Prototypes and Discreteness in Terminology

Pius ten Hacken
Swansea University

Characterizing the nature of terms in their opposition to general language words is one of the tasks of a theory of terminology. It determines the selection of entries for a terminological dictionary. This task is by no means straightforward, because terms seem to have different properties depending on the field that is studied. This is illustrated by a brief discussion of examples: terms in mathematical linguistics, traffic law, piano manufacturing, and non-terms in the reporting of general experiences. Two properties can be derived from these discussions as candidates for the delimitation of terms from general words. Firstly, the degree of specialization. This property distinguishes specialized expressions in mathematical linguistics and in piano manufacturing from non-specialized expressions in traffic law and reporting general experiences. Secondly, the lack of a prototype. In mathematical linguistics and in traffic law, the definition of terms concentrates on the boundaries of the concept. In piano manufacturing and in reporting general experiences, concepts have a prototype and fuzzy boundaries. Defining the word term *as a disjunction of the two properties implies that it is a less coherent concept than general language word, because it is only the complement of the latter. When the two properties are considered in isolation, it can be shown that the degree of specialization is a gradual property whereas the lack of a prototype is an absolute property. Whether or not we choose to use the name* term *for it, the latter property identifies a concept that is ontologically different from general vocabulary. I will reserve the name* term *for concepts that do not involve prototypes and call the professional expressions in piano manufacturing specialized vocabulary. By focusing on the boundary instead of the prototype, a terminological definition creates an abstract object for which there is no equivalent in general language words. Whereas general language words only exist in the competence of the speakers, the abstract object associated with a term can exist independently of the knowledge of individual speakers. There are interesting parallels between the nature of these abstract objects and the nature of a piece of music. The creation of such an object on the basis of general language words can proceed by the selection of properties or the choice of a specific boundary on a scale.*

One of the questions a theory of terminology has to answer is according to which criteria terms are distinguished from general language words. It is the answer to this question which determines the range of entries of termbases. In manuals of terminology, this question is usually discussed from a practical perspective. In this paper, I will concentrate on the linguistic implications, assuming the general linguistic framework developed by Jackendoff (2002) as a background.

Examples of domains and expressions

Terms are necessarily linked to a particular domain. Given the wide variety of domains, the best approach to finding relevant properties of the concept of *term* is to start by considering a number of different domains. The domains selected here represent examples of a scientific field, a legal field, and a technical field. Each of them will be discussed on the basis of a sentence including terms in a characteristic way. As we are interested in the distinction between terms and general language, an example of the latter will also be included, so as to put the differences between terms in different domains in the proper perspective.

Mathematical linguistics

As a scientific field, mathematical linguistics produces text that is full of terms. An example of a sentence in mathematical linguistics is (1).

(1)   The set of context-free languages is not closed under complementation.

The statement in (1) is a well-known theorem and as such it occurs in any textbook of mathematical linguistics, e.g. Hopcroft & Ullman (1979: 135), Partee et al. (1990: 499). It relates a number of terms, *set*, *context-free language*, *closed*, and *complementation*, in a way that can be proven on the basis of the definition of these terms. These definitions are always explicit. A definition of the term *context-free language*, based on Partee et al. (1990:451-2), is (2).

(2)   A context-free language is a language that can be generated by a context-free grammar.

It is typical of a field such as mathematical linguistics that the definition of one term refers to a number of other terms. This does not mean that definitions are circular, because the terms in the definition are simpler than the term defined. In the case of (2), the terms used to define *context-free language* are *language*, *generate*, and *context-free grammar*. The definitions of these terms do not refer to *context-free language*. The definition of *context-free grammar*, for instance, uses constraints on the form of the production rules to distinguish it from other grammars.

Definitions such as (2) and theorems such as (1) create a network of terms with specified relationships to each other. This network constitutes an important part of the knowledge of mathematical linguistics. Ultimately, the concepts come into existence by the selection of a definition. Therefore, each concept has a clear, well-defined boundary. An entity is either a context-free language or not. This is true even if for a particular language no one is able to tell. There is no middle ground.

Traffic law

The domain of traffic law is characteristic of the legal field. It shows some interesting differences to scientific fields such as mathematical linguistics, which can be illustrated on the basis of (3).

(3)   Mopeds are allowed on dual-carriage ways but not on motorways.

In the same way as (1), the statement in (3) contains a number of terms, *moped*, *dual-carriage way*, and *motorway*, and expresses a relationship between them. As opposed to (1), however, (3) does not follow from the definition of these terms, but from additional rules formulated by legislators. In the UK, the definition of *moped* is (4).

(4)   A moped is a motorcycle that has the following features:
a.   maximum design speed not exceeding 50 kilometers per hour
b.   an engine capacity no greater than 50 cc
c.   it can be moved by pedals, if the moped was first used before 1 September 1977

The definition of *moped* in (4), taken from Directgov - Motoring (no date), has a different status to the definition of *context-free language* in (2). The concept of *moped* is rather constrained than created by the definition. There is a certain degree of interaction between the constraints and the creation, because the exact conditions included in the legal definition will be used by manufacturers so that they can sell their products under the label of *moped*. However, from a legal point of view, the class of *mopeds* only comes into existence by its definition. It is because of such a definition that (3) has a different status from (5).

(5)   I saw three mopeds on my way home today.

Whereas (5) expresses an observation, (3) expresses a rule. There are a number of such rules, differing from one country to the next, concerning minimal age of the driver, maximum speed, etc. The enforcement of these rules depends on the ability to determine for each object whether it is a *moped* or not. The awareness that such a definition exists does not depend on knowing it. While few people may be able to cite it, it is generally accepted that there is no point in arguing that a particular vehicle is *almost* a moped when stopped by traffic police.

Piano manufacturing

In many specialized manufacturing domains, large numbers of terms are used to refer to components, tools, processes, etc. An example from the domain of piano manufacturing is (6).

> (6)   In an upright piano, the soft pedal moves the hammer rail closer to the strings.

Again, as in (1) and (3), the statement in (6) relates a number of terms, *upright piano*, *soft pedal*, *hammer rail*, and *string*. It is much more difficult, however, to find definitions for these terms that can be seen as parallel to the one for *context-free grammar* in (2) and for *moped* in (4). In fact, (6) can be seen as a definition of *soft pedal*. As opposed to (2), this definition does not give any boundary conditions, but only explains how the soft pedal works. As a consequence, it is not possible to use (6) as a way of distinguishing soft pedals from other objects in the world of piano manufacturing.

Arguably, no further definition of *soft pedal*, going beyond (6), is needed. In the context of piano sale, a customer is interested in the performance and sound of the instrument, but (6) is sufficient to identify the soft pedal for any purpose. For an apprentice piano builder, it will be necessary to learn how to install a soft pedal. In this task, no amount of text will be sufficient to replace the practical skills involved in doing so, while there is no point in formulating additional criteria to identify the soft pedal. Within piano manufacturing, there is no need to define the exact boundaries of the concept of *soft pedal*. The term is used to identify a type of object without a formal definition.

General experience

In order to contrast the types of term discussed in the preceding sections not only with each other but also with general language without terms, example (7) gives a general language sentence.

> (7)   Traveling by train is so much more pleasant than traveling by plane.

The statement in (7) does not involve any terms. Key expressions such as *traveling*, *train*, and *plane* can be terms in particular fields, e.g. travel insurance, although it is likely that a different expression would be used instead of *plane*. As a general language statement, however, (7) does not have a technical meaning. It expresses a personal opinion and any argument about it turns on aligning or differentiating personal judgements. An argument about (7) is in no way helped by a precise, terminological definition of the key expressions it contains. If one engages in an argument about (7) one is likely to learn at least as much about the people the argument is with as about the relative convenience of different means of transport.

Classification criteria

In order to systematize the data evoked in section 1, I will present two criteria in section 2.1. They give rise to different classifications that will be discussed separately in sections 2.2 and 2.3.

Two criteria for termhood

Two criteria can be used to distinguish expressions in general language as exemplified in (7) from the domain-specific language presented in sections 1.1, 1.2, and 1.3. One concerns the specialized context of use. This criterion corresponds to a widespread view in terminology, as formulated, for instance, by Cabré (1999: 81) in (8).

> (8)   The most salient distinguishing feature of terminology in comparison with the general language lexicon lies in the fact that it is used to designate concepts pertaining to special disciplines and activities.

It is obvious that according to (8) expressions such as *context-free language* in mathematical linguistics and *soft pedal* in piano manufacturing qualify as terms. The status of *moped* in traffic law is much less clear. One might argue that the underlying concept pertains to the special discipline of traffic law, but it is questionable whether *moped* designates a different concept in

(5), where it is clearly not a term.[1] Alternatively, one might argue that, because *moped* designates the same concept in (3) and (5), we cannot claim that it pertains to special disciplines and activities in the sense required by (8). If we only consider specialization as such, this seems to be the correct analysis.[2]

The other criterion for identifying terms concerns the nature of the delimitation of the concept referred to. Jackendoff (1983) shows that the meaning of a general language word cannot be defined by means of a set of necessary and sufficient conditions. Instead, it is based on prototypes and preference rules. A *cup* is a drinking vessel with a certain height-width relation, but no precise boundaries can be given, only a prototypical value. It is not necessary that a cup has a handle, but if it does, one tends to be more tolerant as to the dimensions. In the case of terms in mathematical linguistics and in traffic law, such considerations do not play a role. A language is either context-free or not context-free. Whereas for a borderline case of a cup, some people may call the object a *cup* and others not, the criteria a language has to meet to be context-free are not subject to negotiation. In the domain of traffic law, establishing strict boundaries is central to the creation of terms. Terms such as *soft pedal* in piano manufacturing, however, behave like general language words in this respect. The style of the explanation in (6) is typical of general language lexicography.

The two criteria and their effects on the domains discussed in section 1 are represented in Table 1.

	Strict boundaries	*Prototypes*
Specialized	Mathematical linguistics	Piano manufacturing
General	Traffic law	General experience

Table 1: Four classes of expressions

In view of the situation in Table 1, it is of course possible to define *term* disjunctively. This is not an attractive option, however, because it would imply that in the opposition between *word* and *term*, only *word* is characterized in positive terms. A *term* would then be an expression that misses one of the properties of a general language word. Intuitively, *term* is more rather than less marked than *word*. Therefore we can expect to find a characterization by means of positive properties. In the light of Table 1, then, it seems more attractive to introduce two designations, one for specialized vocabulary and one for concepts with strict boundaries. An important question in the interpretation of Table 1 is whether the four classes partition a universe or should rather be seen as cardinal points with fluent transitions between them. This question should be considered separately for each of the two criteria.

Specialization as a criterion

Although specialization is often taken as the main property distinguishing terms from words, its application is not without problems. First, there is an element of subjective judgement involved. What is specialized for one speaker may be general for another. Second, specialization is a matter of degree. The gradual nature of the transition can be illustrated by the vocabulary used to describe the human body. In (9), four layers of specialization are illustrated by two expressions each.

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[1] The situation is not the same as for, for instance, *language* in mathematical linguistics. Although *language* also occurs in general language, it does not designate the same concept. Partee et al. (1990: 435) define a language as "any subset of A^*", where A is the vocabulary and A^* is the set of all strings formed over A. This concept does not intersect with the one designated by *language* in *She speaks five languages.* or *He should polish his language.* or *Italian is a beautiful language.*

[2] In making this choice, I do not claim that Cabré (1999) intends to exclude traffic law terminology from her domain. However, I would argue that the exclusion is a consequence of taking specialization as a criterion, without considering strict boundaries as another, independent criterion.

(9)   a. leg, blood
           b. ulna, aorta
           c. supinator, jejunum
           d. platysma, pubococcygeus

The expressions in (9), all taken from Abrahams (2006), are listed in an order that approximates their intuitive level of specialization and is supported by the treatment in dictionaries. In LDOCE, (9a) are in the defining vocabulary, (9b) in the list of entries, and (9c-d) not included. CED5 gives (9a-c) but not (9d).

If we intend to define a boundary between words and terms on the basis of specialization, it is clear that *leg* is general and *platysma* is specialized, but there is not enough evidence for any specific boundary on the cline between them which would make its choice non-arbitrary. Inclusion in a particular dictionary can of course not be used as a criterion for specialization, unless the criteria underlying the decisions can be formulated. Therefore, the use of this criterion in determining what is a term makes the concept of *term* itself prototype-based.

A similar observation is made by Myking (2007: 74), who states (10) as the basic theses of a research project.

(10)   a. There are no fixed boundaries between specialised communication and other forms of communication, and, consequently,
            b. there are no fixed boundaries between terms and the rest of vocabulary and phraseology.

Myking presents (10) as "a criticism of traditional positions" (2007: 74). In my view, whereas (10a) is supported by such considerations as the discussion of (9), it does not have the consequence (10b) unless we adhere to (8), which is not necessary. There is an alternative method of distinguishing terms.

Terms and prototypes

As described by Lakoff (1987:12-57), the theory of categorization based on prototypes, developed in particular by Eleanor Rosch, stands in a long tradition of discussion of definitions. The basic idea is that categories have internal structure. For a concept such as *bird*, some species are more prominent examples than others. The prototype of a bird is often taken to be a robin. Eagles and falcons are less prototypical because they are big and carnivorous. This does not mean that they are less than 100% bird, but people are less likely to think of them when asked to name a bird.

The issue is particularly interesting when we compare non-flying birds, e.g. penguins and oistriches, with flying non-birds, e.g. bats. As Lakoff (1987:45) explains, prototype theory is not incompatible with a strict boundary between birds and non-birds. Penguins and oistriches are non-prototypical birds, but they are still 100% bird. Similarly, bats are 100% non-birds. The point about the common-sense concept of *bird* is that people will hesitate when asked *why* a penguin is a bird but a bat not.

The opposition with terms in mathematical linguistics and in traffic law is not primarily the mere existence of boundaries, but their explicit statement. In zoology, *bird* is a term. Therefore, the boundary of the concept is explicitly specified by means of defining criteria. Simplifying somewhat (cf. Burnie 2002), birds and mammals are distinguished from other animals by being the only warm-blooded vertebrates. Of these, birds have feathers and mammals fur. This clearly motivates why penguins are birds and bats are not. It also has the side effect of removing any motivation for internal structure within the concept of *bird*. Robins and penguins are equally representative.

On the basis of this example, we can interpret the opposition between concepts with prototypes and with strict boundaries as intended in Table 1 as follows. A prototype concept has internal structure, so that some instances are more representative than others. It may or may not have a strict boundary, as illustrated by *bird* and *cup*, respectively. A strict boundary concept is *determined* by necessary and sufficient conditions. Therefore it does not have prototype effects

and each instance is equally representative. The concept of *moped* in (3), but not in (5), and of *bird* in zoology are examples.

When we compare the two criteria represented in Table 1, we see that they are of a fundamentally different type. Specialization is gradual. It is a property of language use similar to register. The division between prototype concepts and concepts determined by necessary and sufficient conditions creates a binary partition. Combining these two criteria does not lead to a coherent concept of *term*. Therefore, I propose to distinguish between *specialized vocabulary* and *terms*, and to reserve the latter for concepts with well-defined boundaries and without prototype effects. Whereas *soft pedal* in piano manufacturing no doubt qualifies as specialized vocabulary (depending on the threshold of specialization adopted), it is not a term under this definition. Of the examples discussed in section 1, only the ones from mathematical linguistics and traffic law qualify as terms.

Term formation

In Jackendoff's (2002) parallel architecture, a word is a piece of information in the mental lexicon of the speaker that links a particular form (the sound image), a set of syntactic constraints governing the range of possible positions of the word in tree structure, and a conceptual representation. The formation of a new word occurs in the mental lexicon of an individual speaker. It is influenced by the existing mental lexicon and by external triggers. These triggers may be of a general perceptual nature (e.g. seeing a new kind of machine) and/or of a linguistic nature (e.g. hearing the word another speaker uses to refer to the machine). In this view of the mental lexicon, words only exist in the minds of individual speakers.

The position of terms is different. A term is a triple of a form, a concept, and a domain. Unlike a word, it is not a natural object and its primary locus of existence is not the mind of an individual speaker. The concept of a term is determined by the set of necessary and sufficient conditions specifying its boundaries. This set of conditions takes precedence over any individual speaker's competence. Ten Hacken (2007) draws a parallel between the nature of such explicitly defined concepts and of a piece of music. Both have an existence that is in principle independent of anyone knowing them.

Term formation can take onomasiological or semasiological routes. The onomasiological route is the classical one. It is typical of advanced sciences and exemplified in mathematical linguistics. A concept is first defined, before a name is chosen to designate it. At first sight, this route seems to correspond to what Sager (1997: 27) calls *primary term formation*, defined as in (11).

> (11)   Primary term formation is the process of terminology creation that accompanies concept formation as a result of scientific and technological innovation or change in a linguistic community.

In semasiological term formation, the starting point is the form (word or multi-word expression) and the formation process consists in determining the boundaries of the concept for this form. It is not the same as Sager's *secondary term formation*, which he defines as "the process of creating a new term for an existing concept" (1997: 27). Secondary term formation occurs when a translation is created for an existing term in another language. Semasiological term formation, by contrast, occurs when an existing general language expression is transformed into a term by the specification of a set of necessary and sufficient conditions determining the boundaries of the concept. This phenomenon is frequent in legal terminology.

Jackendoff (1983) argues that the meaning of a general language word is determined by three types of condition. They are illustrated for *cup* in (12).

(12)   a. A cup is a drinking vessel.

b. A cup has a certain height-width ratio.

c. A cup tends to have a single handle.

Conditions such as (12a) are necessary conditions of the type we need in a terminological definition. A condition such as (12b) is a scalar condition, whereas (12c) is an example of a preference rule. Corresponding to this classification of conditions, there are two main techniques for semasiological term formation. One consists of turning a scalar *condition* into an exact measure. It is used in the definition of the boundary between *moped* and *motorcycle*. Thus, according to (4b), the upper boundary for the size of the engine of a *moped* is at 50cc. The other technique is the selection of criteria among preference rules. We have seen this for *bird*. As a prototype concept in general language, *bird* has a number of properties that should be interpreted as preference rules, e.g. flying, laying eggs, having feathers. In zoology, only one of these is selected to distinguish birds from mammals. As a consequence, this criterion becomes a necessary condition, whereas the others are irrelevant to the term. Therefore, we have flying mammals (bats) and egg-laying mammals (platypus), but no feathered mammals.

It is clear that in principle there cannot be a cline between prototype-based concepts and concepts with strict boundaries. However, there are certain problems with the application of strict boundaries that can be illustrated with the example in (13).

(13)   In case of accidental death of the insured person during the term of the contract, the company will pay a sum of _____ to the designated beneficiary or beneficiaries.

A clause such as (13) may well be part of a life insurance policy. The applicability of the clause turns on the definition of *accidental death*. The insurance company will not pay, for instance, if the insured person deliberately drives off a cliff, because this is suicide, not an accident. Given the nature of the concept of *accident*, however, it is very difficult if not impossible to define its boundaries exactly. Reality has so many dimensions of variation that it is questionable whether it is possible to classify each event unequivocally as an accident or a non-accident. Still, *accidental death* in (13) behaves as a concept with strict boundaries. In each specific scenario, (13) will either apply fully, or not at all. Litigation may be more likely in borderline cases, but (13) by itself does not provide for degrees of accidentality influencing the amount paid.

Medical terminology

Medicine is a rich source of various types of terminology. It is the prototypical example of an applied science. Applied sciences differ from empirical sciences because they are not merely interested in describing and explaining phenomena, but also in solving problems. Whereas the primary purpose of astronomy is to describe and explain planetary and stellar phenomena, medicine is expected first of all to cure or prevent diseases, rather than to explain their causes. At the same time, applied sciences differ from crafts in that they aim to explain why a solution works. A baker does not have to know the chemical details of the working of yeast, as long as he knows how and when to add the right quantity of the right type of yeast to produce a particular type of bread. For a medical doctor, however, it is expected that she can explain why a particular cure will work. As far as the knowledge is lacking, this is considered a deficiency that is serious enough to spend considerable amounts of time and money on research into it.

In the field of medicine, specialized vocabulary and terms in the narrow sense occur side by side. However, their distribution is not random. This can be illustrated by some examples of definitions. These definitions have only been edited by expanding abbreviations.

(14)   a. *Francke's needle*: a small lancet-shaped spring-activated needle, used to evacuate a small effusion of blood [Stedman]

b. *nausea*: symptoms resulting from an inclication to vomit [Stedman]

When we consider the definitions in (14), they are clearly of the same type as the description of *soft pedal* in (6). They indicate and classify the concepts rather than defining them by means of necessary and sufficient conditions. This approach is typical in domains of medicine that are

similar to crafts, such as names of tools and symptoms. Here there is little scope for exact definition and explanation, whereas experience is central. In domains that are more similar to empirical science, we find definitions such as (15).[3]

(15)   a. neck: the region lying between the bottom of the lower jaw and the top of the clavicle [Abrahams (2006:40)]

b. malaria: a disease caused by the presence of the sporozoan Plasmodium in human or other vertebrate red blood cells and transmitted to humans by the bite of an infected female mosquito of the genus Anopheles [Stedman]

The status of anatomy, illustrated in (15a), was discussed above. Nosology, illustrated in (15b), is particularly interesting, because with the increase in understanding the definition of a disease will shift from a set of symptoms to the specification of the cause. The definitions in (15) can be interpreted as necessary and sufficient conditions.

In medicine, we can observe both specialized vocabulary and terms in the narrow sense. As suggested by the examples in (14) and (15), specialized vocabulary tends to occur in more craft-like areas, whereas areas with a stronger scientific flavour tend to have more terms characterized by necessary and sufficient conditions.

Conclusion

What is usually called *terminology* is in some fields characterized by the degree of specialization of the discourse, in some fields by the existence of a concept with exact boundaries, and in some fields by both properties. A coherent concept of *term* cannot be based on the disjunction of the two criteria. I therefore propose to call *specialized vocabulary* the expressions that signal a high degree of specialization of the discourse and to reserve *term* for expressions that designate a precisely defined concept. *Terms* in this narrow sense cannot be described by referring to linguistic competence and language use alone. They also exist as non-mental, abstract entities.

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[3] The definition in (15b) is part of a much longer entry including encyclopaedic information. It is not specifically marked as the definition.

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