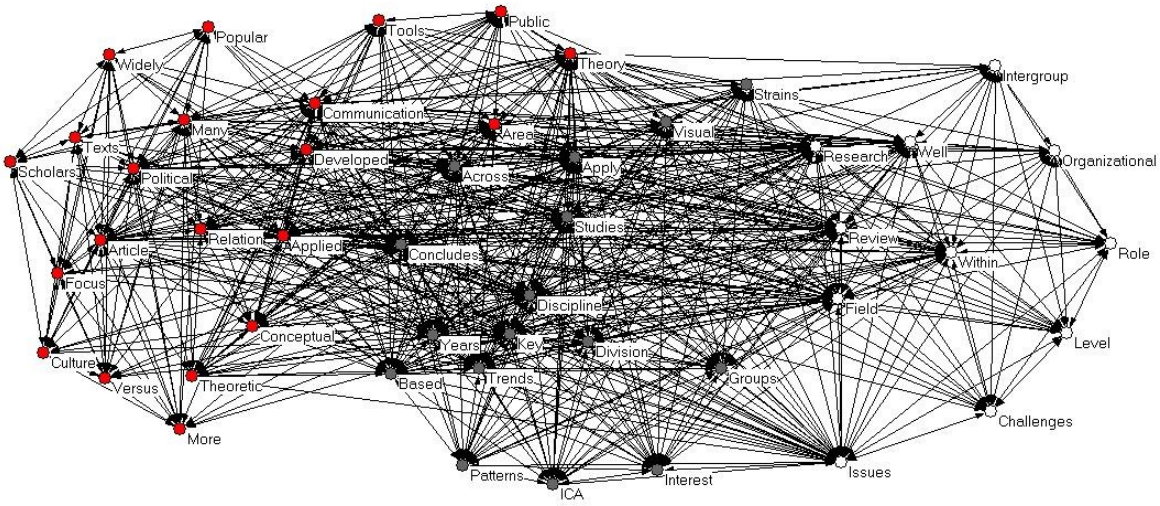

Figure 9 Pajek figureadjusted to factor analysis in SPSS

The initial numbers, corresponding to the different frames, are provided by Pajek using another algorithm than factor analysis (the *k*-core algorithm). Nevertheless, the numbers are always one-to-one related to the colours of the vertices in the figure. As can be seen in Figures 8 and 9, it is difficult to read the words in the current layout of the figure. The different lines are also difficult to distinguish.

There are several options which can increase the readability of the figure. A few of these options are being introduced here. After following these steps, the figure will be better readable and interpretable. Figure 10 provides an overview of the adjustment options in Pajek.

Background	The figure can be read best with a white background. To change the background, choose "Options – Colors – Background" and choose white as the background color.
Lines	To make sure the different lines can be distinguished, it is possibleto remove the lines with a value lower than for instance 0.2 (this depends on the figure, different values can be tried). To do so, close the figure, than choose "Net – Transform – Remove –Lines with value – lower than" and fill in the appropriate value. It is also possible to adjust the width of the lines to their values. In order to do so, draw the partitionedfigure, then choose the option "Options – Lines – Different Widths". Since the cosine varies between zero and one, a value of 3 or 5 will provide differences.
Arrows	The arrow heads are not adding anything to the figure, so they can be removed. To do so,choose "Options – Size – of Arrows" and fill in 0.
Font	The size of the font can be changed through "Options – Size – of Font –Select". Use at least 12 for a PowerPoint presentation in order to make sure the words can be read. To make sure the words do not overlap each other, it is possible to drag the words a little into different directions.
Vertices	The sizes of the vertices can be made proportional to the (logarithm of) the frequency of the words. In order to do so, choose "Options – Size – of Vertices defined in input file".To enlarge all the vertices, choose "Options – Size – of Vertices" and fill in the size. In Figure 10, the vertices have been given the size of 10.
Colors	To change the colors of the vertices choose "Options – Colors – Partition Colors – for Vertices". One can change the colors of the vertices, by clicking on the current color and then filling in the number of the wished color as seen on the color pallet. After that, click on OK and close the color pallet. Thenclick on one of the vertices you want to change and the entire frame will have the wished color. This can be done for each group of vertices. Make sure the colors are in different shades, in order to visually see the differences between thedifferent frames.

Figure 10 Adjustment options in Pajek

Figure 11 shows the same figure as in Figures 8 and 9 after passing through the preceding steps. The words can be read better and the differences in the loadings of the words can be interpreted.

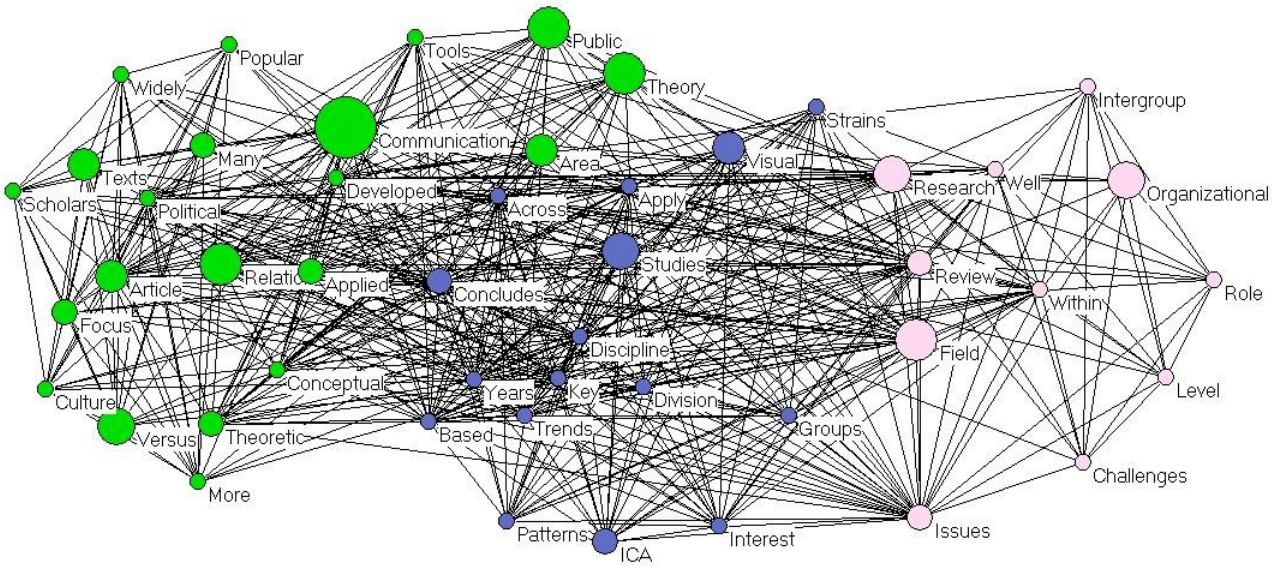

Figure 11 Pajek figureafter changing the layout

A final option to complete the above figure is the addition of the frames to the figure (using Word or a program like Paint). Through the different words it is possible to name the different frames. Figure 12 shows an example of this addition to the above figure.

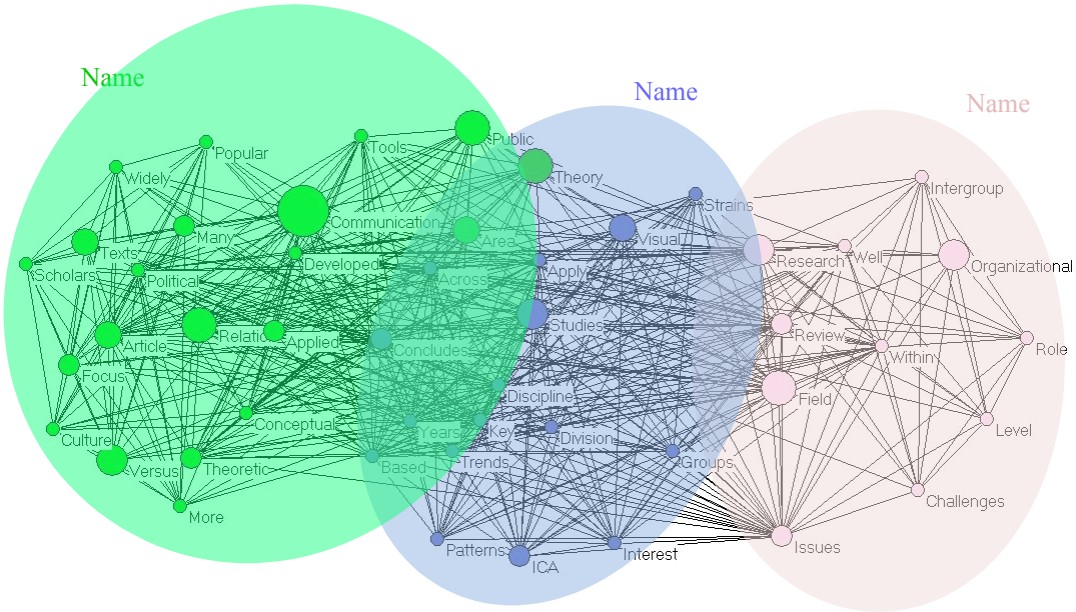

Figure 12 Pajek figureafter highlighting the different frames

4.4. The discourse about "*autopoiesis*" visualized as an example

In this section, a short illustration of the research methodology is provided by visualizing the international discourse on *autopoiesis*. The set of messages consists of nine newspaper articles from various English language newspapers harvested from LexisNexis.[13] The messages were saved as seperate text-files, and the output of the programs Frequency List (FrqList.exe), Full Text (FullText.exe) and SPSS were used to serve as input for Pajek. In Figure 13 the word/document occurrence matrix and the factor analysis are visualized using Pajek.

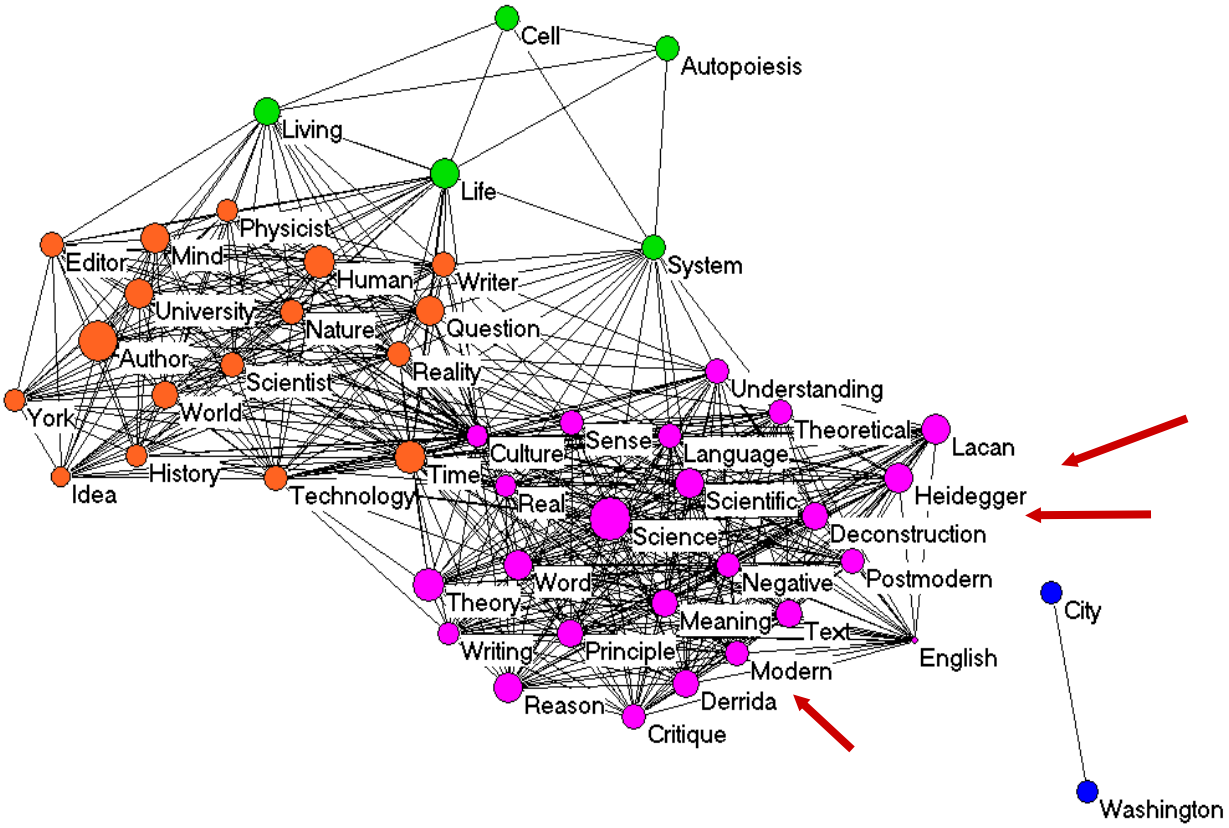

Figure 13 Visualization of the discourse on autopoiesis

The visualization of the discourse on autopoiesis provides an illustration of the use of this research methodology. Although it is difficult to draw substantive conclusions based on the above figure – as the sample was only drawn to serve for the purpose of this illustration – one can see for instance that "Derrida" and "Heidegger" are linked semantically via the concept of "Deconstruction." In the same manner it would be possible to study discourses on various concepts, by analyzing the visualizations as provided by Pajek.

[13] The Washington Post (2), The Australian (1), Calgary Herald (1), The Herald (Glasgow) (1), The Independent Extra (1) The New York Times (1), The Observer (1), and Prince Rupert Daily News (Britisch Columbia) (1).

5. Limitations

Although this method has the advantage of being more objective in frame extraction than other methods, there are of course some limitations as well. First, Matthes and Kohring (2008) argued that all computer-assisted methods in content analysis assume that words and phrases have the same meaning within every context. A human coder could be better able to detect all the different meanings in a text and to provide an interpretation to the contexts of the words. As Simon (2001) also describes, the computer cannot understand human language with all its subtlety and complexiveness. Our methods, however, allow for further extension using, for example, factorial complexity as an indicator of words having different meanings in—translating between—different frames (Leydesdorff & Hellsten, 2005).

Second, one could argue that there is a problem of validity. Some words need to have a large frequency in order to occur in the analysis, in spite of being central to the content of the text (Hertog & McLeod, 2001). This can further be elaborated in terms of various statistics, such as "term frequency-inverse document frequencies", in which a higher degree of importance is assigned to words occurring more frequently in only a few of the texts that are used in the analysis (tf-idf; Salton & McGill, 1983). Another elaboration is the contribution of words (as variables) to the chi-square statistitics of the word/document occurrence matrix. After running ti.exe or fulltext.exe, the file words.dbf contains additional information with these statistics (which are further explained at http://www.leydesdorff.net/software/ti/index.htm; Leydesdorff & Welbers, 2011). Again, this is a problem that occurs as a result of the absence of the researcher in the process of frame abstraction. However, the researcher can manipulate the input file with words (words.txt) which will be used for the analysis.

A final limitation is related to the sources of the media texts. This method can only be applied to texts that are electronically made available (Matthes & Kohring, 2008). As a result of this, visuals or handwritten texts cannot easily be used to study frames using this method. In spite of these limitations, the computer assisted approach of studying frames, as discussed above, provides a relatively researcher-independent assessment of frames, while this objective is hard to accomplish using other methods.

6. Future research directions

Our discussion has been oriented towards "getting started" with Pajek for the visualization of latent frames in textual messages. The resulting output can be further embellished for presentation purposes using lesson 6 at http://www.leydesdorff.net/indicators. Other files at this same page use the same techniques for other purposes. For example, one can be interested in the cited references in texts and thus wish to make a citation matrix instead of a matrix of co-occurring words. The basic scheme is that of textual units of analysis (messages) to which a set of variables can be attributed. These variables can be words, author names, institutional addresses, cited references, etc. One can then generate the file matrix.txt and cosine.dat as described above, and use them for analysis in SPSS and/or visualization in Pajek.

As described in the preceding section about the limitations of the current research methodology, the selection of the words to be included in the analysis may cause problems regarding the validity of the current research method. One can use substantive arguments or statistics for the selection of words in the file words.txt, when creating the word/document occurrence matrix (Leydesdorff and Welbers, 2011). The default is a cutoff at a word frequency level, but after running the routine (ti.exe or fulltext.exe) a first time, one obtains a table file words.dbf which contains several statistics for each word such as the "term frequency-inverse document frequency" (Salton & McGill, 1983; Spark Jones, 1972), the standardized residuals of the chi-square (e.g., Mogoutov *et al*., 2008; Van Atteveldt, 2005), and the value of observed/expected. Let us explain the idea of an expected value first.

A cell value in a matrix (or contingency table) can be measured against its expected value given the other values in this matrix. For example, if one has a matrix with four value 3, 5, 2, and 0 such as in:

3	5	*8*
2	0	*2*
5	*5*	*10*

One can add the margin totals and grand sum of this matrix and compute the expected value for each cell (e_{ij}) from the observed ones (o_{ij}) using $e_{ij} = \frac{\sum_i o_{ij} \sum_j o_{ij}}{\sum_i \sum_j o_{ij}}$. For example, the expected value of the first cell (e_{11}) above is (8 *5)/10 = 4. The observed/expected ratio consequently is 3/4. The standardized residual of the word *i* to the chi-square is $Z_i = \sum_i (Observed_i - Expected_i) / \sqrt{Expected_i}$ and can be used for testing the significance of individual words in the set if the expected value for this word is larger than five (cf. Bornmann & Leydesdorff, 2011).

We found the use of *Observed/Expected* values useful to the extent that we extended the routines ti.exe and fulltext.exe with the possibility to use these values also in the matrix (in addition to the possibility to using them—or other criteria—for the term selection first). Thus, after running the routine, the user is now offered this further option. If one says "yes" on this follow-up version (after running ti.exe or fulltext.exe), the routines also generate a number of other files which are otherwise similar to the initial routine. For our purpose, the file "cos_oe.dat" is similar to "cosine.dat," but based on the values *Observed/Expected* instead of the observed word frequencies. Using this data as input may further improve the quality of the map (e.g., Leydesdorff, 2011).

In addition to the available statistics in SPSS, Pajek hosts a number of statistics which have been developed over the past few decades in social network analysis. We already mentioned

above the *k*-core algorithm which groups together nodes (vertices) which are interrelated with at least *k* neighbours. An introduction to these statistics is provided by: Hanneman, R. A., & Riddle, M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside; available at http://faculty.ucr.edu/~hanneman/nettext/.An introduction to Pajek is provided by: De Nooy, W., Mrvar, A., & Batagelj, V. (2005). *Exploratory Social Network Analysis with Pajek*. New York: Cambridge University Press.

7. Conclusion

In our argument, semantics was considered as a property of language, whereas meaning is often defined in terms of use (Wittgenstein, 1953), that is, at the level of agency. Ever since the exploration of intersubjective "meaning" in different philosophies (e.g., Husserl, 1929; Mead, 1934), the focus in the measurement of meaning has gradually shifted to the intrinsic meaning of textual elements in discourses and texts, that is, to a more objective and supra-individual level (Luhmann, 2002). The pragmatic aspects of meaning can be measured using Osgood *et al*.'s (1957) Likert-scales and by asking respondents. Modeling the *dynamics* of meaning, however, requires further elaboration (cf. Leydesdorff, 2010).

Our long-term purpose is modeling the dynamics of *knowledge* in scientific discourse. Knowledge can perhaps be considered as a meaning which is more codified than other meanings; it is generated when different meanings can further be compared and thus related (by an observer or in a discourse). As we noted above, meaning can be generated by an observer or in a discourse when different bits of (Shannon-type) information can be related and comparatively be selected. Thus, the selective operation can be considered as recursive. However, the generation of knowledge presumes the communication of meaning (Leydesdorff, 2011). As we have shown, the analysis of the latter requires the progression from the network space to the vector space. The current contribution is made to support the user by facilitating this important step.

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Meaning in Animal Communication: A Zoosemiotic Analysis

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"Well, there remained the matter of the uncertain, vacillating *scandal of meaning*."[14]

1. Definition of Meaning: The Game of Defining Meaning.

Before looking at the problem of meaning with respect to animal communication it would be prudent to begin with an analysis of what exactly do we *mean* by meaning? - a dreadful tautology, but one that has preoccupied philosophers and scientists alike for thousands of years. In the everyday understanding of meaning there are three main definitions which come to mind:
i) meaning as signification as in the question "What does that sign mean?" (Type1)
ii) meaning as intention as in the question "What do you mean by that?" (Type2)
iii) meaning as purpose as in the question "What is the meaning of life?" (Type3)

These three main definitions can be joined by a score or more - the authors, Ogden and Richards in their book *Meaning of Meaning* (1923) for example listed sixteen categories. While there are many more, I would like to concentrate on the three main types. These are problematic enough! If we turn to the first in which we have the statement A(R)B. The standing for/signifying is a relationship (R). This relationship is dependent upon a convention. A(R)B because of C. The convention in this case is language. Even in the absence of language one requires a convention for signs. Here we can classify meaning into two types: natural meaning and conventional meaning. Natural meaning occurs outside of a system of signification like language. Often natural meaning is fixed, whereas conventional meaning is arbitrary. In Saussure's model of signification, while there is an implied referent, the process is closed, i.e. meaning is bounded by the system of language. Since there is no explicit referent, Saussure's semiology is dyadic. The model of Charles Peirce differs in almost all the dimensions. It has both natural and conventional components in its definition of meaning, it moreover has a dynamic triadic form that includes an explicit referentiality. It also includes a

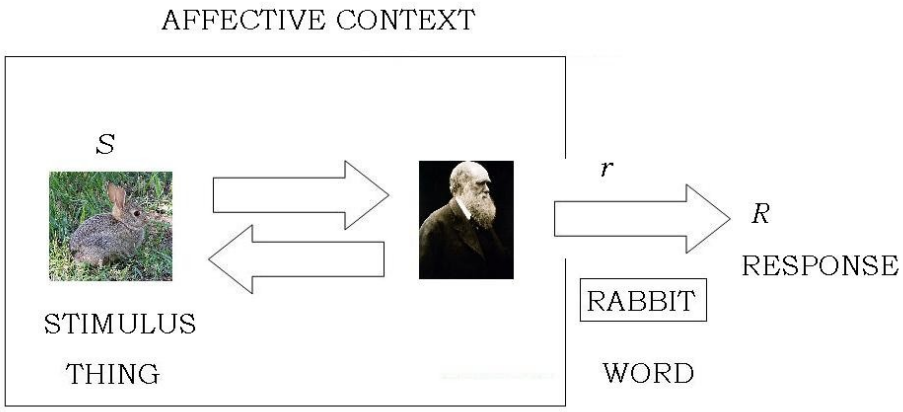
[14] Floyd Merrell, (1997) *Peirce, Signs and Meaning*. Toronto: University of Toronto Press. page vii.

quasi agent/structure called the interpretant. We can briefly then arrange the dimensions of meaning as:
1. closed or open referentiality
2. dyadic or triadic
3. agency or not
4. structural or dynamic
5. quasi-agents or not

These two interpretations of meaning are semiotic and come under the branch of the sciences called linguistics. We find in linguistics several other interpretations with different configurations. Some like Ogden and Richards (1923) have a closer affinity with the common sense dyadic notion of meaning: word and thing. They have merely added thought, as in: word, thought and referent. Others like Leonard Bloomfield have been influenced by behaviourism and view language in Pavlovian terms of : stimulus, word, and response.

Leonard Bloomfield (1933)

S ----> r----->R

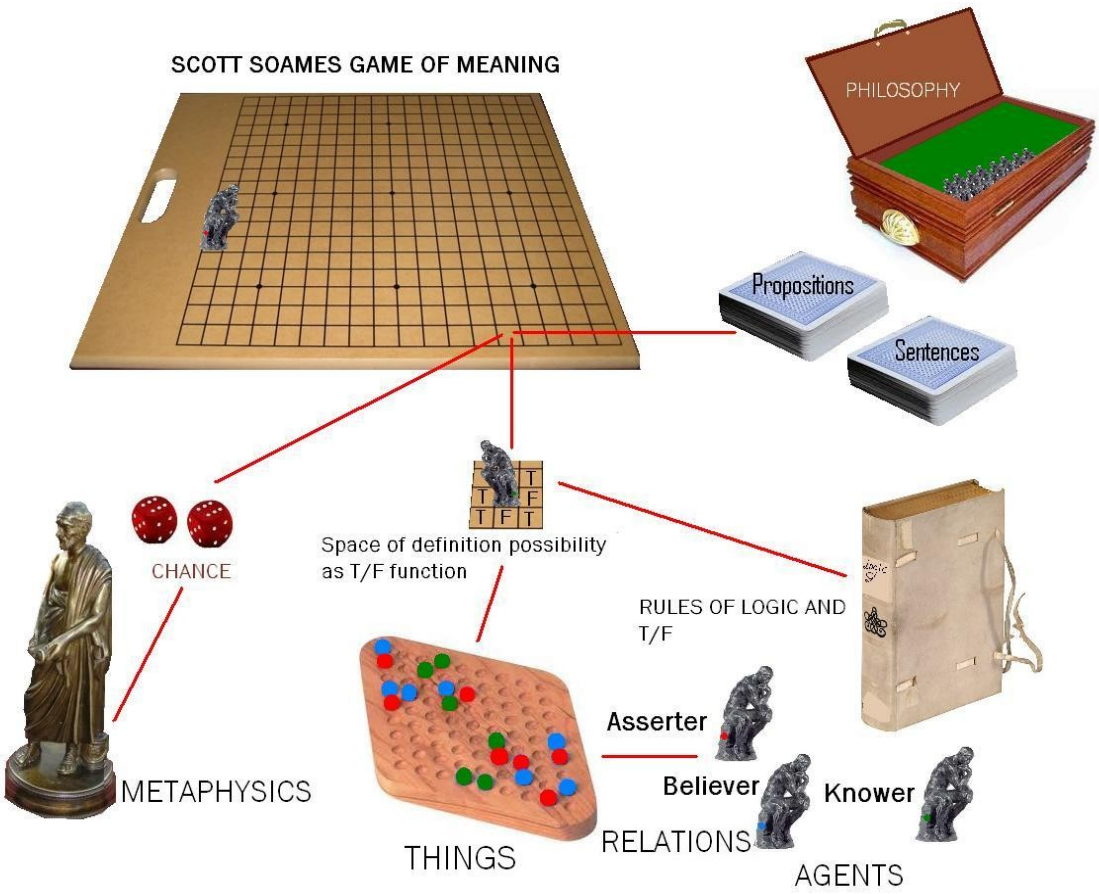


Based on Crystal, 2010, pp. 104-5.

Image Source: http://en.wikipedia.org/wiki/File:Rabbit_in_montana.jpg

The model of Charles Morris has similarities (Morris, 1971); its sign is also streamlined. He wanted semiotics to be scientific - and to this end, he not surprisingly decided that the term "meaning" was too problematic. He called it "imprecise", because presumably it was ubiquitous like Charles Dickens' London fog, getting everywhere, and yet remaining throughout vague. Rather than retain such a nebulous term, Morris argued that meaning

should be replaced with specialist terms for each of its instances. This actually causes definitional inflation. Nevertheless, Morris's theory of the sign is much more *manageable* than Peirce's. We will return to this point shortly, but for now I would like to examine another division in linguistics, one which provides us with two separate but allied sub-branches, namely semantics and pragmatics. These two sub-branches or fields in their way quite nicely correspond with the first two of the main definitions of meaning, i.e. signification and intentionality, respectively. In semantics one studies what words or signs stand for in the context of language or a communication system; whereas pragmatics studies the meaning in use between agents. We can see here that though the definition(s) of meaning are in themselves complex in linguistics, we can add further complexity by comparing these various definitions of meaning with those in other sciences or fields of enquiry. For example linguistics differs in its approach to those used by philosophers. In his encyclopedia of language, Crystal (2010) in his comparison tells us that linguistics has a broad range of interpretations and definitions of meaning, while on the other hand in philosophy, particularly analytical philosophy the focus is on propositions and naming. A good example of the latter is Soames (2010).



In the above illustration we have a ludic display of the components of what is essentially a propositional approach to meaning. At the beginning of his book on meaning Scott Soames provides us with the assumptions behind the problem in the relationship between sentences and propositions. I have reduced them to the following:

A1) Some things are asserted, believed and known. These relate agents [...]
A2) The things asserted, believed, and known are bearers of (contingent or necessary) truth and falsity.
A3) Propositions – the things satisfying A1 and A2 are expressed by sentences [...]
A4) Propositions are not identical with sentences that express them [...]

The problems are to be found in the last. There are a lot of things going on at different levels. The "game" of meaning here is "closed" and formal. The frame is essentially logical. The question of truth and falsity I have illustrated in spatial terms as the "space of definition possibility". A question we might ask, is how do assertions, beliefs or knowing start? What are the relations between the things ASSERTED and the agents ASSERTERS? What are the relations between the THINGS. Note that the game of meaning belongs to the SET of PHILOSOPHY. All of these factors determine the nature of play between the elements in the defining of meaning. In his book the question of metaphysics is not addressed. I added the Aristotle piece (METAPHYSICS) as part of the implicit rules of the game. When Soames states at the beginning of his book:

*In what follows. *I will take it for granted that words, phrases, and sentences have meaning, that for each meaningful expression there are correct answers to the question "What does it mean?", and that two expressions mean the same thing when the answer to this question is the same for both*. p. 1

Here in philosophy the interest is in the discovery and test of core statements, propositions, and their relations in language, thought and the world. Unlike the linguists who seek as many examples as possible drawn from languages, the philosophers tend to work with a discrete number of similar propositions and statements, often as variations on those used by Frege, Wittgenstein Austin, and Searle. There are numerous factors involved in this conception of meaning and language – and of course Noam Chomsky in his review of B.F. Skinner's delivered his *coup de grâce* a long time ago. (Chomsky, 1967). In his review Chomsky argues for a more scientific approach to meaning on the lines of syntax:

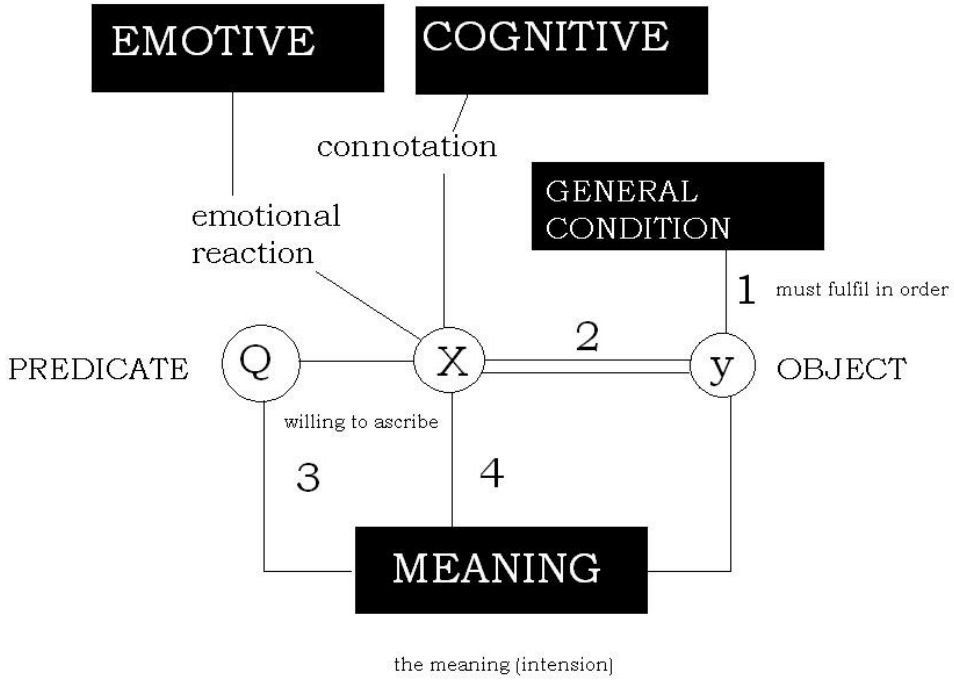
It is at least possible, furthermore, that such a notion as semantic generalization, to which such heavy appeal is made in all approaches to language in use, conceals complexities and specific structure of inference not far different from those that can be studied and exhibited in the case of syntax, and that consequently the general character of the results of syntactic investigations may be a corrective to oversimplified approaches to the theory of meaning.

He also refers to the philosopher Carnap's conception of meaning:

R. Carnap gives a recent reformulation in "Meaning and Synonymy in Natural Languages," Phil. Studies, 6 (1955), 33-47, defining the meaning (intension) of a predicate Q for a speaker X as "the general condition which an object y must fulfil in order for X to be willing to ascribe the predicate Q to y." The connotation of an expression is often said to constitute its

"cognitive meaning" as opposed to its "emotive meaning," which is, essentially, the emotional reaction to the expression.

Rudolf Carnap (1955) Model of Meaning



When we take a bird's eye view of meaning, we discover that the definitions of meaning/s are dependent very much on the system in which they are produced - indeed just as one in nature talks of environmental constraints having an impact on evolution and development, here one can say that the context of definition has a huge bearing on how meaning is defined or even resisted. For example the types of meaning can be categorised functionally as in grammatical meaning and differential meaning in linguistics. In turn these constraints on the definition of meaning colour the whole approach to communication. We saw how Morris wanted it reconfigured because it was imprecise for his scientific application - others like Shannon & Weaver in their mathematical model of communication found it to be an irrelevancy - because their remit from Bell was the study of the flow of information not the analysis of its content. We can see that each field or branch as a system has its own rules and procedures with regard to defining meaning and its own explanation limits. The limit of an explanation is equivalent to what the British philosopher R.G. Collingwood called the "absolute presuppositions" (Collingwood, 1940). These are, and I am taking a more practical approach than Collingwood here, the kinds of propositions that border the system and the metaphysical scope. For example, if I talk to a plumber about his or her work, he or she will talk about the pipes, taps, pressure and so forth. They might even talk about the calcium build up. All these pertain to the work at hand. However, if the plumber starts to talk about the nature of water, one starts to see a drift into questions that are not directly work or system

related. The explanation lies outside plumbing. Also using the same analogy, if you are having a house renovated and need the plumbing and electrics changed - while the plumber and electrician are working towards a common goal - renovating the house - they will however stick to their own field of expertise and work on problems discrete to their own professions. That is similar to how the semantician and pragmatist work within linguistics.

It was from this bird's eye conception of how various academics define meaning that I thought of tests for definitions of meaning. One way of testing something is to put it into the context of a game as above. Here we can consider a game in which two semioticians or semiologists are competing to define meaning. We can envisage a board like a go board in which each of the players has to move their pieces. Imagine that one is concerned with defining type one meaning. What do they require for their game? They might need two sets of cards - one for the signifiers and the other for the signified. They would need a book or guide that gives them the conventional rules. What about the players in their game? They must share the same codes. The game is one of relations. One player randomly turns over a card with a sign on it. The other player must guess its meaning - if they cannot, then another card is over turned. Still no meaning? A third. The first sign is eventually understood in the *context* of the other cards. Once that happens, then the other player starts. Now let us look at the triadic model of Peirce. To play this game we need three sets of cards - one for the *representatum*, another for the *interpretant*, and finally one for the *object*. Meaning arises in the semiosis. Unlike the dyadic system, the triadic is reliant on interpretation and referentiality. If we look at Peirce's definitions of the sign (there were many throughout his life) we find that the basic structure corresponds to the Ogden and Richards model (who were obviously influenced by Peirce). However, Peirce's interpretant is a troubling concept, because it seems to at various times to function as a concept (Ogden & Richards) / the signified(Saussure). One even feels that it sometimes functions as an *avatar* of the interpreter, instilled with *quasi-mind*. When we analyse the "two" games of defining meaning, we see that in terms of play, the dyadic game is the simplest - but could given the need to contextualise - take just as long as to play. But there is another dimension to Peirce's model of the sign - metaphysics. While the relations in the convention of language are taken for granted as being arbitrary - the classes of signs and their meanings in Peirce's model are determined by a kind of Aristotelian metaphysics which divides "the world" into categories of firstness, secondness, thirdness. These three categories are referred to Peirce in his letters and writings as "modes of being". Staying with the metaphor of a board game, we can compare the "rules" in the two subgames. In Gérard Deledalle's intellectual biography of Peirce he tabulates quite nicely the trichotomies of signs:

	Firstness	**Secondness**	**Thirdness**
Representamen	Qualisign	Sinsign	Legisign
Object	Icon	Index	Symbol
Interpretant	Rheme	Dicisign	Argument

This table exemplifies the inherent problem in the Peircian semiotic system, because we see that in its structure a direct metaphysical input that arose from his engagement with Aristotelian categories and phenomenology. How he arrived at these categories is complex, but not it seems up for discussion. Saussure on the other hand in his account of signs does not

have such metaphysical baggage. Charles Morris sensibly took a pair of methodological scissors and cut through the woollier parts of Peirce's semiotics, nevertheless he also felt the necessity to rename key concepts and terms, contributing to the general mystification of semiotics – ironical since his main enterprise was clarification for application in the sciences. In their book *Rules of Play* (2004), an excellent and concise introduction to all aspects regarding design of games, the authors Salen and Zimmerman discuss the nature of the rules in terms of three levels:

1. Operational Rules - the written out rules used to play the game. p.130
2. Constitutative Rules - the "underlying formal structures that exist "below the surface" of the rules presented to players." p. 130
3. Implicit Rules - "unwritten rules of the game". They are rules concerning matters like "etiquette, good sportsmanship, and other implied rules of proper game behavior". p.130

In the dyadic game, the matching or associating of the signifier and the signified are the operational rules. The convention or language provide the constitutative rules. The implicit rules are those to do with culture and society, how these affect the play of the game.

In the triadic game, the linking or associating the three components are the operational rules. The constitutative rules are logical and metaphysical. The implicit rules are those to do with culture and society, how these affect the play of the game.

For the smoothness of the game there needs to be rule cohesion. In other words the rules should not conflict or cause friction in the play. Here we see a clear difference between the dyadic "game" and the triadic "game"; in Saussure's game the first two rules do not really conflict - though the third to do with the character of the convention, might if there is disagreement in the players cause trouble. However, these are formal problems to do with relations. In the triadic game, the problem arises in the first two, because the second level of rules (logic and metaphysics) are not in themselves compatible, and the notion of belief in categories determined by Mind/God, requires a belief which belongs to the third level of rules. The matching of the cards takes place within a logical structure or program that is established not by culture or society, but by a particular deity or force. Consider for example the difference in a Humean and Kantian game of meaning. We would find in the former no recourse to God as an ultimate explanation of the rules of definition of meaning, but in the latter, there is a dualistic logic that has the God create the logic by which one can discover the God: a supreme tautology. Players who like myself do not believe in a religious force, find the inclusion troubling, moreover since as I explained above, here we have crossed over from discussing meaning in terms of the semiotic theory/system into pure metaphysics - which is entirely another game and requires additional rules and cards etc. Indeed here we have an example of Type Three meaning:

<u>Type Three</u>
This game is called Telos. The goal of the game is to interpret the purpose of the message (signs). This is an esoterical game. The game has a box containing figures of philosophers or

religious symbols Each of the players will be assigned a philosopher or religion - this is done through roll of the dice. Each of the players must then play the game according to the guide given to them. The significance of each word or image depends of course on the interpreter. The game is played as follows. A card is overturned and each player must rank from a scale from zero to five what significance that symbol, word or image might have on the other players. The one who is the closest in his or her guess wins. They can roll the dice and move forward according to the outcome.

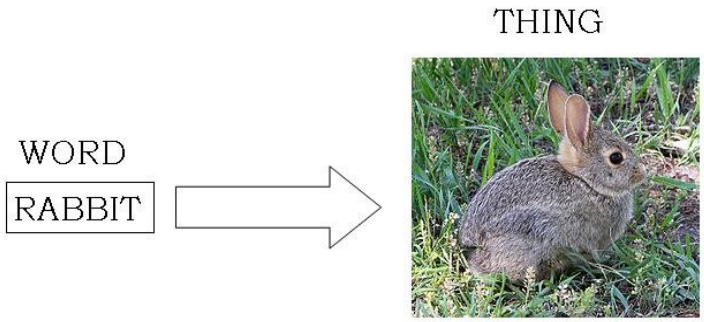
Type Two (The Pragmatic Version)

In this game there are three main sets of cards. One with the signs, another with the things, and one more for concepts. In addition to these cards there is one more set which is for dispositions or affects. The game is a board game. Each of the players has a piece with which they move round the board, the purpose is to successfully interpret what the other truly means (intends). The players can alter their tone, gestures and the other has to guess the real message.

By looking at the definition of meaning as if it were a board game we saw that definitions are constrained:

i. By the particular context or field of enquiry
ii. By competition within the larger field or science
iii. By the players themselves
iv. By publication

2. The Meaning Debate in Animal Behaviour Studies



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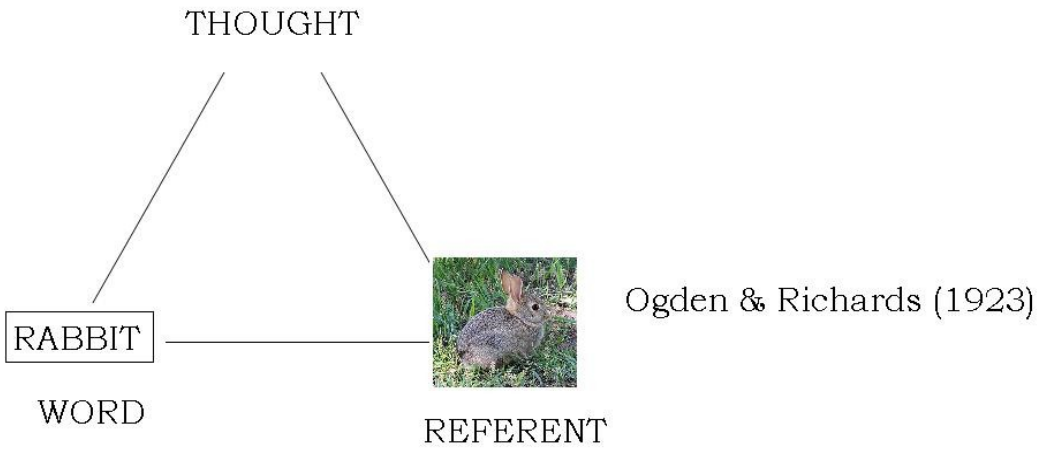


Image Source: http://en.wikipedia.org/wiki/File:Rabbit_in_montana.jpg

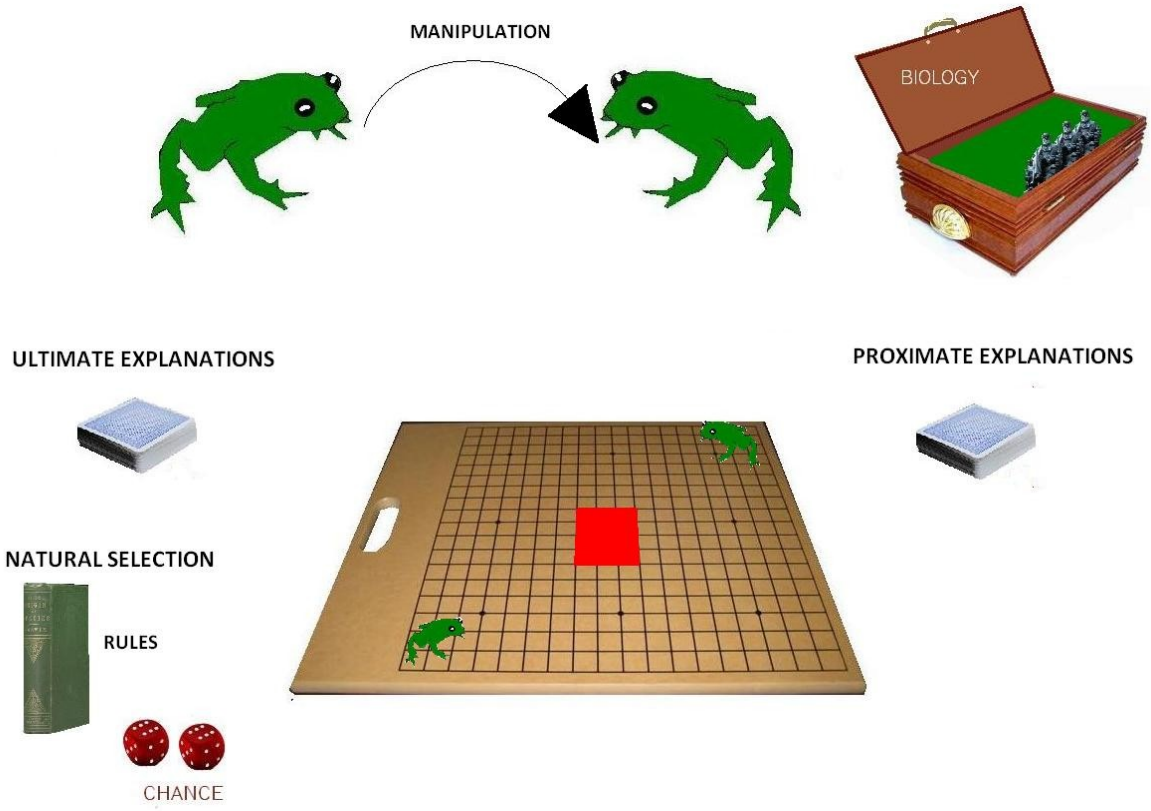
Over the past thirty or so years, since the publication of an article by Richard Dawkins and John Krebs (1978) which argued for a non information based approach to communication ("Animal signals: Information or manipulation?" In J.R.Krebs & N.B. Davies (Eds.) (1978) *Behavioural Ecology : An Evolutionary Approach*. (pp. 282-309). Sunderland: Sinauer Associates.) there has been a division in animal behaviour studies into roughly two camps, the adaptionists following Dawkins and Krebs on the one side that advocates a tough Darwinian stance towards communication where animals manipulate another to their advantage (asymmetrical relation) and the other side that views communication as symmetrical - that is having a sender and a receiver in a mutualistic relation - here the sender *shares information* the receiver. When the 1978 article was first published there was a flurry of publications that took sides. Dawkins and Krebs concluded with a red flag for the informational school:

We are contrasting two attitudes to the evolution of animal signals. One attitude, which we have here called classical, emphasises cooperation between individuals. Cooperation is facilitated if information is shared ... The other attitude, which we espouse, emphasises the struggle between individuals. If information is shared at all it is likely to be false information, but it is probably better to abandon the concept of information altogether. Natural selection favors individuals, whether or not this is to the advantage of the manipulated individuals. (p.309)

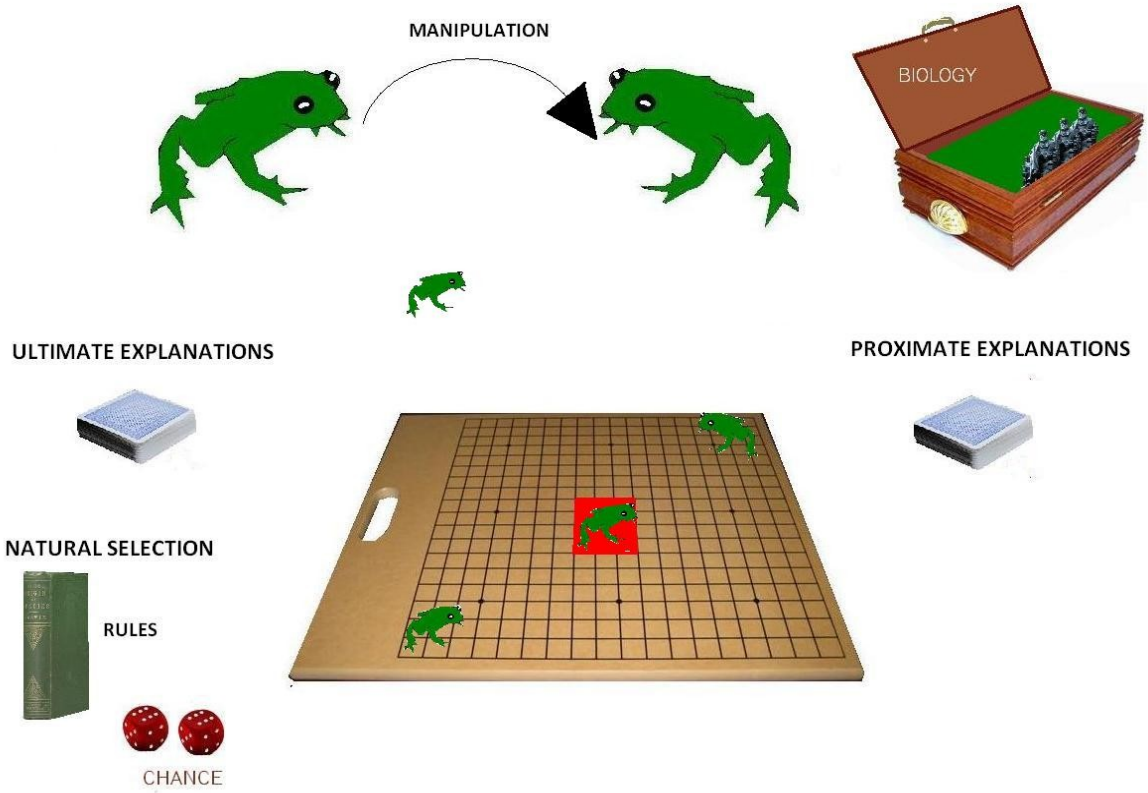
At the time the information school critiqued the D & K thesis of manipulation because it was making "unacceptably strong claims for their manipulation hypothesis" which for Smith (1986) was already incorporated within the informational interpretation. Moreover W.J. Smith argued that the manipulation hypothesis was bringing back some of the now discredited terms used by Konrad Lorenz - i.e. out of date European *classical* ethology prior to the integration of genetic theory. They took a "short-term view of social behavior" ignoring the "long-term social interdependence" therefore rejecting the important aspect of "evolution of cooperative behavior", they also assumed that informing was full and reliable - which it is not, and finally they failed to realise all misleading signals are a form of mimicry.

Reactions to Dawkins and Krebs included both praise of their use of the logic of natural selection, and identification of a problem with their formulation. Myrberg (1981), Beer (1982), Wiley (1983) and Smith (1986a) insisted that "information" and "manipulation" are complimentary rather than alternative concepts. Information, several argued, has to do with the proximate coupling between signaling and situation (e.g. semantics), or between signaling and the behavior of perceivers (e.g. pragmatics). The term manipulation was used metaphorically and is actually defined in ultimate terms, i.e., of the average impact of the signal on signaler and perceiver fitness. ((Owings; Morton, 1998, 41)

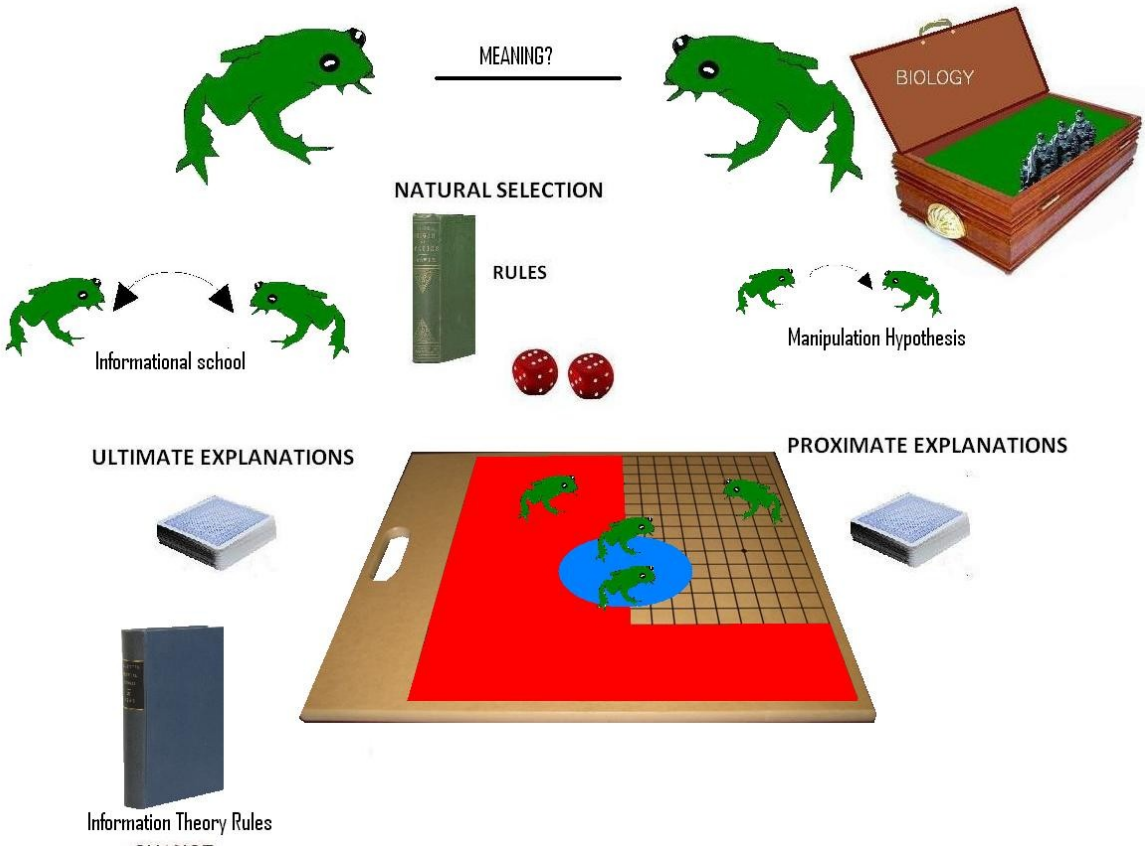
Let us look at a definition of meaning according to a manipulation hypothesis. Suppose we consider the case of a frog ”communicating” with another frog. In the Dawkins and Krebs (1978) model they must explain the event in strict terms of natural selection and explain the event and its proximate and ultimate causation (according to Tinbergen et al). In this game of meaning (which is really the game of non meaning) the players take two animals (frogs) and they must avoid the red area (the danger area which is informational/linguistics) and then move the pieces towards a set goal for example – mating. How do they arrive at being next to each other without communicating meaningfully?



In the above game of meaning the operational rules are governed by evolutionary logic, the constitutative rules by biology, and the implicit rules governed by the scientist's practices. The players here are cooperating which makes it in some ways a non game – unless one has to draw the other into the red square. However, by doing so that player endangers his or her own survival – because the game requires that they mate. We must then have another player. This player is in the middle of the board and is female. The two males must "manipulate" her out of that square – she on the other hand must draw them into the square.



Imagine now if the game is played between those who subscribe to an informational approach and those who subscribe to a manipulation hypothesis. In the centre we have a blue circle representing the females. The males must using their particular strategies attract and mate with the most females. In this particular game I have given the informational school (red) the most territory – this represents their ranking in the *Animal Behaviour* journal. The other school in the unmarked squares has a disadvantage. When we look at how meaning in animal communication is determined – it has a lot to do with academic power relations that establish paradigmatic status, even though the principal rules are accepted by both. There are additional rules that come from the mathematical theory of communication. What are their status? Do they affect the play? What of the implicit rules? Do all the players agree on the implicit rules of defining meaning? Both seem to agree on the constitutative rules – and perhaps on the operational rules. But do the rules of mathematical communication challenge natural selection rules or make the operations of play more difficult. Certainly any additional rules add more complexity and time to play the game. This is countered by the informational school who would argue that if the players take time to learn the rules of information theory, the game would be much simpler and practical. Besides they would argue also that the manipulation hypothesis requires some formidable mathematics as well drawing from game theory among others.



Any game would not be interesting if it did not include penalties or obstacles. One might be the "tautology" card. One cannot in this game use the word "mean" in the definition of meaning. Another penalty card is the "representation" card. If one draws this card. One must prove that the particular instance of meaning is represented physically. This would balance the game, since those in the informational school would need to prove physical sites.

The purpose of using the board game model in meaning definition analysis is that it allows us to be able ascertain relations between models and theories of definition. We can see the nature of the constraints and the elements that are connected with competition.

Problem of Representation of Meaning in Animal Communication

Over the past year or two the problem of meaning has cropped once more in the field of animal behaviour studies (see journal *Animal Behaviour*) . In 2009 Rendall, Owren and Ryan challenged the informational school and its reliance on information theory :

The upshot is that, although informational approaches have tremendous intuitive appeal, they are at one and the same time both too loose and too restrictive to cover the broad range of animal-signalling phenomena. They are too loose because their core explanatory construct, information, is either only ever vaguely defined and operationalized, or, more often than not, left entirely
*tacit.(*p.234)

More importantly they see a flaw in the approach because
Studies of primate communication are often couched in the metaphor of language where meaning is the central explanatory construct and arises from the common representational states of speakers and listeners. This representational parity in language occurs when the speaker and the listener have similar representational processes that ensure corresponding coding and decoding of signal meaning. The details of signal design are not critical. Indeed the design, or form, of most words is thought to be largely arbitrary with respect to the things they represent. What is more critical is that speakers and listeners make implicit attributions about each other's mental states, such as their thoughts, beliefs or states of knowledge, because these are what motivate and sustain reciprocal semantic exchange. (pp.234-5)

When we analyze the above passage we can see that the authors have doubts about attributing meaning and representation (in the linguistic sense) to animal communication. Worrying for biosemioticians and zoosemioticians is that they see no evidence of primates in either their behaviour or in their neurobiology of "perspective taking and mental state attribution abilities considered to be foundational in to the referential quality of human language." (ibid., p.235). This was quite damning -- not surprisingly the informational school responded in an essay in the same journal (Seyfarth el al 2010).

Far from being 'teleological' and 'circular', research inspired by the informational perspective has clarified differences in the mechanisms that underlie the behaviour of signallers and recipients;
revealed differences between species in the information that recipients acquire from signals; suggested fundamental differences between language and animal communication; and inspired
a growing number of studies that examine the neurophysiological basis of call meaning. The informational hypothesis thus continues to prove its value in the most important way possible: by suggesting observations and experiments that drive our field forward.

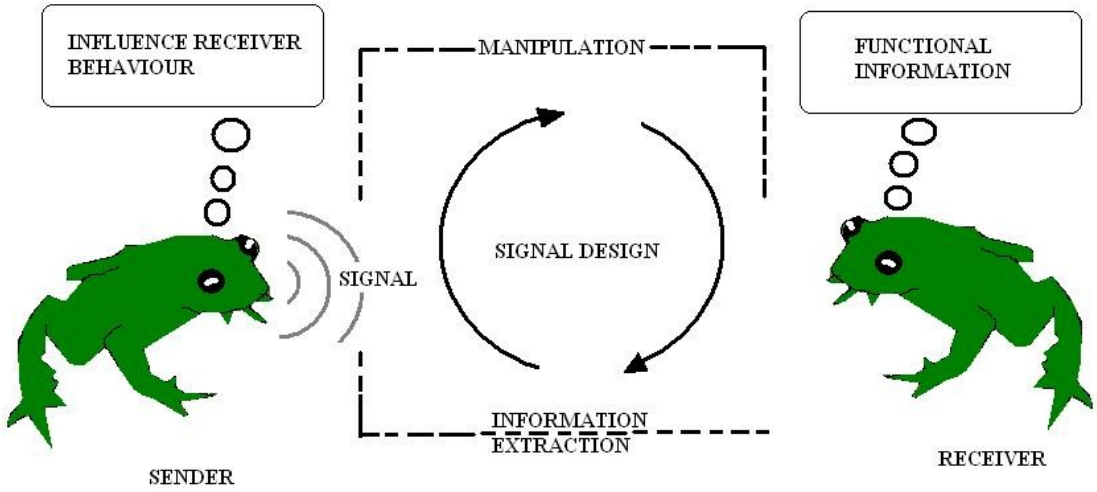
Robert M. Seyfarth Dorothy L. Cheney, Thore Bergman, Julia Fischer, Klaus Zuberbühler, Kurt Hammerschmidt (2010) "The central importance of information in studies of animal communication" *Animal Behaviour* **80** (2010), pp.3–8

Interestingly the authors in their riposte used the same expression used earlier against Dawkins and Krebs (1978) ,i.e,. that Rendall et al "*have set up a straw man*" p. 4. While they argue that information theory has provided good results, they do not elaborate on the criticism regarding information exchange and representation nor really do they address the problem of biological evidence of putative sites, indeed this is what they have to say:

In fact, adopting such heuristic terms has a long and continuing history in the biological sciences. 'Gene', 'memory', 'mental map', 'auditory template' and 'neural representation' are other examples of words or phrases that scientists have used to label an entity whose

physical properties they are only beginning to understand. The inability to specify precisely the information conveyed by a vocalization (that is, its meaning to a listener) does not prove that information is entirely absent.(p. 6).

This does not seem entirely convincing. It seems that they take it for granted that if one primate calls and another as a result changes their behaviour in response – there is learning and meaning in the exchange. There must be. A pragmatic perspective is offered by Font and Carazo who bring together the two strands of animal behaviour studies (adaptionist and informational) into one model.



Model based on Font and Carozo (2010)

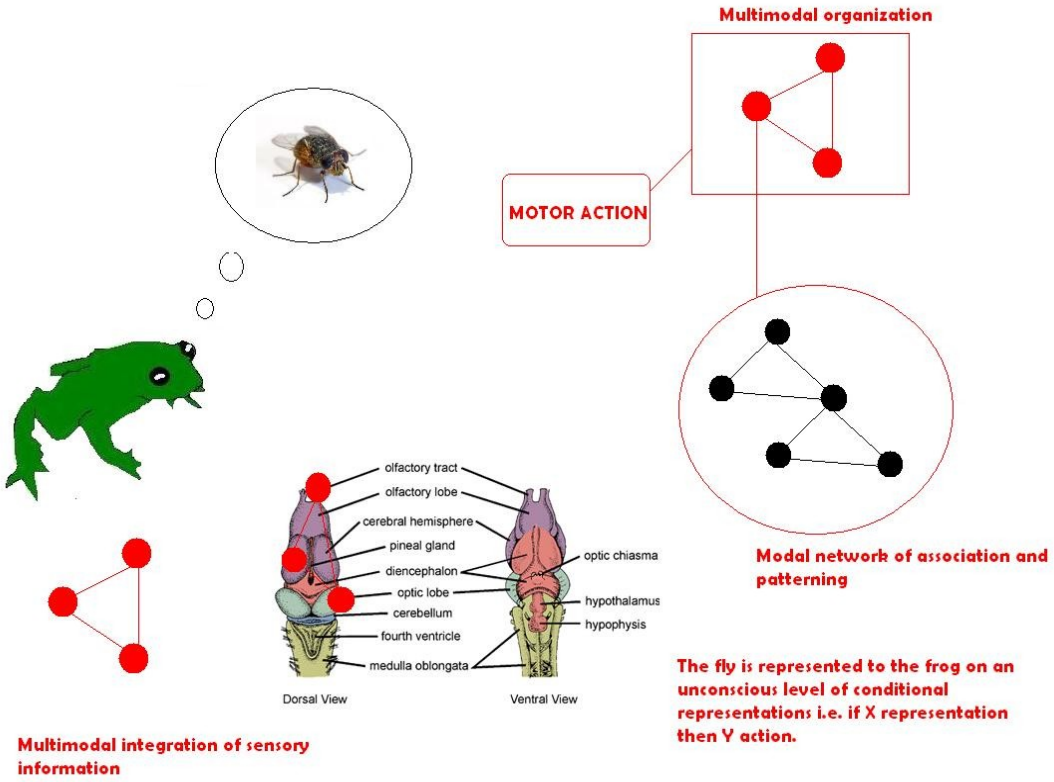
However, this model is dealing with signals – not with signs. One can say that it is still not really tackling with *the* true problem of meaning, since it is principally discussing the observed external behaviour of the animals without discussing issues to do with the notion of inner representation as a prerequisite of meaning production. The signal is the "sign" carrier or the messenger. What about the significance of the content in semiotic terms? What about the sites for meaning representation? At this juncture we can move toward a physical account of meaning.

The Semantic Memory Model

Semantic memory registers and stores knowledge about the world in the broadest sense and makes it available for retrieval. If a person knows something that is in principle describable in the propositional form, that something belongs to the domain of semantic memory. Semantic

memory enables individuals to represent and mentally operate on situations, objects, and relations in the world that are not present to the senses: The owner of a semantic memory system can think about things that are not here now.
Endel Tulving "What Is Episodic Memory?" *(1993) Current Directions in Psychological Science* Volume 2, Number3, pp. 67-70

The concept of semantic memory as one of several memories (multiple memory systems) owes its origins to Endel Tulving who came up with the hypothesis in 1972. Since then much work has been carried out to isolate and identify the differences between episodic memory and semantic memory which belong to a larger category of declarative memory. We can see from the past literature that semantic memory was seen as exclusive to humans and grounded in language and amodal that is operating at another level to sensory motor functioning. However as neuroimaging have shown these theories about semantic memory are wrong. Semantic memory is not amodal, as in the representation of concepts areas of the brain connected with this or that sensory modality are activated too, In other words semantic memory processing is distributed across the divide between declarative and procedural memory zones. This challenge to the amodal model of semantic memory raises the possibility of a non linguistic – conceptual memory.



Information is hierarchical and structured according to the stages in the cognitive processing. In the above cartoon presentation, we see the fly (the referent) and the sites where it is

represented – beginning of course in the sensory organs where cues are received as waves or molecules and then filtered, the information converted into secondary signals that provide more defined information as the animal's sensing systems move through reception, sensation, integration, perception and towards action or non action. The disposition of the animal is dependent on numerous factors including its homeostatic conditions. When a frog is in a predatory mode then the information received will be categorised according to the features or patterns that correspond to prey. Here the information from potential prey such as movement, colour, and so forth is received as cues not as signals. The fly is not communicating to the frog, though its movements etc do *indirectly* communicate information. Here we see the problem of nomenclature as the fly's movements are:

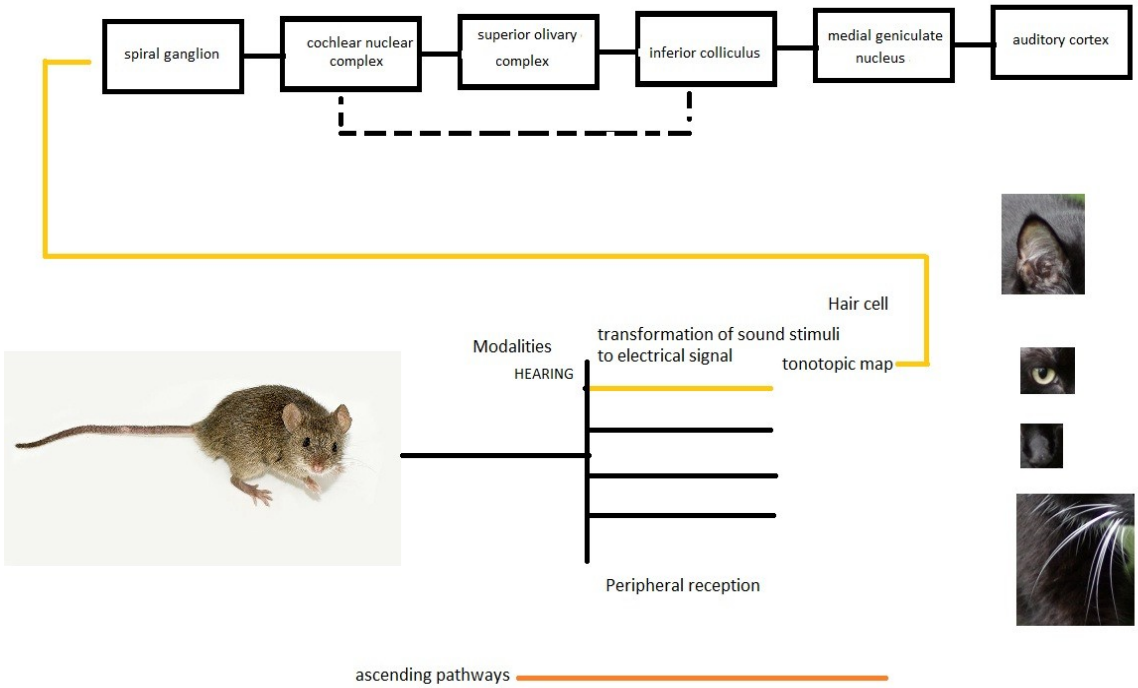
A
1. Received as mechanoreceptive waves (signals)
2. Received as optic signals

B
1. Secondary signal
2. Signal within nervous system

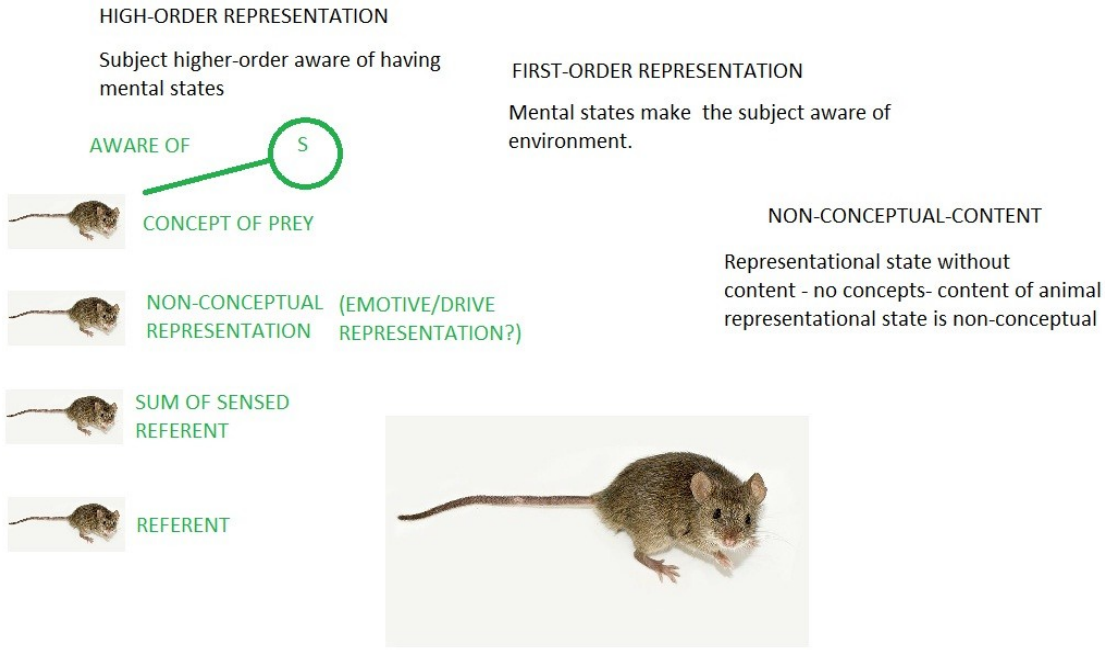
C
1. Cue i.e. not as a signal

D
1. The movements can be interpreted as a "sign" of the fly's presence. (Indexical sign)

The last example is an assigned sign – attributed semanticity, because the information is not conventionalised nor represented in a higher cognitive system – it all occurs fairly automatically. In a single vertebrate, in-coming information from the environment is processed at various stages firstly at level of stimulation without value, then as saliency in reference to immediate homeostatic values, only when it reaches the higher processing areas is it evaluated semantically as this requires association in a multimodal neural working space with memory input. The notion of a pre-linguistic semanticity requires a system of coding – perhaps a vocalization system. Throughout the production of meaning, there are also different levels of awareness. It has been said that animals do not attend behaviourally to more than one task – however it is conceivable that animals with vocalization systems correlate information with vocals. If we consider the Piaget model of object permanence where prey can be inferred from information that is not directly associated with structural cues of a prey (such as scent identification) – information would be a hole (though this is problematic as a hole has a lot of olfactory information – but we will ignore this for the moment) then the notion of a mouse is carried on in experience and reruns during sleeping. Here a cat and dog often vocalizes and moves as if the experience is live rather than recorded – and here one might relate the particular vocable to the object experienced and its correlates in the memory system.

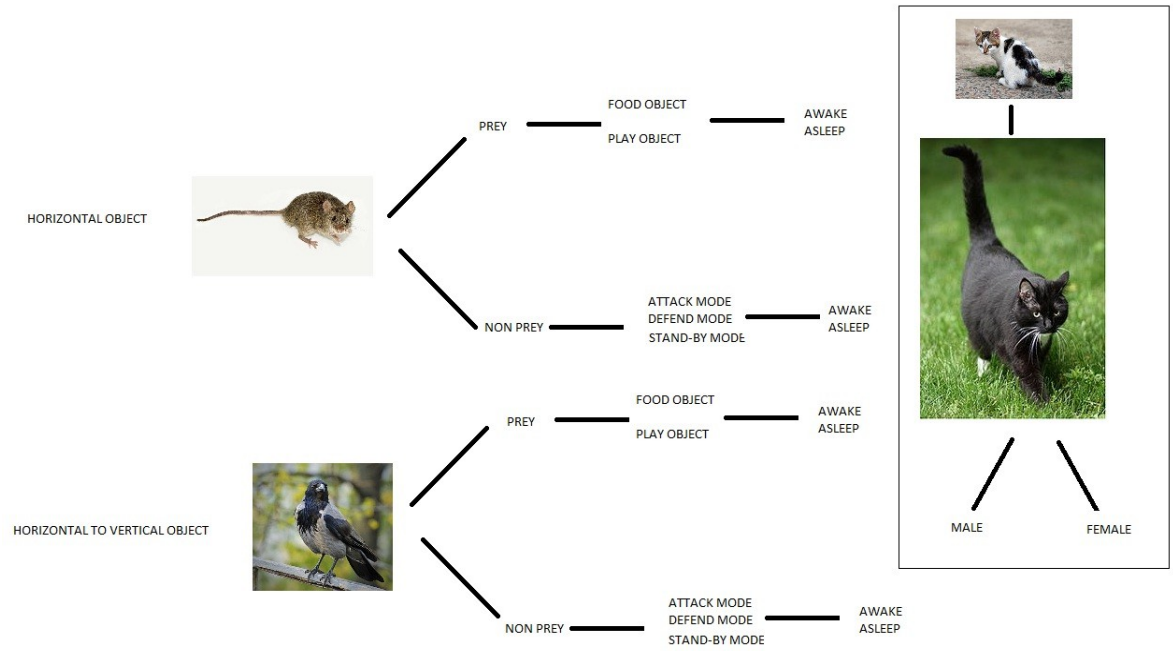


In the above diagram (from Carole Hackney "From Cochea to Cortex" In Roberts, David(edit), (2002*) Signals and Perception* London: Palgrave, (p. 30) pp. 29-40) we see the ascending pathway of the auditory pathway starting from the transformation of sound stimuli (relating here to the mouse) the placing of this in a tonotopic map at the level of the hair cell moving all the way towards the higher cortical areas. The question is what is meaningful at these levels if anything? What are the tests for meaningfulness? What about the memory of the mouse? It has been my argument that representation defers according to the stage in the pathway and is differentiated according to several dimensions beginning with peripheral reception, filtering, (here at level of responsiveness), moving onto another level of biological organization the hair cell where it is "mapped" – this mapping is not be confused with cognitive mapping (i.e., based on Tolman, 1948) , it is neural mapping. If we look at the flow chart, it is only in the auditory cortex where integration from other modalities take place that we can start to consider representation at the level of semantic. At this juncture we should situate the discussion of meaning in animal communication in a wider theoretical framework – discussion of semanticity within the framework of animal mind. Does semanticity require higher order representation? Can it get along nicely at the level of first-order representation – i.e. enriched perception?

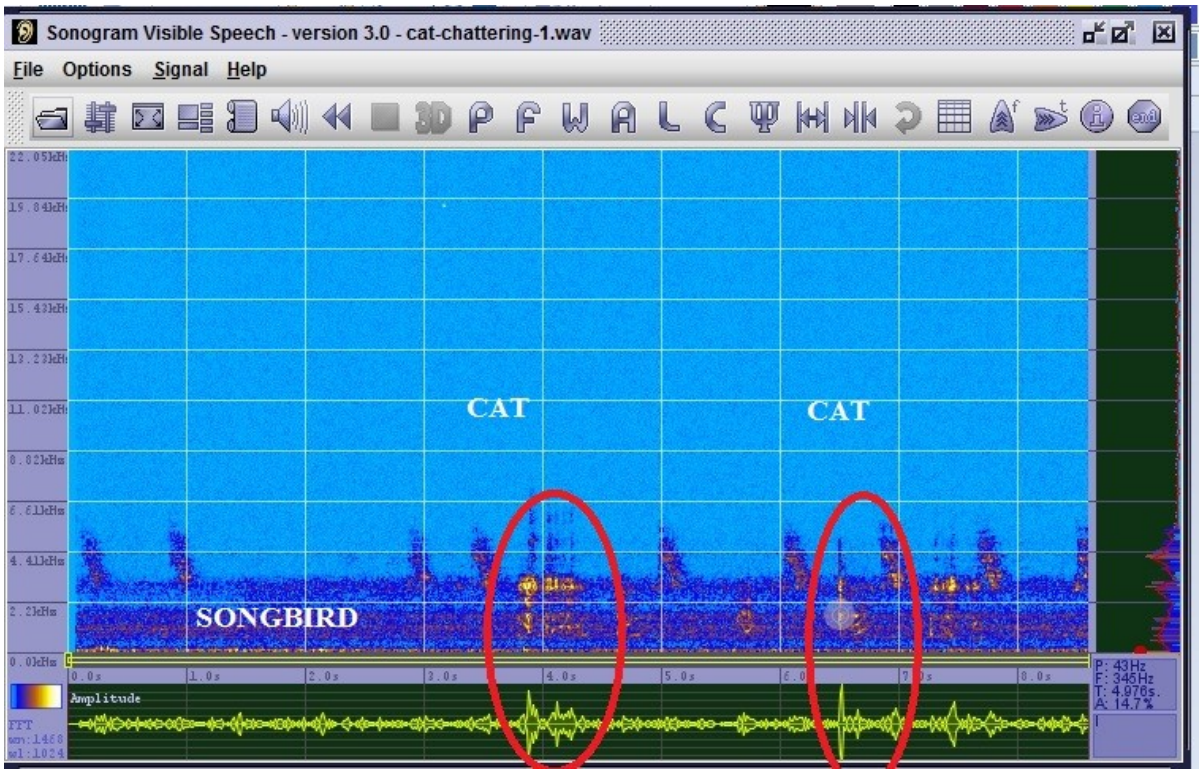


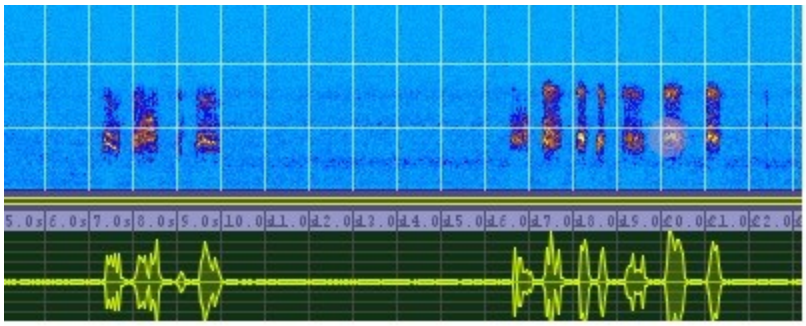
Lurz (2009)

When we look further at the question of semanticity we find there are numerous methodological issues to be dealt with. A mouse is viewed as an object in the world of the cat, its value dependent upon the environment of the cat. If the cat is on an island where the prey is preponderantly seabirds, then the value of the mouse is different – also in the case of a well-fed house cat versus a feral cat. On top of this we can ask developmental questions – such as how old is the cat – since the channels of communication and interpretation will be different from an adult cat. We can also ask what is its sex class. Is it male or female. Below I have added some of the dimensions that have a bearing on how we might infer semanticity or lack of it in a cat. There are here two standard or basic perceptual categories (horizontal – mammal) (vertical – bird) and then the further category of prey or non-prey. An example of non-prey could be due to the proximity of the object or its size (a larger prey is costly). The behavior of a domestic cat towards songbirds like a robin or a blackbird is different to its relations to members of the crow family. Of course if the cat is a large male it might be able to take on crows. The same is true of a cat with small mammals. Large rats are formidable foes and too costly for a domestic cat.



The domestic cat's behavior is also affected by human interaction and domestication. Its relationship to a mouse would be different from a feral cat. Also if we place the behavior in terms of Tinbergen's "Four Questions" then development for example is important. Here as a slight aside, often in cognitive experimentation, important factors that have a strong influence on the outcome and would skew a statistical analysis such as the age and gender of the animals, as well as its endocrinal state are very important. A lactating cat is likely to behave differently towards objects than a castrated male cat for example. At this juncture we can bring in a couple of case studies that exemplify some of the deeper questions of meaning or significance in non primate mammals. Let us further consider for example the case of cat chatter which they do when they see birds or flying animals. Here the cat chatter and its intensity defers according to many factors. From audio files available on the internet I did a sonogram analysis of a cat chattering in the presence of bird song. There was little if any correspondence between the chatter and the song, indeed the two seemed almost independent of each other, as if the cue for the chatter had been the visual rather than acoustic. (see first sonogram). However, when a member of the crow family interacts with a cat, there are several distinctive similarities – these due to the imitative nature of crows, but also it seems in the cat's vocalization. It seemed closer to the crows – there was evidence of vocal convergence. This is significant as it suggests that cats react different vocally to song birds and crows, and moreover, the intensity of the cawing and chattering which is deeply prolonged , seems to some extent satisfying to both animals. Moreover, during playback, a cat with no apparent experience of a bird of prey, would react differently than it would say to a seagull, duck, songbird and so forth. This suggests that cats have a local knowledge of birds within their range, and perhaps are hardwired to the sound of potential predators.

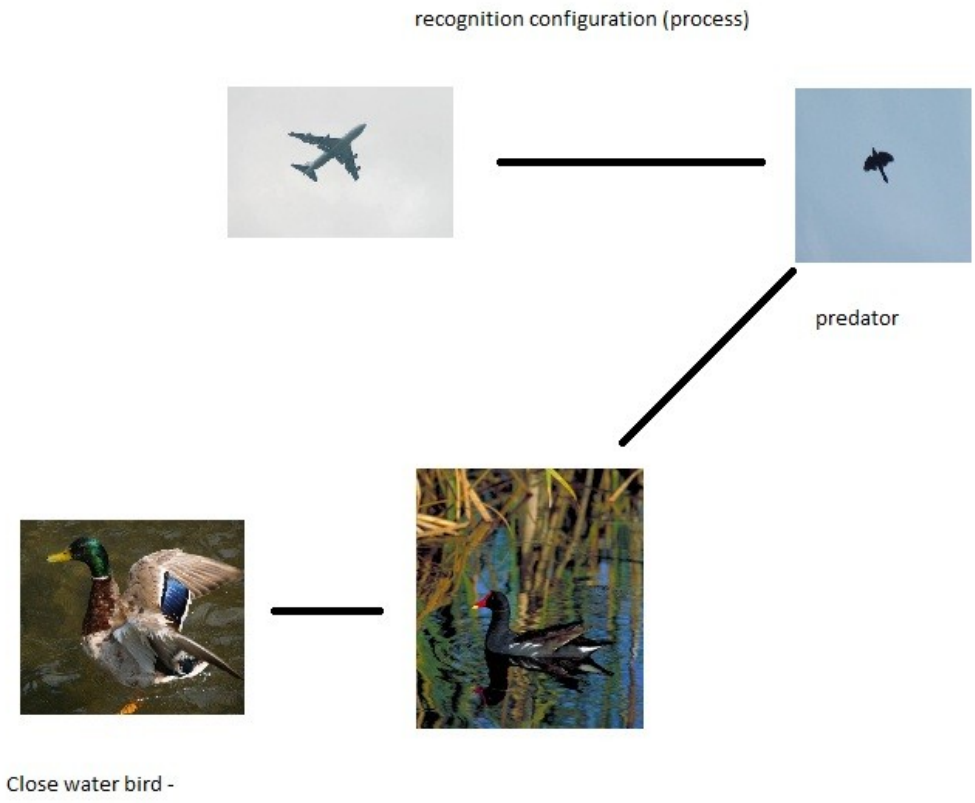




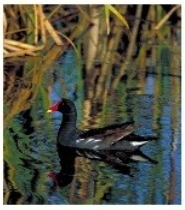
Crow cawing - several.

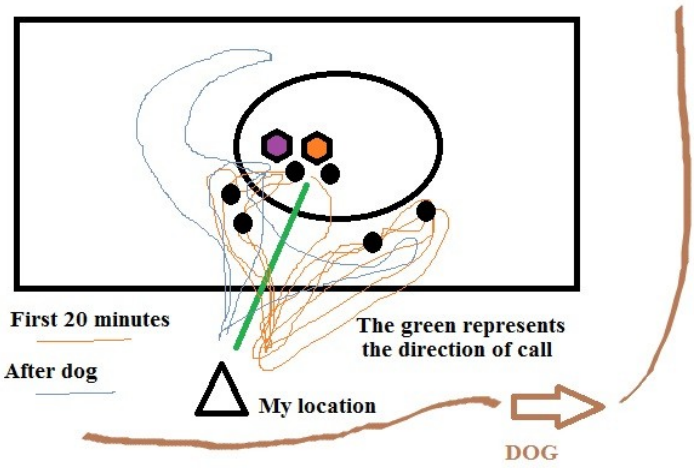
The theory that the cat chatter is an amplification of the sound it makes during the "killer bite" is interesting, but it would seem that if the cat is confronted with song birds and crows, its chatter is remarkably different, suggesting an internal categorization, and not a prerecorded sound that is programmed or triggered by birds. This is not to say that it has semantic memory, but a categorization system that is fairly plastic. There is an object differentiation as I stated above between the prey that is remote, close, horizontal or vertical.

A male moorhen is more territorial and takes greater risks against competitors and potential predators (of young) than a female moorhen. The state or disposition of an animal affects the level of representation. A moorhen primed by hormones to defend territory will attack readily attack objects that correspond to the silhouettes of crows and birds that have a similar appearance such as blackbirds. In this respect the moorhen has a hardwired identification or bird spotter's guide similar to aircraft identification.



In the film aptly named "Father Goose" (1964) the hero Walter Eckland is rewarded according to the number of enemy planes he must accurately identify from a Royal Navy chart. However these "spots" must be confirmed by other spotters on other islands. In some ways the significance of information for a moorhen is cross-referenced by several sources. The most important is the conspecifics – particularly its mate. The mate is more reliable than the chicks who cheep almost automatically and in the early days for food and navigation. I saw for example when a dog came towards the bank of the pond, the size of the dog was assessed – the larger the dog, the more wary and alarmed were the birds, and the moorhen would rush to the small island with their chicks in tow. The memory or object permanence of a potential predator is seen in the following observation. I had "trained" the male moorhen from the year before to come to my call – of course it was always in expectation of food – so it was a primary conditioning, but be as that may be, it trusted me greatly and would come very close. I reasoned that during the season when it is looking after the young, it must seek food for them, and anything that is economical is to be preferred. However it has to attend to several things. Firstly upon hearing my click it left the island and assessed which of the chicks needed feeding first – a kind of algorithm at work – then it would swim, climb the bank and go into what I would call a kind of "begging" posture learnt from earlier times. Then return to feed, preen itself, return and repeat. This would change when a dog and owner came by.

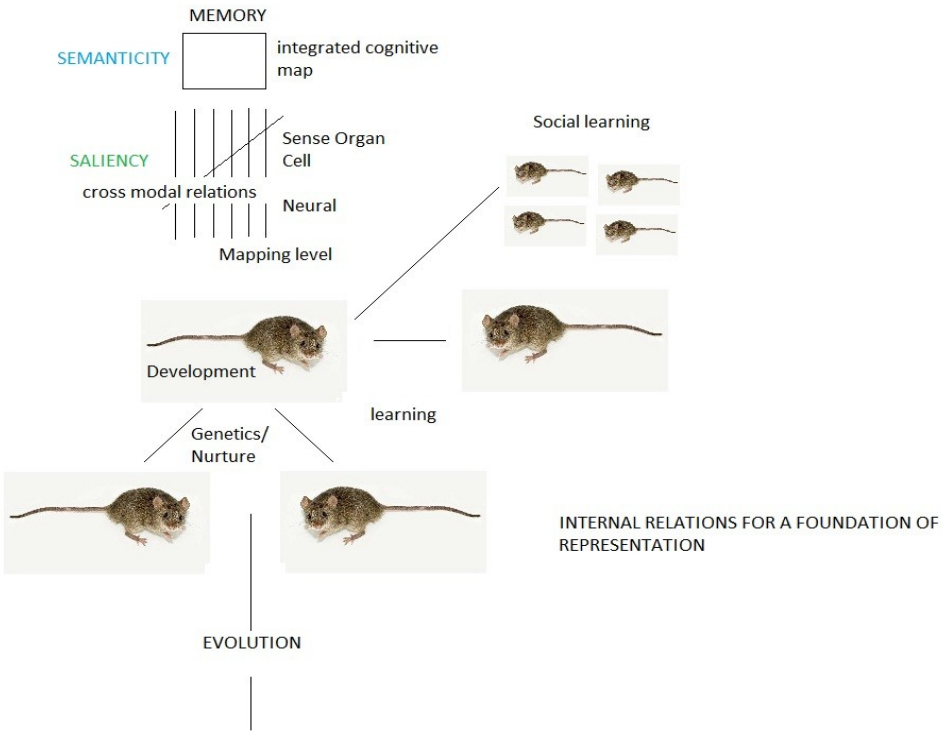


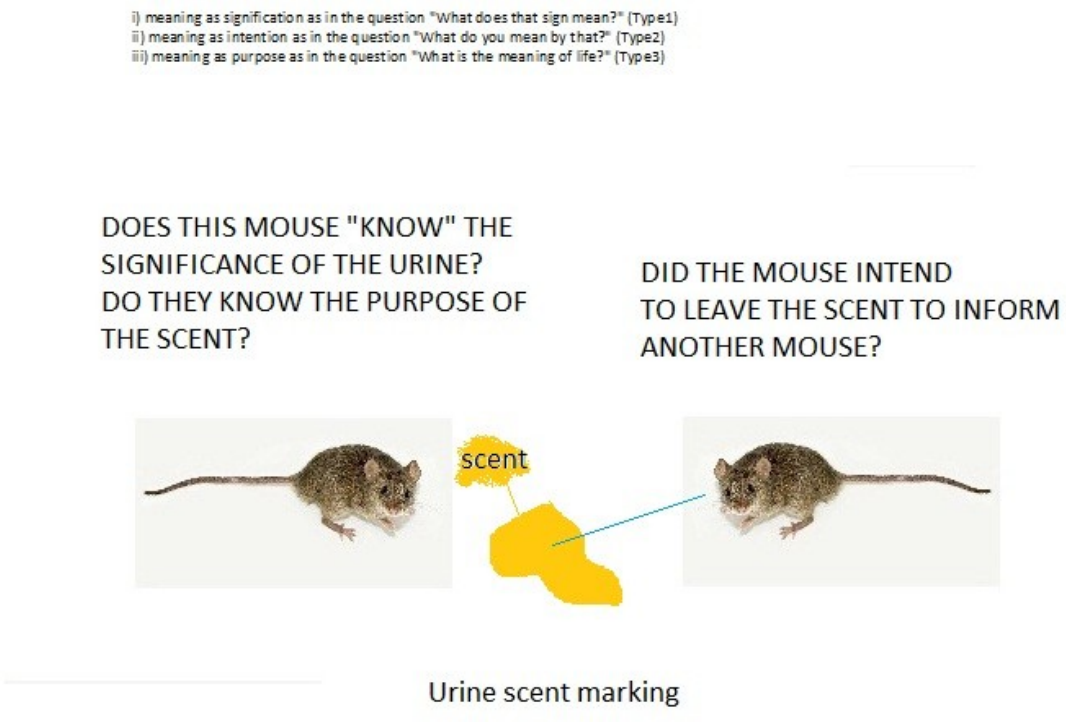


In this diagram the moorhen were on the island. After my call (click sound) the male swam towards me (associating the click sound with food) then swam back and assessed which chicks needed food (chicks are black dots). Swam back to me collected more food and ignored fed chicks. Repeated (see orange). Later a dog and owner came by. The moorhen alarmed returned to the island. After a short while I clicked, and before the moorhen swan directly to me – he swam around the island to check whether the dog had moved completely away. This seems to me to be an example of Piaget's object permanence. He then swam back and continued roughly the same pattern as earlier. More experimentation would be needed to see how the moorhen reacts to broken patterns of behavior – and if it shows plasticity or learning in these situations. Another interesting element in categorization of predator in terms of birds, is whether the predator is looking or has its head towards the birds. On my walks to the university I realized that different species take off at varying times. Crows have through closer contact with humans, a greater estimation of the threat than seagulls. When seagulls panic they fly off together, but a rook may keep on its eye on a jackdaw as a more reliable indicator of a threat. Also if a person walks towards rooks they will fly off if you look at them. The escape distance is shorter if you wear sunglasses, and if you turn your head – they will stay put. Eyes then play a great role in avian assessment of risk. These kinds of categories are hard-wired and the memories connected with them are not semantic. Moreover, I have been discussing mainly the top-end of animals – if look at insects we find similar behaviours: visual recognition in wasps of badges, set tasks according to the season and hormones, etc. The difference is the flexibility – the assessment and memory of prey or a predator. Insects mostly work with honest signals (chemicals) or use very stable and discrete acoustic signals. Whereas in the case of vertebrates often the information is less reliable – and therefore requires greater plasticity in responses and more extensive memorization of a higher order, and of course more learning in development. All of this is done through communication that is strictly speaking from a linguistic sense, meaningless, and might not accord either with

intentional models based on analytical philosophy. I certainly feel that so much is going on in animal communication and behaviour that one requires a whole new epistemology – and it should be based much as possible on the observation of animals, the analysis of their discrete vocal systems (if they have one), the study of visual and auditory configurations as observed by us – and the correlates in MRI scans.

When we analyse the pathways and the relations in potential semantic communication, we see that many of them are hard-wired and inherited. Also even at the higher levels of cognition, the representation is inferred or attributed by humans – from brain mapping and learning tests. Suppose if I wanted to test whether a child knew the meaning of apple, I could use several methods – for example the mixing of food, so to see if the child can discriminate the apple from other oranges. I could ask the child to draw a picture of an apple. I could also interview the child. The range of testing for semantic knowledge is much varied, and not available to those in animal experimentation, since the communication systems do not in the most cases have language properties (see http://www.phon.ox.ac.uk/jcoleman/design_features.htm).





Often communication between animals is chemical, as it is usually the most honest signal, it can convey many things to the receiver, such as the gender, age, possible location of sender (freshness), health, current sexual condition, and much more. Moreover since unlike other signals it lingers, then the scent can broadcast territory as well. A mouse moving into another's territory is likely to be more cautious. While the urine scent is honest in terms of giving kinship information etc., it is not specific. It is to all and sundry and the marking is often regulated by hormones. In this respect the mouse did not "intend" to leave a scent, if intention requires higher processing. The signification is processed at a lower level of representation, the purpose is biological. However, though the propagation and the reception of urine scents are fairly automatic, they do occur in a wider context of behavioural algorithms and goals. It is here where the possibility of semiosis is to be found – in a multimodal dimension of learning, remembering and vocal (internal) feedback.

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Some modern considerations for thinking about language evolution: A discussion of *The Evolution of Language* by Tecumseh Fitch

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A little history

The question of how humans came to have language has been raised ever since humans first recognised themselves as languaging creatures, and the ability to language has always been seen to be the single most distinctive feature of humaness. No humans have ever been encountered who did not speak, but speaking has never been found in any other kind of creature. Nevertheless, it has always been recognised that other creatures had ways of communicating, especially by means of their voices, and many have sensed that, despite differences, human speaking was related to this. One ancient debate has been, then, whether or not we can accept continuities between animal and human expression, or whether there is an unbridgeable gulf.

In the modern era, from the middle of the eighteenth century until the end of the nineteenth century, inquiries into language origins were often undertaken. After this they ceased almost completely because, so it seemed, with the expansion of empirical knowledge, the gap between what we could reliably know that was relevant to the inquiry and what we would need to know to ground the inquiry on a solid base of observable facts had become glaringly apparent. Solutions to the problem of language origins, it was felt, could never be more than fairy tales, one person's views being as good as another's. Thus Dwight Whitney, writing in 1873, declared that "no theme in linguistic science is more often and voluminously treated...with less profitable result in proportion to the labour expanded." He judged the "greater part of what is written upon this topic [of language origins]" to be "mere idle talk." (Whitney 1873-4, as quoted In Jespersen 1922: 412). As a result, the whole topic became disreputable. As it is common to note, in 1865 the Linguistic Society of Paris explicitly banned all submissions on this topic, and the London Philological Society followed suit a few years later.[15]

Notwithstanding this, from the late nineteenth century until the beginning of the period when the topic was to become fashionable again, there were scholars, linguists among them, who continued to contribute to the discussion. For example, important ideas were contributed by Charles Darwin and Otto Jespersen, as we shall see. However, these

[15] For a history of inquiry into language origins up to the end of the nineteenth century, see Stam (1976).

contributions remained isolated. They were neither a part of, nor did they initiate, any thread of discussion. The modern revival, which began in the United States in about 1960 and from which contemporary debate on the topic can be seen to have stemmed, was due to new initiatives by scholars who were taking into consideration information and ideas that had not been available before.

If one were to name a year to be the birth-year for the current language origins debate, one might well choose 1964. This was the year in which Charles Hockett, a well-established linguist reared in the then dominant structuralist tradition associated with Leonard Bloomfield, together with Richard Ascher, an anthropological palaeontologist, published an an article in *Current Anthropology* entitled "The human revolution" (Hockett and Ascher 1964). In this article the authors made a bold attempt to bring together what was then known about hominid palaeontology, new understandings of the environmental changes in Africa, and speculations about the important consequences of bipedalism, to suggest what may have been involved in the evolutionary emergence of humans. However, almost for the first time within the framework of discussions of this sort, they presented the steps and stages involved in the evolution of language. As they pointed out, in previous discussions of human evolution from a palaeontological perspective, language was generally overlooked or dealt with purely in terms of evidence for the presence or absence of articulate speech. In this article, the authors make use of Hockett's notion that human language is a complex of "design features", some of which are found to be in common with other animal communication systems (see Hockett 1960). By setting out these features it was possible to specify more precisely what it was that had to evolve to bring into being a system of communication with all the features of human language. On this approach, language did not evolve as a single package, but in a more piecemeal fashion, each separable feature having its own evolutionary history. Hockett and Ascher supposed that an early step would have been for a primate call system - their proto-hominid model was based on what was then known of gibbon calls, which had been described with some thoroughness by C. R. Carpenter (1940) - to be transformed from a closed system to an open system through 'blending', a process by which calls of different meanings could be joined together to make calls with more complex meanings. It was then further transformed by the discovery of the possibility of what Hockett referred to as "duality of patterning", according to which meaningful units within the system are created through combinations and re-combinations of sound units that have no meaning in themselves but which function to keep meaningful units distinct from one another. Hockett and Ascher's article, in accordance with *Current Anthropology* practice, was accompanied by commentaries by a number of other scholars. In this way, this discussion of language origins was brought to the attention of a wider audience of scholars in disciplines such as palaeoanthropology, archaeology, anthropology, and even linguistics. The article had the effect, thus, of beginning the process of re-legitimating the topic of language origins.

Shortly after this, and from another quarter, came the publication of Eric Lenneberg's *Biological Foundations of Language* (1967). In this book Lenneberg set out to show, in great detail, the biological features of humans that seemed to be special adaptations for speech and language, arguing that humans are biologically specialised as speaking creatures. This book contained an appendix by Noam Chomsky in which the idea that humans

are equipped with what Chomsky called a "Language Acquisition Device". He suggested, that is, that humans have an innate device that shapes their liguistic productions, as they begin to become capable of them, according to pre-established grammatical patterns. He proposed the idea that humans have a "language organ" much as they also have a liver, a heart, and so forth.

Chomsky had, already, with his publications of 1957 (*Syntactic Structures*) and 1965 (*Aspects of the Theory of Syntax*), initiated what has often been regarded as a "revolution" in American linguistics, of which an important feature was the directing of linguists' attention toward the *faculty* or *mental capacity* for language as being the true object of linguistic study. This idea, that language was to be understood as a cognitive operation, meant that linguistics was to be regarded as a branch of *mental* science. This firmly re-set the study of language within an organic, and therefore, biological framework. As a consequence, the issue of the biological origin of language was again relevant.

A next important development in the modern debate about language origins, was the announcement by Allen and Beatrice Gardner, in 1969, that they had successfully taught a chimpanzee to use, in an apparently symbolic manner, manual expressions borrowed from American Sign Language (Gardner and Gardner 1969). This created a considerable sensation. Chimpanzees had long been recognised as being very close, biologically to humans and it seemed that, with a little training, it ought to be possible to teach them to speak. Valiant efforts had been made by the Kelloggs' (in the 1930s) and again by the Hayes' (in the 1950s), who had tried the experiment of rearing a baby chimpanzee in their own home as if it was a member of their family (Kellogg and Kellogg 1933; Hayes 1951). Their efforts to teach the chimpanzee to speak in both cases ended in failure. Now, however, with the Gardners' work, using the medium of manual action, a languaging ape seemed possible.

The achievement of the Gardners' sparked much controversy, since this seemed to suggest that the great Rubicon separating man from beast that Max Müller had defined in 1873 and which he had declared no animal would ever cross, was now about to be crossed.[16] At the same time, it prompted a real effort to look into the true nature of sign language. Some years before, in 1960, William Stokoe had published what is generally taken to be the first attempt to analyse "a system of visual communication as used by the deaf" (as his publication was titled - see Stokoe 1960) using a framework derived from the so-called structuralist analysis of spoken languages, which showed that such a system in many ways had its own linguistic structure. Stokoe's work aroused interest and gained acceptance rather slowly, however. It was not until the work of the Gardners gave urgency to the question of the linguistic status of sign language that work commanding wider notice was commenced. Thus the Gardners' work prompted Ursula Bellugi to begin her project on sign language at the Salk Institute which led to the publication of *The Signs of Language* (1979). This played a very important role in demonstrating that these systems have all the characteristics needed to deserve the label (and therefore the prestige) of 'language' and in

[16] For an account of this see Radick (2008). For the controversy that the whole phenomenon of language-taught apes gave rise to, see Sebeok and Sebeok (1980) and Wallman (1992) among many other publications.

showing how interesting it would be to delve further into them.[17]

But the Gardners' achievement was also, of course, of great importance for the development of interest in the question of language origins. It was one of the main pieces of evidence that Gordon Hewes drew upon in his "Primate communication and the gestural origins of language" which he published in *Current Anthropology* in 1973. In this article, Hewes drew together a wide range of evidence, including findings from the then recent new work on the behaviour of chimpanzees in the wild, recent work on the neurological bases of primate call systems, as well as anthropological and historical findings, to argue that language first emerged in the gestural modality. He suggested that a form of gestural *protolanguage* was established, which then, subsequently, was transposed into a spoken form.

Hewes' article, followed as it was by extended comments by many scholars, had a greater impact that the earlier article of Hockett and Ascher. Perhaps this was because the Gardners' work had made the question of language origins more pressing. A major symposium on language origins held at the New York Academy of Sciences in September of 1975 then followed. This symposium, which resulted in a very large book (Harnard, Steklis and Lancaster 1975), involved the participation of many prominent scholars, including several linguists - Noam Chomsky among them. This further contributed to the serious attention that the topic of language origins was beginning to receive in academic circles. Thereafter, investigations extended in every direction: the neurology of speech, the nature of sign language, the study of human gesture, in palaeoanthropology, in linguistic theory, in the observational study of the behaviour of apes and monkeys in the wild.[18]

Further impetus was given to this discussion in 1990 by an article in *Behavioral and Brain Sciences* by Steven Pinker and Paul Bloom. This article accepted the theoretical framework advocated by Noam Chomsky. However, the authors argued that the human specialisation for learning a grammatical language could have evolved by way of a conventional neo-Darwinian process. The impetus that this discussion provided was part of what lay behind the subsequent organisation of a successful series of biannual international conferences on language origins, under the inspiration and guidance of Jim Hurford and Chris Knight, among others.[19] The series of volumes that

[17] Kendon (2002) summarises this history. See also Bronowski and Bellugi (1970) and Bellugi (1981).

[18] Although it has been claimed that this was the first symposium to be held on language origins sponsored by a major scientific academy since the essay competition promoted by the Berlin Academy of Sciences in 1769 (essays submitted in 1771, with Herder winning first prize), a symposium on this topic was held in 1972 in Toronto at the meetings of American Anthropological Association. This was published as Hewes, Stokoe and Wescott (1974) and it should not be overlooked. It was a result of this meeting that William Stokoe became interested in language origins (leading, ultimately, to his book of 2001, among other things). Furthermore, the publishing company Linstok Press, founded by William Stokoe and which was the first publisher of the pioneering journal Sign Language Studies, was apparently started as a way of publishing the 1972 symposium which, at the time, no other publisher was prepared to touch!

[19] The first of these conferences was held in Edinburgh in 1996. The most recent, known as Evolang 8, was held in 2010 in Utrecht. Volumes published from these conferences, or from related occasions, include Hurford, Studdert-Kennedy and Knight (1998), Knight, Studdert-Kennedy and Hurford (2000), Wray (2002), Botha and Knight (2009a, 2009b)

these conferences have produced, together with an ever increasing number of articles and books on the topic, testifies to a veritable explosion in interest.[20] It is as if, now, at last, there has developed a sense that an understanding that can lead to a solution is somehow within sight and, as a result, is worth struggling for.

However, anyone who gives even the briefest consideration to any of these more recent developments in the literature will discover that if anything intelligible is to be said on this topic it will be necessary to have an acquaintance with a very broad range of disciplines. Nowadays, whatever one's discipline, in beginning to explore this literature, one is likely to find oneself drowning in a vast sea of publications on topics that seem very far-flung from one another. One must read about bird song, fossils of the hyoid bone of early hominids, neuroimaging explorations of brain activity, sign languages, computer simulation studies of the development and change of artificial languages in artificial communities. It is rapidly becoming very difficult, if not impossible, for any one scholar to hold all of these diverse lines of investigation together and to arrive at an informed position.

Thus it is that the publication of *The Evolution of Language* by W. Tecumseh Fitch (Cambridge University Press, 2010) is to be greeted with both relief and enthusiasm. Although this is a long book (over 600 pages, altogether), it is written with such clarity and elegance that reading it is as pleasurable as it is informative. The book does us all a great service.[21] Fitch lays out almost all of the major components that any one would need who wishes to gain a grasp of how the problem of language evolution is currently being approached. As Fitch states (p. 3), his book is meant to provide "an overview of many different perspectives on language and the many types of data relevant to the debates, accepting each as a necessary component of some future synthesis." In writing this book he says (p. 3) he has sought to fill the need for a "dispassionate survey of the available hypotheses and an even handed evaluation of their strengths and weaknesses in the light of currently available data."

What Fitch's book contains

This prospectus might lead one to expect a rather bland style, but just the opposite proves to be the case. Fitch is strongly committed to an approach that is fully informed by modern evolutionary biology. Especially important, for him, is the value of the comparative approach. As he explains, there are two aspects to this. On the one hand, by comparing species who are within the same descent grouping, or clade, as we do, for example, when we compare humans with chimpanzees or other great apes, and by identifying features that are homologous with one another in these various species, we can hope to reconstruct what traits characterised the common ancestor of the species within such a group. By means of this approach, Fitch attempts to reconstruct what features must have belonged to what he refers to as the Last Common Ancestor of humans and great apes, or LCA. Doing so allows us to be clear about what sorts of evolutionary transformations must have occurred to

[20] See, for example, Johansson (2005) who lists more than 2000 references, the majority of them dating from 2000 and after.

[21] Perhaps the book was finished in some haste. Both its Author Index and its Subject Index are woefully inadequate. This is unfortunate in a book which could be a useful reference work.

give rise to modern humans. On the other hand, it is also extremely useful to compare what appear to be parallel adaptations. For example, with regard to human speech, we find nothing which bears any resemblance to it within the group of species from which we reconstruct the LCA for apes and humans, although we do find certain cognitive capacities in the LCA that are also a part of human language. This means that speech is something that must have evolved after the divergence of the hominid line from the line that led to the great apes. On the other hand, in several different, unrelated vertebrate groups, including song birds, parrots, humming birds, bats, whales and dolphins, seals and elephants, we find capacities for more or less elaborate vocalisations, in some species used in a song-like manner, which are learned, rather than innate. Vocal learning and imitation are fundamental to human speech so, given these other vertebrate lines in which this is also found, it would be appropriate to study these to see what light this may throw on the kinds of evolutionary processes may be involved in the emergence of this characteristic. Indeed, the parallels between bird song and aspects of human speech have impressed investigators ever since Darwin drew attention to them in his *Descent of Man* (1871), and as a result there is a considerable body of literature investigating bird song, including its neurological basis (Catchpole and Slater 2008 is a recent survey).

Since this is a book about the evolution of language, Fitch includes in the first section of the book, two chapters which set out, first how language might be approached from a biological perspective, and then how language is to be defined. Here Fitch does not set up a categorical definition. Rather, he shows how we must think of language as a "suite of different but interrelated mechanisms" (p. 511). His approach is similar to that of Charles Hockett (Fitch acknowledges his debt to him) who, as we noted, proposed that language be regarded as an assemblage of "design features". Fitch's own list of features (given on p. 141) is rather different from those of Hockett, most notably, perhaps, because he includes pragmatics. Fitch notes the importance of using context to make inferences about meaning, the human capacity to take the other's perspective and adjust his communicative acts accordingly, and what he calls *Mitteilungsbedürfnis*, a German word that refers to the urge people have to express their thoughts and share them with others. Fitch suggests that this is an important human drive, that must have played an important role in the development of language.

As Fitch argues, it seems likely that each of these design features or components of the suite that we refer to as 'language' has had a different evolutionary history. From this point of view, then, 'language' did not evolve as a single thing, but came about as a result of a particular combination of separately evolved traits or features. Thus we may expect rather different considerations are needed to throw light on the origin of speaking from those that might be needed to throw light upon how signals of any sort came to have semantic significance. The problem of the development of syntax may require different considerations again, while the subsequent development of languages as shared communication systems, and how this has shaped it and how it has shaped the niche or niches in which humans have come to live, and how this may have had consequences for our further evolution, these also are questions that demand somewhat separate treatments.[22]

[22] For an exposition niche construction theory in relation to language evolution see Odling-Smee and Laland (2009) and see also Bickerton (2009).

If we are to understand human language from the point of view of evolutionary biology, it is obviously important to compare human cognitive and communicative capacities with those of other species, not only looking at monkeys and apes, but much more widely. From the middle of the last century onwards there has been a great expansion of work on the cognitive and communicative capacities of other primates, of birds, as well as of certain other groups, such as wolves and dogs (Hauser 1996 is a recent survey). Appropriately, Fitch provides a long chapter which reviews much of this work. Here he shows how greatly our understanding of animal cognition and communication has changed. As a result of decades of careful observations of animals in the wild, often combined with some very sophisticated experimentation carried out in the contexts in which animals live, especially using the technique of 'playback' by which one can manipulate the calls and cries of conspecifics to see how they react to them, the conclusion, as Fitch summarises it, is that "animals possess a rich cognitive world, but are quite limited in their ability to communicate their thoughts to others." (p. 201).

Accordingly, it is clear that the common ancestor of humans and apes must have had a rich cognitive life and must have had a sophisticated capacity to interpret the vocal signals of its conspecifics and probably those of other species as well. However, it must have been much more limited in its capacity to engage in communicative acts that could serve in wilfully informative ways. According to current evolutionary theory regarding animal communication, however, there are many difficulties in accounting for how a system of cheap to produce, trustworthily informative communication signals that is characteristic of human language could have evolved. Very particular circumstances that created the development of co-ordinated attention and honest communication must have come to prevail in human evolutionary history to make possible the emergence of the sort of system language is. As Fitch says (p. 202), how this came about is a "central question for theories of language evolution." In a later chapter, Fitch offers his own solution to this problem in terms of a theory in which communication systems can be shaped by kin selection. We will return to this below.

The two chapters on language and the chapter on animal cognition and communication are included in Part I of the book which is titled "The lay of the land: an overview of disciplines and data relevant to language evolution." In addition to the three chapters discussed above, this part also includes a chapter on contemporary evolutionary theory. Here basic notions such as natural selection, sexual selection, kin selection and inclusive fitness are explained, fundamental concepts in current molecular genetics are expounded, and recent developments presented, such as how developmental phenomena are to be understood in evolutionary terms (so-called "evo-devo"). This chapter will prove useful to anyone needing a quick refresher on these issues, and it is useful to refer back to it when reading later sections of the book, which often make use of these ideas.

Part II of the book continues with the presentation of data and theories that are needed for developing an evolutionary approach to language, but now concentrating more specifically on the group of organisms that include humans. After a whirlwind tour of biological evolution from the beginnings of life to the emergence of the common ancestor of apes and humans in the Oligocene (from about 20 million years ago onwards), there is a chapter that

attempts to describe the features of the Last Common Ancestor of apes and humans (referred to as the LCA). This is followed by a chapter which surveys the current state of hominid palaeontology and archaeology.

With Parts I and II of the book, thus, Fitch has sought to equip the reader with much of the background that is needed to tackle some of the specific issues in the study of language evolution. Now, in Parts III and IV, Fitch turns to a detailed discussion of issues that are specific to the evolution of language. Part III contains three chapters devoted to the evolution of speech. In Part IV we find a detailed discussion of each of three different 'phylogenetic models' of language evolution: models which propose a lexical protolanguage, such as those of Derek Bickerton or Ray Jackendoff (Chapter 12), gesture protolanguage models, such as those proposed by Gordon Hewes and Michael Arbib (Chapter 13), and "musical protolanguage" (Chapter 14), according to which speech first emerged as a kind of song-like vocal communication system, acquiring the segmental character and semantic functions of modern speech only latterly. This theory, originally elaborated by Charles Darwin, subsequently developed by Otto Jesperesen, and argued for more recently by Brown, Mithen and Falk, among current writers, Fitch sees as being in some ways the most promising of all.

The final chapter of the book is a summary and an evaluation of future prospects. Fitch concludes that all of the solutions that have been proposed to the various specific problems of language evolution have something to offer, but that no single author has been able to offer, up to now, a unified view that is consistent with all available data. Nevertheless, he concludes, "an empirical, hypothesis testing approach, embracing a comparative multi-component view, offers realistic hopes for real scientific progress in the next twenty years or so." (p. 512).

In what follows, I will treat in a little more detail what emerges from Fitch's discussion of the evolution of speech, and the three 'phylogenetic models' of language origins.

The evolution of speech

Regarding the evolution of speech, Fitch concludes, first of all, that little can be derived about the origin of the speech apparatus from the comparative study of fossils. Fitch shows that even if it were possible to reconstruct the vocal tract of Neanderthals or even *Homo erectus*, as some have tried to do, this would tell us little about the speech capacities of these creatures. Philip Lieberman had attempted to reconstruct the vocal tract of Neanderthals and had argued that because the larynx in this kind of human appeared to be set very high, the Neanderthal would have lacked the pharyngeal space that is characteristic of the modern adult human, when, soon after birth, the larynx descends to a lowered position. Fitch argues, on the basis of analyses of the acoustic capacities of the vocal tracts of a number of different animals, including the tiger, the seal and the red deer, as well as the chimpanzee, that, contrary to what has been believed before, these animals would be capable of producing a human range of frequencies. Furthermore, he cites recent work in which the actions of the vocal apparatus are observed during vocalisation by using x-ray cine-photographic techniques which show that the position of the larynx at rest in animals such as the red deer is quite different from its position during vocalisation, when it can be

lowered considerably, thereby greatly altering the shape of the vocal tract. It thus remains quite possible that this kind of flexibility in the position of the larynx also occurred in the Neanderthal, something which cannot be gathered from the study of fossils. The only piece of fossil evidence that, according to Fitch, might bear on whether speech might have been present or not has to do with the size of the spinal canal in the thoracic section of vertebral column. In modern humans and Neanderthals this is larger than it is in other primates, and this could have to do with the more extensive innervation necessary for the muscles involved in breathing, the control of which is more elaborate because of the fine vocal control characteristic of speech. Evidently, expansion of the thoracic spinal canal began sometime in the million year period before the emergence of *Homo ergaster* , and before Neanderthals. This could suggest that in this period there was a development of increased vocal control. This could be compatible with the emergence of speech or with the emergence of some form of elaboration of vocalisation that could be a precursor to speech. Nevertheless, Fitch's conclusion from this discussion of the comparative fossil evidence is that little can be said about the timing of the emergence of human speech.

From his discussion of comparative studies of the vocal tracts of non-human primates and other mammals Fitch concludes that it does not seem to be the anatomical form, or indeed the articulatory apparatus of tongue, lips and larynx that marks out humans as specially capable of speech production. Rather, what is special lies in how vocalisation is neurally controlled. Chapter 9 provides a detailed review of recent work on this matter. Drawing upon work by Jurgens and his colleagues, especially,[23] It is concluded that there are direct cortical connections between the motor cortex and the motor neurons that control the muscles of the tongue and larynx. In most mammals, it seems, including non-human primates, the connections between motor cortex and the muscles of tongue and larynx are mediated by interneurons in the brainstem. In humans, the connections are direct. This may underlie the ability that humans show, that other primates do not, of being able to co-ordinate in a voluntary manner, actions of the vocal folds in the larynx with actions of the tongue and lips. It is perhaps this that makes possible the voluntary use of the voice in vocal learning and imitation, so fundamental for the capacity for speech.

Song birds, who are capable of vocal learning and imitation and of course produce very complex vocalizations, also have direct connexions between the frontal motor cortex and the syrinx (the apparatus that produces sound in birds). This is certainly a most interesting parallel. However, birds are quite different from mammals and parallels with them can only be indirectly illuminating for understanding the development of human vocal capacities. There is, however, a mammal that is capable of complex vocal imitation, and that is the seal. Fitch suggests it would be very worthwhile to investigate the neural connections of the vocal apparatus in this animal for this could shed a useful light on the evolution of this aspect of human vocal capacity which is crucial for speech.

Fitch concludes the chapter on the neural basis of speech with a discussion of the molecular genetic basis of motor control of vocalisation. Here we find a discussion of the FOXP2 gene that has attracted so much attention in recent years. As has been widely reported, various members of a family living in London were found to suffer from certain defects in speech production and it was found that these members had a deleterious

[23] See, for example, Jurgens (1995, 2000, 2002)

mutation in a regulatory gene known as FOXP2. This suggested that this gene plays a role in the development of fine motor control of the musculature involved in vocalisation. Comparative studies have shown that the FOXP2 gene is highly conserved and found in all vertebrates, but its human form differs in a quite specific ways from the form of this gene found in chimpanzees. Recently it has been shown that the human form of FOXP2 is also found in Neanderthals, so if the specific form that it has is indeed connected to a capacity for speech, this was present at least 400,000 years ago. What is intriguing is that it has been shown that the FOXP2 in song birds is also involved in the development of fine vocal control. As Fitch stresses, the FOXP2 gene is not a "language gene." Its discovery, however, is the first time a genetic regulator has been found that affects the fine motor control of the vocal apparatus, which is crucial for speech. That it seems to play a similar role in song birds only strengthens the interest of the apparent parallels between song in song birds and speech in humans.

Whatever changes may have come about in neural organization that made speech possible in humans, these need not have been all that radical. In Chapter 10 Fitch summarises and synthesises the work of several investigators (including Jurgens, Philip Lieberman, MacNeilage and Deacon) in which separate attempts have been made to present syntheses of what is involved in speech production and its possible evolution. From this it emerges that whereas the lip, jaw and tongue movements crucial to the production of the acoustic variations characteristic of speech are all present and under voluntary control in chimpanzees, where they are employed in the processing of food and in certain other manipulatory activities, as well as certain non-vocalised, intimate kinds of communicative activity, as in lip smacking and grooming, what is novel in humans is the ability to coordinate these voluntary movements with voluntary control of the vocal folds in the larynx, controlling phonation and pitch.

This means that the behavioural system that enables humans to produce the complex of actions we term *speech* is a newly developed coordinative use of an already existing, evolutionarily more ancient system. As Fitch puts it (p.371), "speech has been 'tinkered' together from old parts". This is, of course, utterly characteristic of biological evolution. Changes occur in the re-assembling and re-coordination of already existing systems and rarely involve the emergence of something completely novel.

As Fitch makes clear, speech, although fundamental for language, is not to be identified with it. An account of the evolution of speech is not the same as an account of language evolution. So it is that in Part IV phylogenetic models of language, not just speech, are discussed. After a brief historical chapter in which Fitch describes some of the earlier contributions, such as those of Condillac, Monboddo, Rousseau and Herder from the eighteenth century, and Darwin's theory of language origins and Max Müller 's attack on this in the nineteenth century, Fitch presents three chapters in which, respectively, he considers theories about lexical protolanguages, the idea that protolanguage first emerged as a form of gestural expression, and finally the idea that language emerged as a differentiation from a system of vocal expression which had many of the characteristics of song.

Lexical protolanguages

Chapter 12 begins with a review of the idea of 'protolangauge', as this has been developed by Derek Bickerton (e.g. Bickerton 1990, 1998) and subsequently, in a slightly different way, by Ray Jackendoff (e.g. Jackendoff 1999). According to Fitch, proponents of protolanguage all agree that pre-linguistic hominids and other primates, indeed, mammals generally, all were capable of entertaining conceptual models of their worlds. Protolanguage emerged first as a capacity to match signals *referentially* to these concepts. It is important to note that this is not exemplified, as some have supposed, by the so-called "functional referential" signals of primate alarm calls, such as those made famous by Cheney and Seyfarth in their study of vervet monkeys (Cheney and Seyfarth 1990), for in such cases these alarm calls, though differentiated according to type of predator, are not used in different contexts to *refer* to a given predator. Rather, they serve as a way of alerting fellow monkeys to different kinds of danger, when that danger is present. Exactly how functionally referential signals came to be *conceptually* referential, and so become units in a protolanguage is not anywhere clearly explained, however, and this does remain one of the unsolved mysteries of language origins.

Bickerton's original concept of protolanguage was, essentially, that the first hominids to begin to acquire a protolanguage would have developed a lexicon, but there would be no syntactic organisation to their utterances. Bickerton proposed as models for protolanguage the asyntactic utterances of language trained apes and the earliest stages of language acquisition by children, where single words are used but without being a part of any grammatical sentence. He argues that the transition to syntax was sudden, and came about as a consequence of a mutation induced re-organisation of neural structures in the brain. As Fitch points out, apart from the rather uncertain value of the data from language trained apes, the actual way in which children appear to acquire syntax seems gradual and does not seem to support Bickerton's idea. Better support for it comes from studies of transitions from pidgins to creoles. Bickerton himself first came to prominence in 1981 with the publication of his book *The Roots of Language*, which argued that the seemingly abrupt way in which children, in refashioning a language as their own, creating a creole out of the language materials of the pidgin which their adults spoke, suggested an innate component to the stucturing of language which Bickerton called a *bioprogram* (Bickerton 1981). This idea has strongly informed the interpretation of the findings of Kegl, Senghas and colleagues in their study of the emergence of Nicaraguan sign language. This developed as an apparently new language when very young deaf children appropriated elements of what was a mixture of home sign systems, which they encountered when they entered a school for the deaf that had not itself been in existence long enough to establish a stable shared sign language of its own (Kegl, Senghas and Coppola 1999).

Jakendoff (1999) presents a modified and extended version of Bickerton's idea of a protolanguage. Unlike Bickerton, Jackendoff proposes that it is possible to identify intermediate stages bewteen the grammarless lexicon of a protolanguage and the emergence of fully grammatical speech. He also recognizes the importance of the role of the combinatorial nature of phonology in the generation of syllables which, for him, being combineable in multiple ways, provides the basis for the development of an unlimited pool of words.

Taking these two models of protolanguage together, Fitch then goes on to show that current evolutionary theory poses serious problems for the idea of a protolanguage, at least as it has been formulated hitherto. The basic problem is this. The assumption that all the proponents of protolanguage rely upon, indeed the assumption relied upon by so many who discuss language evolution, is that it would be obviously advantageous for hominids to communicate with one another, sharing information. However, as has become clear, an evolutionary explanation for the emergence of cooperative information sharing is very hard to formulate. This was a problem that troubled Darwin himself, and it is only in fairly recent years that a plausible solution has been arrived at. It is a problem because although a given *group* might benefit in comparison to another if more and better information was shared among its members, selection does not work at the group level. It works at the level of individuals, and why does it benefit an individual to share valuable information with another? It would usually be better for an individual to give misleading information to others, for then it would be able, for example, to take advantage of food sources without letting others know about them. As Fitch says, the free sharing of propositional information that language makes possible is one of the "central oddities of our species from an evolutionary viewpoint; one that cries out for selective explanation." (p. 425).

The solution that Fitch offers, which has become widely accepted elsewhere in biology but has not, according to him, received much attention in discussions of language evolution, is to apply the theory of *kin selection* . From the viewpoint of current evolutionary theory, to share information among close relatives, especially dependent offspring, gives selective advantage to all those who share the same genes. So that, for selfish genes, for a mother to help her children is advantageous because this contributes to the survival of the shared genetic makeup. Once this point is accepted, the evolutionary mystery of information sharing among honeybees, for example, is cleared away - for all worker members of a beehive are sisters of one another. There is now a considerable accumulation of observations that suggest that animals related to one another do share information co-operatively if they are related, but do not if they are not. To take just one example, among ground squirrels, when outside their burrows a ground squirrel will emit alarm calls when it sees a predator, but only if it is in the company of kin-related individuals. A male ground squirrel who has recently joined a group as a mate, will not emit alarm calls at all, unless his own offspring are present. Similarly, vervet monkeys, famous for their differentiated alarm calls, do not emit alarm calls when they are among unrelated individuals. There is good reason to suppose, thus, that the honest sharing of information can develop among kin groups, when it does not among unrelated individuals. Emitting an alarm call, while useful to others, makes the individual who emits the call more vulnerable to predation, but this will not disadvantage its genes if, in emitting the alarm, it thereby reduces the vulnerability of its relatives and thus improves the inclusive fitness of those who share these genes. As Richard Dawkins made clear in his *Selfish Gene* (Dawkins 1976), it is the differential survival of genes, not of specific individuals, that counts in evolution.

Fitch argues, thus, that *kin selection* is the process that most likely made it possible for reliable information sharing to develop among primates and he emphasises the importance of this for understanding how a communication system like language could have come

about. He suggests that it was the advantage gained, particularly by the highly dependent young, of reliable information about the environment, how to obtain food, the kinds of dangers, what to avoid, and so forth, that would have been selected for, for in this way whole groups of related offspring could have been advantaged. He suggests that the speed and ease with which children learn language, and the way in which language exchanges develop between parents and offspring support this notion, a feature of human communication which, he suggests, is hard to explain without the idea of kin selection.

Fitch points out that the selective advantage of sharing information with related others can explain, or at least provide the circumstances in terms of which we can explain how the sharing of propositional information can have a selective advantage. It could thus provide an account of the circumstances in which the conveying of propositional information by communicative signals could emerge and thus lay the foundations for a protolanguage. To understand how, among humans, the use of this mode communication came to be extended to include *unrelated* individuals, on the other hand (and language is obviously used in this manner), other processes need to be invoked.

Accordingly, Fitch proposes a two stage model for the emergence of protolanguage and how it came to be a system that can be shared reliably beyond close kin. He suggests that the extension of the use of language beyond kin groups would not need any further biological changes. Once the propositional informational value of communicative acts came to be established, its further extension, "the implementation of regulated information exchange between adults" (as Fitch puts it) could "evolve culturally, as a set of social norms, without any further biological specialisations beyond those already present 'for free'..." (p. 428).

This "second stage" of Fitch's model deserves a good deal more elaboration. This is not provided. However, his discussion suggests that it would be interesting to examine further who, in fact, does share information with whom. If one reflects on this one can see that the development of the sharing of propositional information beyond circles of kin probably happened quite slowly and would have been clearly related to the extent to which it became possible for humans to extend kin categories to non-kin persons. The classificatory kin systems still in use today among Australian Aborigines could provide an illustration of how this kind of extension could come about. Today, in "advanced" societies, information sharing can still be highly differentiated. People are quite selective in who they talk to and what they tell others and biases related to kinship can often be strong. A person who sees another as similar in background and culture is more likely to consider them trustworthy. If the rules of information sharing in groups were to be examined it would probably emerge that these would reflect patterns of kin relations or patterns of relationships which could have a kinship interpretation.

Now although it seems that Fitch's emphasis on kin selection as having a crucial role in creating the circumstances in which a system of trustable low-cost signals conveying propositional information could have evolved and goes further than any other competing model in making this evolutionarily plausible, as Fitch himself recognises, at least two very important issues are left unresolved. The first is the origin of syntax. The second and, in some ways more fundamental issue, concerns the origin of the actual signals employed in the creation of utterances. What behavioural material, we might ask, came to be

fashioned for the units of the protolanguage and how did these units come to have the semantic significance that enabled them to function in a protolanguage?

Fitch's treatment of the problem of syntax is fairly brief. We have already mentioned Bickerton's idea that grammar somehow emerged in one fell swoop, as a result of a 're-wiring' of the brain brought about by some mutation. As we have mentioned, Fitch rejects this suggestion, and it does indeed seem very unlikely.[24] Fitch seems to prefer Jackendoff's stage-by-stage approach, but few details are given regarding how these stages came about. Fitch's discussion of the problem, however, does point the reader in the direction of two possible avenues that would warrant further exploration. Both of these suggest ways in which the emergence of syntax can be understood as developments from already existing biological systems. That is, Fitch does not see 'syntax' as being a somehow separate phenomenon, that emerges autonomously, but sees it as an elaboration and specialisation of already existing dispositions. These are, on the one hand, conceptual constructs - that is, constructs that arise from the basic way in which all vertebrates, not just humans, understand the world of things and events and how events may relate to one another. On the other hand, the complex hierarchal structures of extended sentences could be understood as deriving from the way in which extended sequences of motor control are organised. In skilled and goal directed action, as in tool making, feeding routines, hunting routines, and the like, a kind of syntactic organisation can be detected. Fitch agrees that important aspects of syntactic organization could be derived from this.

The second, and more fundamental problem is the origin of the units of action that serve as referential signals, and how they came to do so. As Fitch points out, all of the proposed protolanguage models, including the 'gossip' model of Robin Dunbar (e.g. Dunbar 1996), also discussed by Fitch, as well as his own idea of it, take for granted that 'meaningful' signals are already available. This leads to the two final chapters of the book: Chapter 13 which discusses the idea of a gestural protolanguage, and Chapter 14 which discusses what Fitch calls "musical protolanguage" - which is the idea that speech emerged from a form of vocalisation that was similar to a kind of singing.

Protolanguage as gesture

In discussing the idea that protolanguage first emerged as a form of gesture, Fitch first reviews in some detail the proposal to this effect put forward by Gordon Hewes in 1973. We already mentioned this publication in the introductory part of this essay. Hewes' article of 1973 is a landmark publication and, in many ways, must be seen as initiating the modern conversation on language origins. Hewes, first of all, was impressed with the achievement of the Gardners in teaching a form of manual gesture to a chimpanzee. This was in such contrast to the great difficulties that had earlier been encountered in trying to teach chimpanzees to speak. This, together with the flexible way in which chimpanzees and other apes were already known to make use of gesture in communication, suggested to Hewes that the adoption of gesture as a medium for language would be the path of least resistance, biologically. Ape and monkey vocalisations were understood to be limited and stereotyped in their repertoires and these did not seem to offer themselves as a model from

[24] Bickerton (2009) no longer supports this idea.

which anything like spoken language could be derived. There was also neurological evidence that suggested that non-human primate vocalisations were not under voluntary control. In addition, Hewes pointed out that gesture could readily still be used by humans for communication (he cited reports of explorers encountering strange peoples in distant lands being able to engage in complex communication via the use of gesture) and he also referred to the existence of sign languages. Hewes recognised, however, that to propose a gestural origin for language immediately ran into the fact that modern languages are *spoken*, so he was faced with the challenge of proposing how and why there should have been a changeover to using speech for language.

He suggested a number of reasons that might account for this. These included the idea that speaking would be more convenient as a form of linguistic communication, such as that it could work in the dark or that it made it possible to talk and do things with the hands and the same time. He also suggested that a phonetic form of language would make large vocabularies possible and would provide a better basis for lexical items to be stored and retrieved from memory. He also was favourable toward the "tongue gesture" hypothesis put forward by Sir Richard Paget (Paget 1930), according to which the mouth, in making movements parallel to gestural movements by the hands, would, if these were accompanied by vocalisations, produce complex articulated sounds which could serve as acoustic indices of these movements. Paget's observations, which led him to suggest mouth-hand synergies that could lead to a sort of mouth gesturing, does receive some modern support in recent work by Gentilucci and his colleagues (see Gentilucci and Dalla Volta 2007), and Rizzolatti and Sinighalia (2006) have recently sought to revive this idea. Recent interest in so-called 'echo-phonology' in signers, in which the mouth sometimes moves in sympathy with hand movements might also be mentioned here (see Woll 2009). However, as Fitch concludes, none of these proposals by Hewes ultimately provide a plausible model for the selective pressures that might have led to a switch from the manual to the spoken modality for language or for how the transfer might have occurred.

Subsequent advocates of the 'gesture first' scenario for language origins include William Stokoe, who pioneered the modern linguistic study of sign languages, and his colleagues David Armstrong and Sherman Wilcox (see Armsrong Stokoe and Wilcox 1995), and Michael Corballis (2002). Fitch does not consider their contributions in any detail (although he does mention them), perhaps because (or so he seems to imply) to him their suggestions are in many ways similar to those originally made by Hewes. Although this is arguable, it should be pointed out that Stokoe and his colleagues, especially, were able to bring to bear on the argument a much more sophisticated view of sign language than was available to Hewes and their contribution, especially as expressed in the book they jointly published in 1995 and also the contribution of Stokoe's last book (Stokoe 2001) deserves a much more ample treatment than Fitch gives it here.

Instead, Fitch discusses the more recent ideas of Michael Arbib, who has taken into consideration the findings on so-called *mirror neurons* (see Arbib 2005). Mirror neurons are neurons, first discovered in the motor cortex of the rhesus monkey, which are found to be active both when the monkey observes a grasping action being made by another monkey or by a human being and when the monkey itself performs a similar grasping action. It suggests that the observation of actions by others can produce patterns of neural activity that

are similar to those that occur when the action itself is performed, and this suggests a neural basis for the understanding of others. It can provide a basis for *parity* of communicative actions (in the theory of Rizzolatti and Arbib 1998), that is, for an action to mean the same thing for both actor and recipient, a necessary condition for communication. Arbib attaches much importance to the fact that these mirror neurons were found in a region of the macaque monkey's brain that is considered to be homologous to Broca's area in the human brain, an area known to be much involved in human speech. As first understood, it was proposed that the neural circuitry of the mirror system provided the foundation for the audio-motor mirror capacities which, presumably, are at the foundation of the human capacity to speak.

In its original formulation, the mirror system hypothesis was criticized on a number of grounds. In particular it was pointed out that rhesus macaques, and indeed other monkeys, do not imitate, and the function of mirror neurons in imitation, a process fundamental to the development of any sort of shared communication system such as language, is thus not clear. It has also been pointed out that although mirroring might allow the recognition of the grasping actions of others and, with some additions, allow for the other to imitate such actions, this does not provide the basis for how an action might acquire referential meaning. Furthermore, it is hard to see how the mirror system, as the basis for action recognition, can also be extended to the recognition of features of the environment, such as fruit and trees and predators, and how actions referring to these things could be derived from mirror recognition of actions.

Arbib has responded to some of these criticisms by elaborating a so-called "extended mirror system hypothesis". This is a complex hypothesis, which Fitch makes no attempt to summarise. However, there are two important points in Arbib's later work which deserve emphasis. First of all, one of his arguments for the idea of a gestural protolanguage is that by way of mimetic gestures it would be easier for the pre-linguistic hominid to "break through" the restricted repertoire of meanings possible in the vocal system than it would were the capacity for mimicry to extend first to vocalisations. This is because, according to Arbib, following principles of visual imitation, gesturing would offer so much more scope for representing objects and actions and their relationships than would seem possible if one relied only on an auditory medium. Second, unlike Hewes or Corballis, Arbib does not suppose that first there was a gesture protolanguage that later somehow switched over to a spoken language. Rather, he suggests that the transition from a gestural system augmented by vocalisations to a mainly vocal system was a gradual one. This he calls an "expanding spiral" and suggests, thus, a long period during which both systems were subject to selection, each "scaffolding" the other.

Fitch himself seems to be sympathetic to the idea that a gestural protolanguage could have provided a way in which a system of signals could develop an expanded semantics. As he puts it (p. 457), "gestures and mirror neurons appear to provide a good way *into* a meaningful protolanguage". However, even if one might agree to this (and neither Arbib nor Fitch provide any hint as to how an action of imitation ever comes to be *recognized* as such, and thus they offer no idea as to how it ever might acquire status as a *referentially semantic* action), one is still left without a convincing account of why

vocalisation took over as the principal medium of language.[25]

Protolanguage as musical

So how *is* speech to be accounted for and why is it the dominant vehicle for language? That is, how did the elaborate control of the vocal apparatus that is characteristic of humans emerge and how did it acquire the capacity to serve as a *semantic* signalling system? In Chapter 14, the last main chapter of the book, Fitch elaborates on the idea that speech is a development of what he calls a "musical protolangauge" or, as he also calls it, a "prosodic protolanguage". The relationship between speech and song has long been noted. It was discussed by Rousseau in the eighteenth century, and Charles Darwin, writing in 1871, supposed that there was an evolutionary relationship between song and speech. Later writers who have also proposed the idea include Otto Jespersen and, much more recently, Brown and Mithen.[26] Fitch's presentation and discussion of the idea draws mainly on the work of Darwin and Jespersen.

As Fitch had made clear earlier in the book, and as he reiterates here, it is necessary to keep *speech* separate from *language*. Looked at in this way, one can view "phonology" (as he calls it here) as an autonomous generative system, according to which more or less unlimited sound sequences can be created through re-combinations of repertoires of "phonic elements". These are not to be confused with phonemes, since, as Fitch points out, this is a concept employed in relation to a system that conveys linguistic meaning, and in prosodic or musical protolanguage we are not yet dealing with such meaning.

The justification for supposing such a system of "bare phonology" is based on a number of considerations.[27] First, when children are acquiring language, they go through a sort of practice phase of "bare phonology" when they babble. In this period the child seems to be trying out his capacities for articulation and exploring the range of sounds that it is possible to make, producing complex sequences of articulated vocalisations coordinated with intonation patterns - certainly a form of "pre-speech", but with no linguistic meaning. This in itself suggests that "phonology" is a separate system.

In addition, adult speakers may often make use of meaningless syllabic sequences, simply for sonic and rhythmic effect, as in various kinds of singing ('scat' singing is one good example) and ritual performances. And even when we are dealing with linguistic speech, in a variety of contexts, much use may be made of nonsense words, repetitions, and the like, as in many varieties of song and poetry. Such phenomena have led a number of writers, as already mentioned, to propose that there are many parallels between speech and song, and indeed a survey of the ethnographic literature suggests that often the boundaries between what can be considered speech and what can be considered song are by no means

[25] See Kendon (2008, 2009, 2011) for further critical discussion of the 'gesture protolanguage' idea.

[26] See Brown (2000) and Mithen (2005) for details.

[27] Instead of "bare phonology" I suggest the term "laliation" adapting "-lalia", a terminal element from a Greek word which means "talk" or "chatter", used in English to refer to various kinds of speech disorder or strange practice (as in "echolalia"). Here, however, "laliation" is to mean the capacity to produce articulate sounds that are speech-like and can be used in talk, as in a baby's babble or in nonsense talk or scat signing. I prefer it to Fitch's "bare phonology" for then one does not have to apologise, as Fitch does, for using the word "phonology" in a sense different from its usual meaning in lingusitics.

always clear cut.

One is led to the view, thus, that the capacity for producing, using and imitating complex articulatory vocalized sequences and exploiting their sonoric and rhythmical virtues is a separate capacity and has separate functions from the production of sound when governed by semantic uses as components of a lexicon. The theory of a prosodic protolanguage, thus, supposes that what emerged first in evolutionary history was an elaborated capacity for articulated vocal production. Only later did these sequences begin to acquire semantic functions, eventually developing into spoken language. Since we do not see this capacity for anything like a "bare phonology" in any of the apes (as far as is known, the complex sound sequences produced by gibbons are genetically pre-determined), we must suppose that this capacity developed in the hominid line, after the split from the Last Common Ancestor.

What might have led to the evolution of this capacity? Darwin may be credited with proposing that, in the light of the many parallels between human speech (as "bare phonology") and song in song birds - parallels we alluded to earlier in this essay - the selection processes that led to song in birds might very well be paralleled in humans. He proposed that it was sexual selection that brought about song elaboration in birds (this is now widely accepted and there is now much evidence to support the idea) and suggested that this would also have operated among humans.

There are at least two difficulties for a sexual selection theory for the origins of a musical protolanguage in humans, however. First of all, the human capacity for speech production, imitation and learning is the same in both sexes. Traits that develop as a result of sexual selection usually develop to a much greater extent in one sex. In northern song birds, it is typically the male that has the elaborate song. Second, traits developed through sexual selection usually become manifest with the onset of sexual maturity - as is the case with singing in birds - but in humans, of course, the capacity for speech begins very early indeed. Thus, while it is probable that sexual selection played a role in the development and elaboration of the human voice - the differences between male and female voices in humans would suggest this - we must also look for other possibilities.

One possibility that Fitch favours derives from the importance of the voice, especially a singy-songy voice, in establishing and maintaining and elaborating the adult-infant relationship. Mothers all over the world sing to their infants, and singing games, word play of various kinds, play a very important role in interaction with infants, as has been pointed out by Ellen Dissanyake (2000). It has been suggested by Dean Falk (2004) that because the human infant is so very dependent at birth, but because, since humans lack fur, it cannot easily remain clinging to its mother for long periods (as chimpanzee infants can and do) but must be carried, for the mother to become free enough to engage in gathering food and other activities, it would be useful for the mother to "park" its infant. But to do so, would require that there be some way for close contact to be maintained. Falk suggests that this could have been an important factor favouring the emergence of complex, voluntary vocalisation, as part of a system of maintaining mother-infant contact. This idea not only solves the question of sexual equality in human vocal capacities (human males also look after their children and, in any case, adult-infant interaction is highly interactive, involving the baby as much as the adult), it also is consonant with the fact of very early development

of speech capacities in humans.

In addition to the adult-infant interaction hypothesis, there are a number of other considerations that could also be brought to bear on this issue. Fitch only mentions this in passing, but it seems to me he could have made more of the fact that there are many species of primates - such as certain species of baboon, and also some of the forest dwelling South American species, such as tamarins, who engage in extensive reciprocal chatter, chorusing and grunting, which serves an important role in maintaining contact between individuals in the group. This phatic use of reciprocated vocalisation is obviously of great importance and a comparative study of this kind of vocal usage in relation to the ecology and group structures of the species involved could suggest some further important hypotheses as to why complex vocal communication can be favoured in evolution, hypotheses that could very well apply to humans as well. Indeed, a recent study by McComb and Semple (2005), in which group size and complexity of social relations in the group were compared across several primate species, demonstrated an increase in the complexity of the vocal repertoires as group size and complexity of social structure developed. Here it is appropriate to mention again Robin Dunbar's "grooming" hypothesis for the origin of language (Dunbar 1996). As Fitch points out in his discussion of it (in Chapter 12), although Dunbar 's treatment seems to take for granted the presence of propositional communicative functions and does not account for the origin of this aspect of language, his idea that vocal exchanges could substitute for grooming exchanges when group size extends beyond a certain limit, is a valuable additional hypothesis to account for the origin of musical or prosodic protolanguage, even if it is not useful for accounting for the origin of the semantic functions of modern language.[28]

Taking all this into consideration, there seems to be good reason to suppose that 'speech' (in the "bare phonology" sense of it, or "laliation" as I suggest we call it) had a separate origin in the hominid line, and comparative considerations, some of which we have outlined above, can suggest what might have been the selective pressures that favoured its emergence.

But how did this musical protolanguage come to have *meaning* in the sense that we understand that language today has meaning. How did speech become a vehicle for language? One route to a more language-like meaning that Fitch favours was originally suggested by Otto Jespersen (1922), whose contribution he describes in some detail. According to Jespersen, units of song-like utterance could have first acquired signification by being repeated in certain situations or by specific individuals, and could, thus, have become *leitmotifs* for these. Then, as they were repeated, they could, by being applied to associated circumstances or individuals, come to have a more general significance. For Jespersen, these meanings are *holistic* - units of utterance would acquire complex meanings as complete units, and would have functioned rather as very complex words do in some highly fusional languages, as in North America, where a single long word can have a meaning, which, if translated into English, would have to be rendered as an entire sentence.

In support of the idea that units in a protolangauge, as they acquired semantic

[28] See also the highly suggestive observations and discussions by Bruce Richman, who has made extensive studies of the vocal behaviour of gelada baboons (see Richman 1978, 1980, 1987)

significance, would have been holisitc, Fitch appeals to the work of Allison Wray (1998, 2002). Wray does not discuss the relationship between music and language and does not entertain the idea of a musical protolangauge, but she argues that words were complex wholes originally and have become composed of separable parts, detaching nouns from verbs, developing particles and pronouns much later on. She points out that much spoken language has a holistic character today. We speak often in formulae, patterns of word sequences are often highly repeatable, as in social ritual interactions of all kinds. Furthermore, she points out, children, when acquiring language, often understand utterances as wholes, rather than as being divided into separate words. An objection that has been raised against this idea is that it might be difficult to envisage how, from the holistic complexes of a protolangauge, units would come to be separated and come to function as individual words. This issue has been raised with respect to how a child, encountering a parental language of utterances with only holistic meanings, would arrive at individual words. It has been suggested that individual words would arise from a process of over-generalisation by the child. Children, in acquiring language, often do employ meaningful units such as words in over-extended ways. For example, a child might use a word by which he designates a 'dog' to designate also a 'cat', generalising its meaning to cover all four footed creatures. It has been suggested, also, that children might over-analyse holistic utterances and generalise the results. This could result in the separation of words. We know that lexical innovations are often created by children, and sometimes they enter into the family lexicon; and we have also seen, from the work on Nicaraguan sign language, the important role children can play in creating innovations in linguistic systems. The idea that children, in acquiring a linguistic system, may change it in a certain way is thus not an idea without support.

As a kind of proof that this sort of process is plausible, Fitch turns to the work of Simon Kirby (2000) who, in a series of ingenious computer simulation experiments, has demonstrated how a compositional, syntactically structured language will emerge, simply if you start with a population of individuals, each of whom possesses the capacity to emit utterances composed of sequences of symbols that map as wholes on to meaning complexes. These individuals can learn, simply by observation. The utterances that each produces initially are for meanings that they are instructed to express, selected at random from the repertoire of meanings supplied. From time to time, some individuals are withdrawn from the population and replaced by new ones, who know nothing. This ensures there is always a new generation entering the population, who must learn from the language already established in previous generations. It is found that over a series of runs, a stable system of compositional utterances will emerge, with the parts of these utterances slowly coming to have stable meanings. As this happens the utterances come to be organised according to a simple syntax.

This demonstration by Kirby is meant to show that, starting with a 'phonological' system of re-combineable elements, and given that conceptual meanings can be mapped on to them, a lexicon with a compositional morphology will arise automatically, provided you build in certain assumptions about how the individuals in the system learn from each other. It shows how, starting from a non-syntactic holistic protolanguage, a syntactically organised system of utterances using stable lexical forms can emerge. This is offered by Fitch as an

answer to the critics of Jespersen and Wray who had claimed that this was not possible.

Discussion

Fitch begins his book with the parable of an elephant exhibited in a dark room. Each person who approached the elephant could only experience it by touching it and, accordingly, depending upon what part of the elephant he touched and how he did so, he would arrive at a different conception of what the elephant was like. In approaching the problem of the origin of language, Fitch suggests, "[a]ll of us are still exploring the elephant of language in the darkness, all of us with only a partial understanding, and each discipline will have its place in the richer description and understanding that all are seeking" (p. 2). He insists (pp. 4-5) that language "must be viewed as a composite system, made up of many partially separable components." He suggests that it "is not a monolithic whole, and from a biological perspective may be better seen as a 'bag of tricks' pieced together via a process of evolutionary tinkering." He eschews the idea that there is just one aspect of language that is "core" or "central". Nonetheless, although he says that many of the components that go to make up language are found in other animals (and this is what justifies the emphatically comparative approach he follows throughout the book) there are a few "core aspects of the human language capacity that remain unique to our species." (p. 6).

Not surprisingly, it is these few "core aspects" that are the main focus of attention in the various models of language evolution that are evaluated in the last three chapters of the book - the various lexical protolanguage models, the gestural protolanguage models and the musical protolanguage model. As I have indicated in my discussion of these chapters, Fitch evaluates these models, and he points out the shortcomings of each of them. He says, however, that all of them also bring us valid insights and he suggests that we should not see them as conflicting. He is right about this, at least insofar as each model might be said to tackle the problem of language origins at different stages of development. The lexical protolanguage models already assume that humans had at their disposal units of expression that could serve as "words" in some sense. The gestural protolanguage models perhaps try to address the issue of how such "words" could have come about in the first place - Fitch suggests (p. 509) that these gestural models provide "the signalling prerequisites for a later 'lexical protolanguage'" - while the musical protolanguage idea is an attempt to address the problem of providing an adaptive explanation for the discontinuity among primates in vocal learning. It also seeks to account for the relationships between musical and spoken uses of the voice and offers an approach which can account for the origin and importance of intonation tunes which serve such a fundamental role in speaking.

The emphasis of Fitch's book, it should be said, is very much upon those aspects or capacities that individuals must have if they are to be able to 'have' language or to 'do' language (as it might be preferable to say). Fitch makes this explicit in his discussion of Chomsky's distinction between "E-language" and "I-language". According to this, 'I-language' is the neural cognitive system which exists within the individual that makes possible the ability to use language. E-language, on the other hand, as Chomsky saw it, is simply an aggregate epiphenomenon, no more than the output of a set of I-languages. Chomsky argued that I-language should be the proper object of study in the study of language. Fitch agrees with Chomsky "that

scientists interested in the genetic and neural mechanisms underlying language need to focus on I-language, as instantiated in individuals' brains." (p. 34). For him, thus, "I-language is the proper empirical starting point for this investigation" (*ibid*) - by which he means an investigation into the evolutionary origins of the various capacities and abilities humans have so that they can engage in languaging. However, Fitch agrees that E-language must also be investigated, and here he differs from Chomsky, for he does not dismiss E-language as an epiphenomenon. He says that the shared social systems that correspond to specific languages, such as English or French or Warlpiri are systems that become part of the human environment, they are part of the 'niche' that humans construct for themselves and they must, accordingly, have consequences for biological processes of human adaptation (p. 34).[29] This means that such systems are also properly within the purview of language origins studies. He recognises, however, that the processes by which these systems come about are *social* processes, processes that he refers to as *glottogenic* , and these are not fully accountable in biological terms.

Since it is the biological processes that are the principal emphasis of the book, these social processes receive rather brief discussion. For example, as we have seen, Fitch recognises that for a fully developed theory of protolanguage, as discussed in Chapter 12, a 'two-stage' theory is necessary. A second stage is needed to account for the fact that the propositional information that utterances can convey, can be shared beyond circles of immediate kin. Fitch also recognises, as we see in Chapter 3, where he outlines the main features of 'language', that in order to understand how linguistic utterances can have meaning, they must be understood in terms of the inferences they allow their users to make about what each had intended to convey. This, of course, has implications for the kinds of cognitive abilities that are required for being able to 'do language'. In developing this theme, he devotes some space to Gricean theory and to Sperber and Wilson's elaboration of this.[30] He relies on Grice to bring out the point that, in human linguistic communication, participants *cooperate* with one another in the light of "an essential common interest in getting some point across" (p. 134). He suggests that this common desire of participants to communicate cooperatively is peculiar to human communication and is not found anywhere else in the animal kingdom. What demands explanation, from an evolutionary point of view, according to Fitch, is how it is that human speakers are able to modulate their communicative signals according to the information that they know that this will provide their conspecifics and that they can do this in the light of their understanding of what information it is that their co-participants need so that they can collaborate in the realisation of a jointly entertained goal.

This issue of how participants in interaction can come to share a common perspective is central to understanding how shared referentiality is possible. Fitch's approach to this question is decidely 'cognitivist'. He accepts the idea that humans develop what has come to be called a "theory of mind" and it is in terms of this that each other 's behaviour is interpreted. Although widely followed, this approach depends upon a number of assumptions that may be open to question, and it does not direct attention to the detailed

[29] Bickerton (2009) makes a similar point.

[30] Sperber and Wilson (1995).

study of how humans actually accomplish interaction when they are co-present.[31] A considerable body of work has now been carried out in which the way in which ongoing interaction is actually organized has been described and from this it seems clear that an account in terms of the kind of refined inferential processes that a "theory of mind" approach implies is not necessary. Behaviour is highly patterned and humans (and not only humans) are immersed in this patternedness from the beginning.

We can gain some clues regarding this from the work of Erving Goffman (e.g. Goffman 1961, 1963, 1973) whose work is not usually mentioned in the context of language origins discussions. From this we understand how people characteristically enter together into occasions of what he has called "focused interaction" in which they jointly agree upon what is relevant for the occasion and what may be disattended. Such jointly sustained attentional frames seem to be a fundamental feature of coherent interactions of any kind and it is only by seeing how communicative exchanges depend upon the creation of such jointly constructed shared "micro-worlds" that we can come to see how mutual understanding is achieved.

Approaching this problem from a somewhat different perspective, this point is similar to the one that Tomasello (2008) has been arguing for: that shared referential understanding can only come about within a joint attentional framework. That is, for an action to have common referential significance it is necessary for the participants to somehow share an understanding that they are both attending to the same things in the same way.

The achievement of this joint attentional frame may be accomplished in a variety of ways, but in fully co-present or non-mediated interactions much depends upon delicate coordinations between movements and orientations of the participants. It is through such coordinations that shared cooperative intentions can become manifest for the participants and so be established among them. In some of my own work of some years ago (Kendon 1985, reprinted in Kendon 1990: 239-262), for example, I described how the spatial-orientational systems that participants in focused interaction can enter into and cooperatively sustain, play an important role in the means by which is achieved the attentional "frame attunement" necessary for the common understanding in terms of which participants' actions make sense. This need not be done by words or by gestures, but by reciprocally sustained spatial and orientational manoeuvres. Accordingly, when it is seen that intelligible linguistic exchanges pre-suppose and depend upon the setting up of such joint attunements, we come to see that the very activity of uttering linguistic acts of some sort can only be understood when the setting up of interactional settings, the establishment of "participation frameworks" is also understood. There are now a number of good descriptions of this for human interaction. Studies of great ape interaction that take a comparable approach would be extremely useful. A few beginning steps have been made, for example in the work of Simone Pika (Pika and Mitani 2009) with chimpanzees, the work of Joanne Tanner on gorillas (Tanner 2004) and see also the book by Barbara King *The Dynamic Dance* (King 2004). Such work will allow us to compare the organisation of occasions of interaction between species, not just the vocal and gestural signals they produce as discrete units of action (a common approach hitherto, see Call and Tomasello 2007), and this will

[31] For critiques of Theory of Mind see, for example, Leudar, Costall and Francis (2004) and the papers that follow in the same Special Issue of *Theory and Psychology*

greatly enrich our understanding of the circumstances in which the emergence of joint referentiality of actions, in whatever modality, might have been enabled. Almost nowhere in the language origins literature are issues of this sort discussed.

Another important feature of languaging, already alluded to above, is the fact that when speakers construct utterances they *always* do so through an orchestration of diverse semiotic resources (Goodwin 2000). Now although acknowledgement is often given to the fact that in speaking speakers also make use of "paralanguage" - intonational modulations in speech production and various kinds of kinesic accompaniments, these generally tend to be treated as *auxiliary or decorative accompaniments* and not as integral to the very activity by which an utterance is produced. For example, Fitch says (p.509) that modern humans in all cultures "use gestures meaningfully" and adds, accordingly (noting that apes also use gestures "meaningfully")[32], that "we have every reason to believe … that gesture played an important supporting role in communication throughout hominid evolution." But what is meant here by "supporting"? Should we not be impressed by the fact that verbal language, when produced by speakers, is *never* produced as only words?[33] We can, of course, write down a person's words, presenting their utterances so that they seem to be made up only of words. However this does not represent what was actually done when the utterance was produced. Whenever a person speaks he employs, in a completely integrated fashion, patterns of voicing and intonation, pausings and rhythmicities, which are manifested not only audibly, but kinesically as well. Always there are movements of the eyes, the eyelids, the eyebrows, the brows, as well as the mouth, and patterns of action by the head. In addition there are, from time to time, variously conspicuous hand and forearm actions or 'gestures' (as they are often called), as well as postural and orientational changes. All of this is produced in full orchestration with speech - complex and variable, to be sure, but always orchestrated - and must be seen as inseparable components of the utterance as the utterer produces it.[34] Few theorists of language offer an account of this.[35] This may be, of course, because most theorists of language hitherto have not seen it as their business to do so since 'language' in most such cases is thought of as a self-contained, autonomous system that is confined to only one modality. But is this view of language anything other than a convenient abstraction? And if so, does it then constitute an appropriate target for evolutionary explanations?

This question, posed a long time ago by Bolinger in his "Thoughts on 'yep' and 'nope'" published in 1946 (Bolinger 1946), has been posed again more strikingly, perhaps, as

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[32] Fitch seems to overlook the fact that the way humans use gestures "meaningfully" is quite different from the way apes use them. Apes probably do not point and they have never been seen to use their hands to describe things, which is a very common kind of gesture use in humans!

[33] Some of what follows here has been adapted from my essay "Language's matrix" (Kendon 2009)

[34] Early demonstrations of this were by Condon and Ogston (1967), see also various chapters in Birdwhistell (1970) and Kendon (1972). Detailed discussions of gesture in relation to speech are found in McNeill (1992) and Kendon (2004).

[35] Fitch does make reference to Donald (1991), who discusses speech co-ordinated gesture, which he agrees has undergone evolutionary change along with speech. He links it to an earlier mimetic stage in the evolution that was to lead to language, and Fitch (p. 505) favours the idea of a "multimodal communication stage". Putting it this way, however, leaves the impression that multimodality has been or is being left behind. This is far from the case, and the relevance of this for theories of language evolution has yet to be adequately developed.

a result of the recent work on sign languages (Liddell 2003: 355-362). When, after William Stokoe's demonstration in 1960 that the "visual communication system of the deaf" (as he called it) could be analysed, at least to a considerable extent, in terms of the analytic principles developed for spoken languages by Bloomfield and his followers, such as George Trager (who directly taught Stokoe), there developed a determination to demonstrate that such structuralist principles were completely adequate for the analysis of sign languages, for in this way it would be shown that sign languages were indeed *languages*, and not, as had been maintained for the prior eighty years or so, "mere pantomime" or "unsystematic gesture". In doing this, the concept of 'language' as a self-contained system was extended to include sign languages which meant that they also came to be conceived of as well demarcated autonomous systems.

However, because there is no tradition of writing for sign languages and so no pre-established criteria for deciding what is "in" the language and what is "outside" it, any attempt to suppose that there can or should be a separation between 'paralinguistic' features and 'linguistic' features becomes very problematic. In recent years it has become clear that central to the construction of utterances in sign languages are forms of expression such as 'classifiers', 'constructed action', or "highly iconic forms" (on this, see Cuxac and Sallandre 2007), as well as an exploitation of space that is not possible in speech, but which have much in common with various kinesic devices used by speakers (although these are not as systematic in speakers).[36] This proves to be an embarrassment to those who want to maintain a model of sign language that is derived from existing models in spoken language linguistics. On the other hand, this has also led others to suggest that when comparing spoken and signed language, the comparison should be with language as it is performed in speaking, for it is only the performed version of a sign language that is ever available. If this suggestion is followed, however, this means that, after all, from the point of view of how utterances are constructed, it is as essential to view what speakers do as an integrated performance in the study of spoken languages, as it is in the study of sign languages.

In short, we may suggest that the 'natural' state of spoken language is a *speech-kinesis ensemble*. Presumably, this has always been the case. With the development of writing, and its ultimate emergence as an autonomous form of language with its own properties, which, nevertheless, has provided the dominant model for what 'language' is, at least since the end of the eighteenth century, we have ceased to see how gestures and other aspects of utterance performance are a part of "what is said." In (relatively) recent history, as human cultures have developed to sustain ever larger units of social organisation, especially, we repeat, with the development of writing technologies, the separation and specialisation of modalities of communication has been favoured. In many glottogenetic discussions, it is the separated modality of written-down spoken language (which dominates our conception of language) that tends to be projected backwards to the earliest days of language, making it very difficult to imagine how it might have arisen.

We may suppose, however, that just as 'languaging' is, in fact, a poly-modalic activity today, so it must have been in its beginnings (incidentally, to take this point of view

[36] See Kendon (2004: Ch. 15).

obviates the problem that "gesture first" scenarios have raised)[37]. This leaves us with the question as to why there is this poly-modality and why, in particular, when speakers speak (or signers sign, for that matter) they tend to mobilise all kinds of bodily resources beyond those that might seem necessary from a mono-modalic point of view. The model of 'language' as an autonomous mono-modalic system, which tends to be taken as the target in so many language origins discussions, is a system that is a product of latter-day reflections on language, greatly facilitated ever since systems of writing came to be regarded mainly as representations of spoken language. A model of language of this kind is not appropriate to apply in those primordial times when what were to become specifically human forms of communication were first emerging. 'Language', as it is so often conceived of in contemporary language evolution discussions, is a late differentiation from a complex and dynamic orchestration of communicative action. Furthermore, it is a continually emerging system. The 'target' of our evolutionary explanations perhaps should be re-formulated so that the poly-modality of utterance is taken as the starting point. If this is done then 'language', when it is considered in its mono-modalic form, can then be understood as a consequence of processes of specialisation and differentiation from poly-modal ensembles of action. Accounts of language origins can then be recast to become accounts of these processes of progressive specialisation and diversification, emerged and emerging systems that are shaped through an evolution that involves social interaction as much as biology.

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[37] See also Kendon (2011).

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