

Semantic Dimensions in the Field of Reporting Verbs

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Abstract

This paper proposes a methodology to detect the *semantic dimensions* along which members of a semantic field are distinguished. The notion of semantic fields, while often assumed, has not to date been explicitly exploited in lexicography nor computational lexical semantics. Exploring the semantic field of *reporting verbs* in detail, we suggest that a principled treatment of semantic dimensions leads to more consistency in the definitions of members of the field as well as more concise and computationally more useful entries.

1 Introduction

This paper assumes that there is a perceived need for computational lexica or lexical databases that are consistent, structured, striving for comprehensiveness but admitting that completeness is not achievable. In order to build these lexica, conventional dictionaries will have to be mined for their information. Rigorous lexical semantics will enhance and improve the definitions for individual entries as well as the overall structure of the lexicon (i.e. the connections between entries.) In computational linguistics and as a basis for deriving new printed dictionaries, consistency of description is a key factor. Recent work has addressed the consistency issue. Atkins [Atkins, 1991] has described entry templates for hierarchically structured MRDs that allow the different word senses to be grouped within the entry in a systematic way. Levin [Levin, 1991] discusses the relationship between semantic ‘components’ (*means, manner*) of verbs of sound to their syntactic behavior. This paper addresses the problem of finding a systematic way to define word meaning, i.e. the semantics proper of an entry.

We claim that this research benefits from the notion of *semantic fields* [Trier, 1931], which implicitly underlies most lexical semantics. Levin [Levin, 1991], for instance, uses the notion of a semantic class and characterizes “. . . *the genus word is that part of its [=the entry’s] meaning that a word shares with other hyponyms of the particular genus term selected, and the differentiae are properties that distinguish that word from these co-hyponyms, . . .*”. This is very close in spirit to the basic notion of a semantic field as a collection of semantically related words that cluster around a basic, shared meaning component and are defined as they are distinguished from each other, in particular from their nearest neighbors. This is not to suggest a change in terminology, but in basic approach. While Levin uses the implicit genus term hierarchy to collect words of sound and then studies in detail their syntactic behavior in order to extract the minimally required semantic components for the semantic class (yielding isolated features that do not make up the word’s meaning, but stand isolated and are derived from its syntactic behavior), we propose to look at the semantics of the field first in order to structure the meaning components (here called semantic dimensions) from which to define the individual entries. Using this procedure, some systematic ‘extended senses’ in Levin’s terminology can be detected as a systematic meaning shift rather than described at the level of the individual entry.

Using the field of reporting verbs this paper first identifies some important points about its function and general syntactic structure, then discuss the notion of semantic fields in more detail. The focus is on demonstrating a technique to extract semantic dimensions for a field of reporting verbs partly from existing dictionaries and to show their importance in judging semantic closeness of words. By looking at the entire field of reporting verbs, we are also able to identify a systematic meaning shift for utterance verbs with a change in syntactic behavior which can then consistently be described as a Lexical Implication Rule [Ostler and Atkins, 1992] over all utterance verbs. This methodology is intended to systematize the process of arriving at templates for lexical database entries [Levin, 1991] and meta-lexical rules [Ostler and Atkins, 1992] that reduce the number of explicitly described word entries.

2 The Semantic Field of Reporting Verbs

2.1 Reporting Verbs

Reporting verbs are verbs that can be used to report the speech of others. The importance of reporting verbs for computational linguistics lies in their extremely frequent occurrence in American newspaper articles. Both direct and indirect reported speech are used to establish the source for almost any information or commentary on events. Thus in a frequency count of words¹ on a corpus of Wall Street Journal articles, *said* was the 16th most frequent word. Considering that this is only one form of one reporting verb, the importance of the phenomenon for the newspaper domain is obvious.

Say is by far the most frequent reporting verb encountered. Other verbs include *admit*, *deny*, *insist*, *acknowledge*. These verbs are listed with different syntactic patterns, thus we find

<i>admit (to)</i>	
<i>deny</i>	<i>wrongdoing</i>
<i>acknowledge</i>	

But they can all stand with a *that* complement, as in

<i>admit (that)</i>	
<i>deny (that)</i>	<i>foulplay was involved</i>
<i>acknowledge (that)</i>	

For instance, for *acknowledge* we do not find a *that* complement attested in the Oxford English Dictionary (OED) [Simpson and Weiner, 1989] while it is explicitly mentioned as entry **I.1.b.** for *deny*. This apparent inconsistency is problematic for computational use of dictionaries.

2.2 Meaning Shift

We can resolve some of this inconsistency by noticing that the field of reporting verbs encompasses all utterance² verbs. Thus in their reporting verb sense, all these verbs potentially take a *that* complement (except where blocked.) We can describe this systematic behavior as a Lexical Implication Rule (LIR) [Ostler and Atkins, 1992], that generates derived lexical entries from base lexical

¹The count also included punctuation marks and tags specific to the corpus and was conducted by Ken Church, distributed by the electronic newsgroup "langage.naturel".

²We consider as utterance verbs all those verbs that specifically denote verbal communication and thus include for instance *insist* in its appropriate word meaning.

entries. As with the LIRs described in [Ostler and Atkins, 1992], the meaning shift for reporting verbs is grammatical in nature, not common sensical.

One example of an LIR is:

LIR Vehicle Verb³:

NC singular: vehicle → VTI (verb trans./intrans.): to travel/transport using that vehicle

e.g. He's got a new cycle. / Let's cycle into town.

also *motor, ferry, canoe, ship, jet* etc.

Our claim is that utterance verbs undergo a similar systematic meaning shift from their base form to the evidential reading found in newspaper texts. The semantic difference varies from verb to verb, some base forms already carry an evidential reading, for others it is a major shift. The basic characteristic of the evidential reading is that a *that* complement in a reporting context is quasi factive, where its *credibility* is contingent on who the source is and under what circumstances the reported utterance had been made⁴. We call this the evidential reading because the matrix clause acts as an evidential [Chafe, 1986], indicating the evidence the speaker has for reporting the statement of the complement clause. The role of this device in newspaper articles is to attribute utterances to sources that are relevant to the point in order to maintain “objectivity”⁵.

For reporting verbs we stipulate here:

LIR Utterance Verb – Reporting Verb:

V: utterance → VT [+ *that* complement] OR [+ quotation]: reported utterance

John mumbled something. / John mumbled that he had told you so.

The president declared war. / The president declared that the country was at war.

2.3 Semantic Fields

The reporting verb use of utterance verbs is not always recorded in dictionaries. Human users can easily extend the recorded uses to the reported speech use, yet for computational lexica used for newspaper analysis we need this information to be represented explicitly. It is not sufficient, however, to introduce the **LIR Utterance Verb – Reporting Verb** as stated, we also need a precise definition of the semantic aspects conveyed by the individual verbs if we are to support evidential analysis. To define lexical entries for reporting verbs that are rich enough to allow an evaluation of the credibility of the information in the complement requires that we contrast different verbs. We are following here the basic ideas of Trier, namely that paradigmatic behavior of a word can only be detected when compared to the behavior of other words in the same *semantic field* [Trier, 1931]. This approach is common for syntactic analysis (see [Levin, 1991]) but has not been used for semantic notions to the same degree. One result of contrasting analysis of members of the semantic field of reporting verbs, reported elsewhere, was that interesting preferences of seven reporting verbs emerge when comparing frequency of metonymy concerning *degrees of animacy* in subject position [Bergler, 1991]. Interestingly, the patterns for semantically close verbs were more similar than for semantically more distant words.

To study different words of a semantic field together allows us to perceive ‘deep’ semantic properties and distinguish them from accidental meaning components of individual words. Both are important for the understanding of a word; their distinction is important when judging semantic closeness of ‘synonyms’ and preciseness of antonyms in a given context. However, the study of a semantic field also reveals whether certain syntactic constructs are more closely connected to a

³As described in [Ostler and Atkins, 1992, p. 89]

⁴For more detail on the analysis of reported speech in newspaper articles, see [Bergler, 1992].

⁵Reported speech in itself, of course, guards in no way against bias or subjectivity.

semantic concept or whether, for instance, there are any collocational restrictions on arguments beyond the selectional restrictions.

A lexical semantics for a semantic field must, therefore, address the following points:

- (1) (a) Define the semantic field, i.e. the semantic commonality that all members of the field share⁶.
- (b) Define syntactic and other structural commonalities *typically* shared by members of the field.
- (c) Define the structure of the semantic field, i.e. give the relationships of the members towards other members (see also [Véronis and Ide, 1991]).
- (d) Define a set of semantic dimensions along which the individual words are distinguished.
- (e) Define the individual words as they deviate from the general pattern and each other.

Evidential analysis of reported speech addresses point (1a), namely the commonality that all members of that field share; the commonality is the *function* of these verbs to indicate *credibility* of the embedded statement by linking it to *circumstantial information* about the original utterance.

Point (1b), syntactic and other structural commonalities shared typically by members of the field, is captured in our case by the LIR⁷.

The next section describes (1c), the structure of the semantic field.

2.4 Structure of the Field

The “hierarchies” that lexical definitions in conventional dictionaries form are entangled, shallow and often circular (cf. [Amsler, 1980]). Unfortunately, lexicographers do not consider semantic fields (or even parts of semantic fields); words are defined in isolation, no doubt the reason for some awkward two-item circular definitions in conventional dictionaries.

Nevertheless, contrasting the structure of the “hierarchy” of genus terms and choice of differentiae in different dictionaries yields interesting insights into the implicit semantic dimensions involved. To categorize these and to apply them consistently is a first step towards definition of the entries.

Figure 1 shows the structure underlying the definitions in the Longman Dictionary of Contemporary English (LDOCE) [Procter, 1978]. The LDOCE is a learner’s dictionary and thus keeps the lexical definitions simple, using only a core vocabulary of 2000 words for their definitions. This fact is clearly illustrated in Figure 1 by the central position of *state*, *make known*, and *declare*. LDOCE also focuses on *explaining* words, not *relating* them, resulting in fewer interconnections between words compared to the American Heritage Dictionary or the Oxford English Dictionary. Combined, these two factors explain why the reporting verbs considered form two separate hierarchies in LDOCE⁸.

The roots of the two distinct hierarchies are *make known* and *state*. Several distinctions can be construed: the hierarchy rooted in *make known* seems to focus on verbs that encode an *official* or *formal* aspect, whereas the verbs rooted in *state* focus on *truth*⁹ But likewise, the *state* hierarchy contains those verbs that *presuppose* the proposition of the complement (or its negation) in the

⁶This is similar to the notion of *prototype* (cf. [Rosch *et al.*, 1975]).

⁷In [Bergler, 1992] a more elaborate meta-lexical structure has been defined within the framework of the Generative Lexicon [Pustejovsky, 1991].

⁸This paper only shows a subset of the semantic field. [Rodale and Mulock, 1947] list over 240 members derived from mostly literary works, which is not even a complete list for current usage.

⁹Note that this distinction is not explicit in the dictionary. This step will therefore best be performed by human specialists for maximum accuracy.

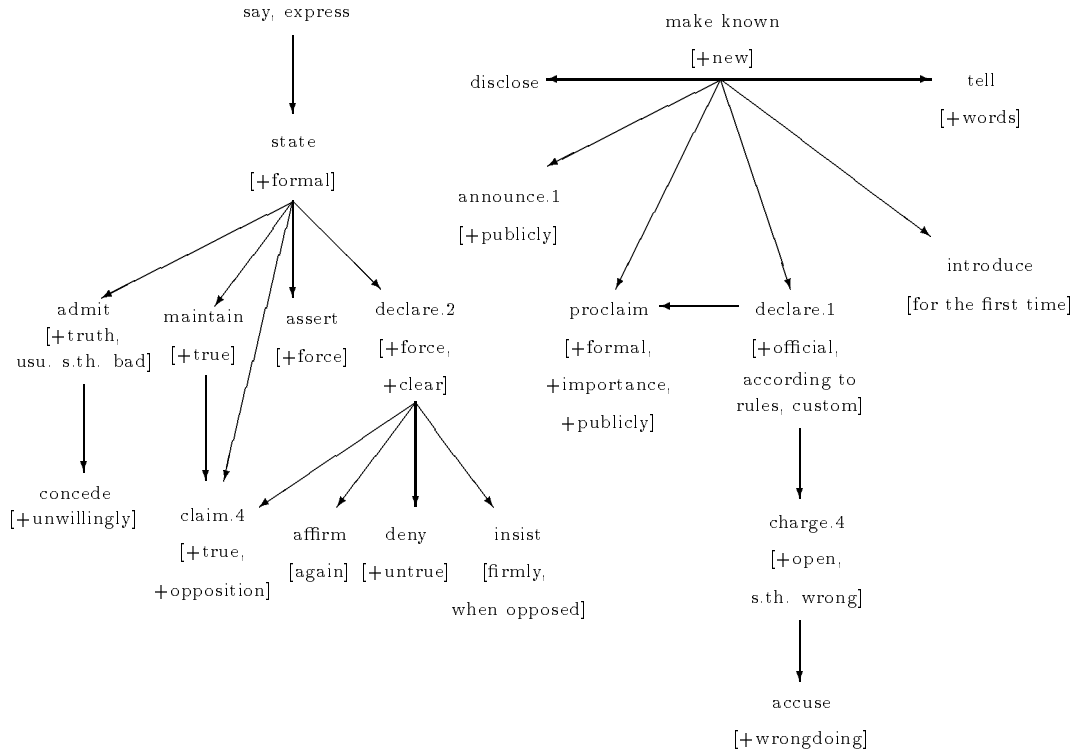


Figure 1: Hierarchy of genus terms in LDOCE.

discourse situation, while the *make known* hierarchy implicitly encodes *novelty* of the embedded proposition.

Figure 2 describes the more connected structure underlying the American Heritage Dictionary (AHD) [Berube, 1987]¹⁰. *Make known* here is the root of the whole tangled hierarchy, focusing on the shared *information* aspect of reporting verbs. Two subhierarchies can be distinguished, rooted in *disclose* and in *state*. This is different from the distinction in LDOCE between new and presupposed information, here the distinction is made between *withheld* information and *new* information (where *new* here encompasses *presupposed*). Aside from this distinction, no further subhierarchies can be determined. The AHD does, however, have word clusters, groups of words that are defined in terms of each other and contrasted with each other. Word clusters are structures that one would expect to find in a semantic field oriented approach, where the basic meaning of the words is determined by the field and the individual word meanings are determined by how they differ from their closest neighbors. Thus, the definition

- (2) **AHD:**
 affirm: to declare or maintain to be true

conveys that to *affirm* can mean both putting forth the statement for the first time (*declare*) or repeatedly (*maintain*).

¹⁰Figure 2 does not contain *say*. This is because *say* is defined as: 1. *To utter aloud.* 2. *To express in words.* 3. *To state; declare.* 4. *To recite.* 5. *To allege.* 6. *To indicate; show.* 7. *To estimate or suppose.* This forms more of a characterization of the field than a definition of a word. I have omitted the many entries for *say*.

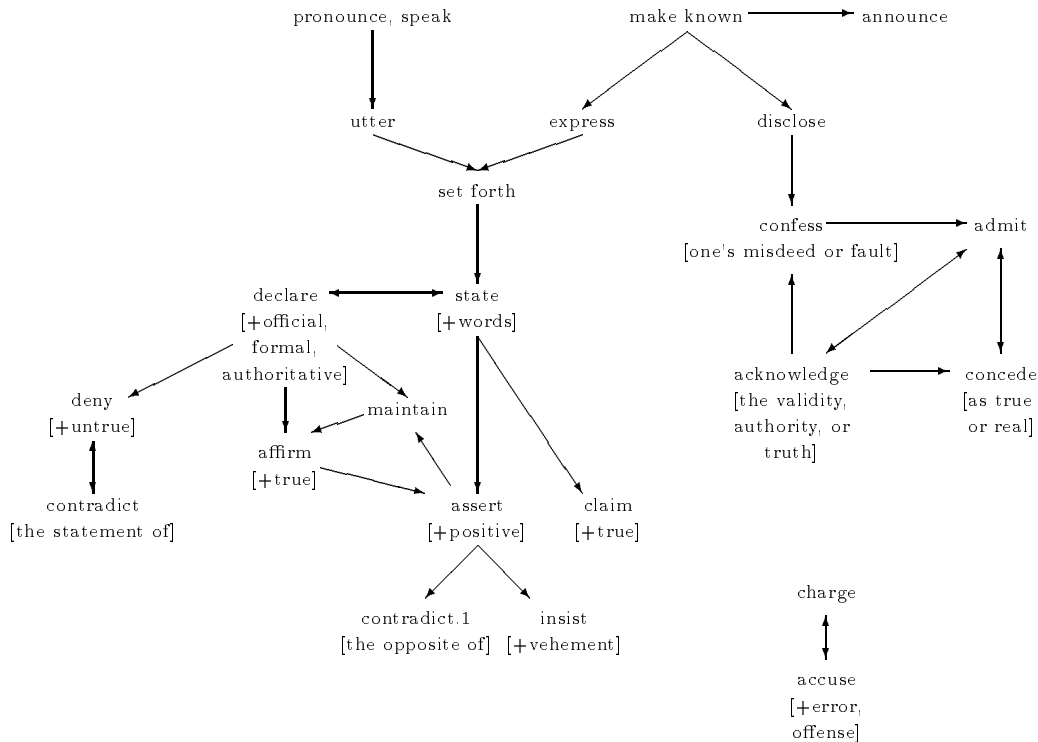


Figure 2: Hierarchy of genus terms in the AHD.

The hierarchies shown here were derived from the pocket versions of LDOCE and AHD. If we consider definition hierarchies in the Oxford English Dictionary (OED), we find many more interconnections, even when we restrict attention to the word senses that most closely describe the reporting verb meaning. The OED exhibits far more word clusters where verbs are defined in terms of each other. Similar to the AHD, the OED focuses on providing synonyms, which taken together will delimit word meaning for the native speaker.

(3) **OED:**

acknowledge: 1. To own the knowledge of; to confess; to recognize or admit as true.

To give an equivalent picture of the definition hierarchy in the OED would require too many links to be useful here. We have simplified the connections by treating a definition such as (3) as a set of relations, where the definiendum is the first element and the genus term is the second element of an ordered pair in the relation, thus (3) contributes (acknowledge, own knowledge), (acknowledge, confess), (acknowledge, recognize as true), (acknowledge, admit as true). From the set of pairs obtained for the verbs under consideration, we delete the pairs that would have a double arrow, i.e. pairs (a,b), (b,a). Then we delete all pairs that can be inferred in the hierarchy, i.e. if we have (a,b) and (b,c) and (a,c), we can delete (a,c). The resulting graph is much simpler and corresponds to a Hasse diagram for partial orderings [Rosen, 1991, p. 390 ff]; while not complete, the resulting graph in Figure 3 allows for easier categorization.

We can distinguish three subhierarchies in the OED, rooted in *state*, *make known*, and *contradict*. The *state* hierarchy, again, largely contains words that presuppose the complement, the *make known* hierarchy implies new information, and the *contradict* hierarchy has negative polarity

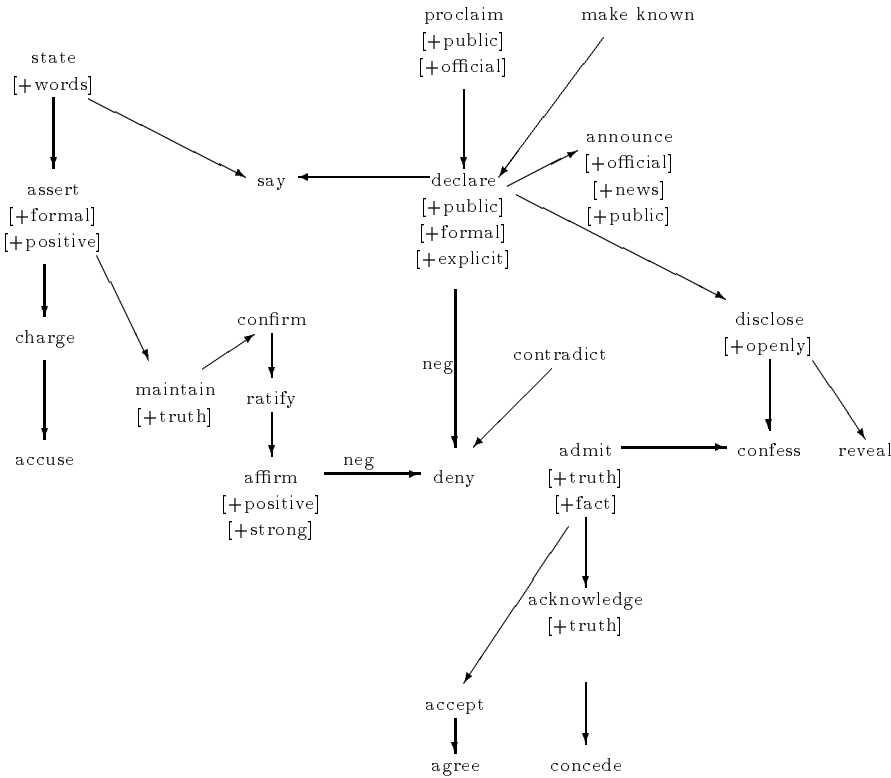


Figure 3: A subset of the hierarchy of genus terms in the OED

for the complement. In a hierarchical lexicon this would have to be explicitly inherited from the entries for *state*, *make known*, and *contradict* or the replacing more general entry.

3 Semantic Dimensions

The previous section describes the semantic field of reporting verbs in an informal way, guided by dictionary definitions and enhanced by a theory of the function and evaluation of reported speech. To define lexical entries in a systematic way, however, we need to specify the set of semantic notions that distinguish the members of the field from each other, as found in the previous discussion. We call these the *semantic dimensions* of the field: polarity of the complement, new versus presupposed information, official or formal context, etc. Semantic dimensions are reflected in the differentiae in dictionary definitions but they have to be carefully categorized. Not every differentia is a semantic dimension. Not all semantic dimensions are made explicit in an entry. A contrastive analysis of the entries together with an analysis of the function of the semantic field in context is required to find the proper granularity of definition of semantic dimensions. For reporting verbs we know that there are three major ‘topics’: the original utterance, the original utterance situation, and the interpretation of the original utterance (situation) by the reporter. All semantic dimensions fall into one of these three areas. Thus, LDOCE encodes about the utterance that it is assumed *true*, *untrue*, *new*, *bad*, or *wrong*. About the utterance situation the entries specify *formal*, *unwilling (source)*, *public*, *official*, or *opposition*. The AHD encodes *true*, *untrue*, *fault*, *misdeed*, *offense*, *opposition*, and *positive* for the utterance and *formal*, *official*, *authoritative*, *vehement* for the utterance situation.

The OED encodes *public*, *official*, *formal*, and *strong* for the circumstance of the utterance, *truth*, *explicit*, *polarity*, and *news* as characteristics of the utterance itself.

3.1 Specifications of the Original Utterance

Voice quality of the source at the time of utterance. The values for *voice quality* range over the entire spectrum of possible voice descriptions (high — *to cry*; low — *to whisper*; clear — *to enunciate*, unclear — *to mutter*, *to mumble*; high pitched — *to shriek*; low pitched — *to groan*; ...). The default is *unmarked*, as in *to say*.¹¹

Explicitness is a scale ranging from *explicit* (*to explain*, *to elaborate*) to *implicit* (*to imply*) with all shades in between (*to hint*, *to suggest*, *to describe*, ...). An ordering of these entries according to increasing explicitness is not useful (and would in any case be subjective). A binary value *explicit*, *implicit* is sufficient; the default is *explicit*, as is the case for *to say*.

Formality is a ternary feature with the default value *unmarked* and the two marked values *formal* (*to address*) and *informal* (*to blurt out*)¹².

Audience has three values, *public* (*to announce*, *to proclaim*), *private* (*to confide*), and the default value *unmarked*. The default assumption that the reporter witnessed the original utterance can always be overridden (*It is reported that X said ϕ* , *Apparently X said ϕ*) explicitly; this is therefore not part of the range of possible values for *audience*.

3.2 Specification of Attitudes toward the Complement Clause

Reporting verbs, here defined as utterance verbs and thus excluding cognitive verbs such as *to doubt*, encode attitudes¹³ of type *polarity*, *presupposition*, *speech act*, and *affectedness*.

Polarity characterizes whether the speaker asserts the complement or its contrary, the values are *positive* (*to insist*) and *negative* (*to deny*). The default is *positive*.

Presupposition refers to the status of the reported clause in the context of the original utterance, the values are *new* (*to announce*) and *presupposed* (*to insist*). The default value is *unmarked*.

Speech Act takes as value any of the generally assumed speech acts (see [Bach and Harnish, 1979]), the default is *inform*.

Affectedness has three values, *positive* (*to brag*) and *negative* (*to concede*, *to admit*) referring to the impact of the reporting clause on the source. The default value is *unmarked*.

3.3 Strength of the Complement

Strength of the complement refers to the reliability, certainty, or credibility of the complement as encoded in the reporting verb by the reporter. *To claim*, for example, has much less strength than *to state*, which is still lower in strength than *to announce*. This semantic dimension is only part of the evaluation of the reported speech. In fact the semantic dimension does

¹¹As observed by Levin [Levin, 1991], verbs of sound can be used to report utterances and to specify voice quality.

¹²This is different from the register of the reporting verb itself, a feature that is called *familiar* or *slang* in dictionaries.

¹³The term *attitudes toward the complement clause* is used here much more restrictively than the term *attitude* is used in the general literature, compare for instance the use of *attitude* in TAMERLAN [Nirenburg and Defrise, 1992].

not even indicate the full impact the reporting verb has on the evaluation of the reliability, certainty, or credibility of the complement but only encodes whether the reporter leaves any room for doubt. The values are *high* strength (*to announce*) and *low* strength (*to claim*) with the default value *unmarked*.¹⁴

3.4 Overview

Let me summarize the semantic dimensions outlined briefly in the previous paragraphs. The list of semantic dimensions is limited to those affecting the field of reporting verbs and even within this field further refinements are possible. Semantic dimensions are in part subjective; different use warrants different granularity in the semantic dimensions. The dimensions given above provide a minimal partition of the field and are supported by the structures implicit in the definitional structure in LDOCE, AHD, and OED.

Coarse Structure	sem. dimension	values		default
Original utterance sit.	voice quality	range : high, low, clear, ...		unmarked
	explicitness	explicit	implicit	explicit
	formality	formal	informal	unmarked
	audience	public	private	unmarked
Attitude to complement	polarity	positive	negative	positive
	presupposition	new	presupposed	unmarked
	speech act	range : request, question, ...		inform
Strength of Complement	affectedness	positive	negative	unmarked
	strength	high	low	unmarked

Figure 4: Semantic dimensions of the field of reporting verbs.

The semantic dimensions of Figure 4 fall into two classes, which I will call *essential* and *optional* semantic dimensions. *Essential* semantic dimensions are those whose default value differs from *unmarked*, i.e. those dimensions that are by default specified by every reporting verb (*explicitness*, *polarity*, and *speech act*) and thus are part of the basic concept or prototype. It is no coincidence that the default values of these semantic dimensions are often seen as a pragmatic basis for successful communication: the Gricean maxims, for example directly specify two of the three default values (“be informative” specifies a default speech act for communication; “be relevant” subsumes that the salient information be explicit; cf. [Grice, 1967]). Positive polarity for the complement clause is generally assumed along with the default assumption that what is being said is also being asserted, i.e. has positive polarity.

Reporting verbs will typically only encode one *optional* semantic dimension, putting the specified optional dimension into *focus*.

4 Judging Semantic Distance in Different Contexts

The usefulness of a system of semantic dimensions becomes obvious when we consider possible classifications of some reporting verbs¹⁵.

¹⁴Note that strength is not frequently mentioned in the genus hierarchies in Figures 1-3 but is consistent with our analysis of the usage of reported speech [Bergler, 1992]; this is in fact how a field analysis can enhance dictionary structure.

¹⁵Figure 5 uses “-” for *unmarked*.

Verb	Voice	Explicit	Formal	Audience	Polarity	Presup.	Speech Act	Affect.	Strength
thunder	loud	explicit	-	-	pos.	-	inform.	-	-
say	-	explicit	-	-	pos.	-	inform.	-	-
claim	-	explicit	-	-	pos.	-	inform.	-	low
affirm	-	explicit	-	-	pos.	presup.	inform.	-	high
concede	-	explicit	-	-	pos.	presup.	inform.	neg.	-
deny	-	explicit	-	-	neg.	presup.	inform.	neg.	-
allude	-	implicit	-	-	pos.	new	inform.	-	-
announce	-	explicit	-	public	pos.	new	announce	-	high
declare	-	explicit	formal	public	pos.	new	announce	-	high

Figure 5: Semantic dimensions for some reporting verbs.

One way to judge semantic distance (and therefore contexts in which words are synonymous) is by finding minimal difference in specified semantic dimensions. Thus in a formal context, *declare* and *announce*, even possibly *say*, are equivalent, because the context already specifies [+formal], thus lexicalisation of this aspect is not required. *Thunder* and *say* are fine synonyms in the appropriate context, because the difference in the dimension *voice quality* is *loud* against *unmarked*, a difference that can easily be expressed using an adverb, if required. However, *announce* and *affirm* can never be substituted (unless clearly marked as irony or such), because they lexicalize opposed values on the dimension *presupposed*. Thus semantic dimensions also make incompatible implications explicit, as well as requirements for the context in which substitution is legitimized.

To the computational linguist semantic dimensions provide one important component to tackle the problem of compositional semantics: should all reporting verbs internally be represented as *say* and what was their individual contribution? For the analysis of credibility of reported speech in newspaper articles we are currently investigating the influence of the dimensions *presupposed*, *affectedness*, and *strength*.

Semantic dimensions do not define the entire word meaning, for instance *to allude* and *to insinuate* could not be distinguished on the basis of the dimensions sketched out here. But they provide typical features of a semantic field and thus a ‘template’ for word meaning. It is beyond this paper to discuss how finer distinctions can be derived systematically to further distinguish words that share all semantic dimensions.

5 Conclusion

This paper has outlined a methodology for the systematic categorization of semantic information contained in conventional dictionaries into *semantic dimensions* for an entire semantic field. The notion of semantic field groups entries that share a basic definition and differ from each other in ways often described explicitly in current dictionaries. But while dictionary entries are compiled in isolation and thus no systematicity can be found between different semantically related entries, a semantic field analysis as outlined here first considers the structure of the entire field, then describes relevant semantic dimensions and lastly defines the individual entries in terms of the basic definition of the field, the semantic dimensions, and additional, finer grained differentiae.

While this process cannot currently be done automatically, improvement in corpus analysis tools (and availability of different kinds of corpora) together with automated dictionary conversion tools will enable us to explore the notion of semantic fields in practical terms and hopefully result in a computational (and computationally tractable) theory of semantic fields for practical applications. Then we could achieve for semantics what recent research has done for syntactic information: open

the compiled wisdom of existing dictionaries for use in computational linguistics and improved lexicology.

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