Words, Concepts and Meaning Representation

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Abstract:

The complex nature of words renders a sufficient description of language a nightmare for language specialists. A word is a culturally familiar linguistic unit that is said, heard, written or read according to peoples' mutual intentions, knowledge and command of the language. Traditionally, natural language is a combination of words comprising sound sequences that may be combined to form sentences with different constructions and meanings. This paper attempts to explore the mystery of words with regard to their form, meaning, conceptual relations, knowledge about words and their meaning representation. The aim of this paper is to shed some light on the neglected status of lexical semantics in linguistics. It considers a range of analytical issues including lexical polysemy, lexical semantic and relations. This paper also provides a representation of problematic words or lexical items in both English and Arabic. One other

issue of a great importance in this paper is about the psycholinguistic notions of interest to lexical semantics and how words are reptesented in the human memory or in the so called the human mental lexicon.

1. Introduction:

Words are combinations of units, 'morphemes' that are identified by, but not as, combinations of sounds (phonemes). For example, the verb *drive* is a minimal verb, which may enter into other forms like *drives, driving, driver, driven.* when it is followed by other parts called formative morphemes such as *–es, -ing, -er etc*. Some words differ from each other in both form and meaning. Other words have the same form but carry different meanings. Others are different in form but similar in meaning. According to Matthews (1974:11) "Words do not have a structure about which a 'theory' may be formulated.", and it is not words that form the basis of the primary or grammatical articulation. However, the view about words might be different to different linguists, lexicographers and psycholinguists. This paper will highlight the following points:

o Is it possible to select the correct sense of a word in any given context? Word senses are permeable as they overlap and make reference to other senses of the word;

o Is it possible for any representation to express multiple syntactic forms and not to separate word senses for each syntactic type ignoring the relation between words;

o Is it possible for any representation to cover the complete range of usages for a lexical item?

2. Words, their Form and Meaning:

The study that approaches the minimal linguistic units or morphemes is known as morphology. Morphology is about the explanation of the

recurrent properties of morphological systems and the description of the correspondence between meaning and morphological expression i.e. the relation between meaning and form. "The goal of morphology is to provide a theory within which word structures in all languages can be described". (Jensen, 1992:1) Any morphological study must deal with the identification of morphemes, i.e. "dividing words into parts and assigning meaning to the parts." (Bybee, 1985:10) According to Jensen (1992:2) "morphemes are primarily structural units and they are typically but not necessarily meaningful".

A word form may contain only one morpheme, as in /*haus*/ '*house*' or it may be composed of two or more morphemes as in /*hauziz*/ '*houses*', where '*house*' is the (stem) of the word while '-*s*' is an (affix). A morpheme can be classified as *free* where it can stand as a meaningful word by itself or *bound* where it requires joining with other morphemes to make a word.

Our main concern here will be directed towards morphemes or units that have a status as words on their own right, i.e. lexemes that can carry or express meaning independently or in combination with other elements. By lexemes we mean that minimal unit, as a word or a stem, in the lexicon of the language, e.g. '*go, gone, going*' are all members of the English lexeme '*go*'. "The lexeme is in an important sense an abstract, indivisible entity-simple, compound or 'derived' alike." (Matthews, 1974:38).

3. The Notion of Meaning:

What does a word mean? Moisl (2003) argues that meaning is a notoriously slippery notion, but central to it is denotation, the connection between a word and what it refers to. What a word refers to is our mentally stored experience of that word and what it denotes in the real world. In other words, a word refers to knowledge in the mind that forms the

memory of certain shapes, sounds, tastes, events etc. in the real world that we have experience of, or learn about. What is involved in knowing a word? Miller (1999) provides a substantive interpretation of that question as: "What does a person who knows a word know?" He assumes that the ready answer is that a person who knows a word must know its meaning(s). The ability of knowing the meaning of a word is the skill of incorporating that word appropriately into meaningful linguistic contexts. Before going any further, it is worth examining some words in Carlin (1997) cited in Yule (2010). "The words *Fire Departmen"* sound like they're the ones who are starting fires, doesn't it? It should be called the "Extinguishing Department." We don't call the police the "Crime Department." Also, the "Bomb Squad" sounds like a terrorist gang. The same is true of wrinkle cream. Doesn't it sound like it causes wrinkles? And why would a doctor prescribe pain pills? I already have pain! I need relief pills!

Cronbach (1942) cited in Miller (1999) describes different kinds of knowledge of a word as the ability to define it, the ability to recognize situations for using it, knowledge of its alternative meanings, the ability to recognize inappropriate uses of the word, and the availability of the word for use in everyday life.

Goddard and Wierzbicka (2013) introduce and examine key expressions from different domains of the lexicon - concrete, abstract, physical, sensory, emotional, and social. They focus on complex and culturally important words in a range of languages that includes English, Russian, Polish, French, Warlpiri and Malay. It is a vital task for any study to explore basic words like men, women, and children or abstract nouns like trauma and violence; describe qualities such as hot, hard, and rough, emotions like happiness and sadness, or feelings like pain. Any study must examin relations between meaning, culture, ideas, and words.

A word is a linguistic object or a label used to denote an object and what it denotes is a non-linguistic object, that is, a concept in the mind. "Concepts are mental constucts, abstractions which may be used in classifying the individual objects of the inner and outer world." (British Standard Recommendation for the selection, formation and definition of technical terms, BS. 3669:1963, in Sager 1990:23) Concepts are those objects that represent all fields of knowledge and human activity. "A remarkable feature of human thinking is our ability to combine concepts and, in particular, to understand new combinations of concepts (Gärdenfors, 2000). The classical or Aristotelian view of concepts assumes that all instances of a concept have one or more common properties that are perceived as necessary and adequate in order to define a concept. According to this theory, concepts are formed by means of recognition of similarities among entities where a formation of any concept progresses from the specific entities to the general ones. However concepts may vary in their defining features which might be difficult to specify. That is to say concepts may vary in the degree to which they share certain properties. Another identical approach adopted by prototype theory which was developed in the 1970s, by Eleanor Rosch, as an alternative to the classical theory of concepts. This theory suggests that a concept is a summary description of an entire class. According to this approach, concept representation is a process of placing given objects in a particular category, thus organizing the world knowledge into categories and classifying concepts in relation to other concepts. Results of their experiments suggest that some members within a particular category are found to be typical examples which are called '*prototypes*'. Categories are represented in a hierarchical structure organized in several levels in descending order from the more generic to the more specific, e.g., animal, chordate vertebrate, mammal, placental, carnivore, canine, dog, etc.

For any theory to achieve an adequate representation of possible meaning relations, it has to have a clear notion of well-formed and richer semantic representations. Any approach must find an answer to the following questions:

o How do words behave in different contextual structures?

o What is the simplest means of encoding sense variations?

o Can the approach to lexical design address the real nature of polysemy?

o Is the data adequately described, and what are the necessary components of an adequate semantic description?

o Is it a learnable system that the theory suggests?

4. Lexical Semantics and Knowledge Representation:

Lexical semantics deals with the meaning of content words and focuses on topics such as ambiguity and the meaning relations between words. "Not only can words be treated as 'containers' of meaning, or as fulfilling 'roles' in events, they can also have "relationships" with each other" (Yule 2010). We often recognize or explain the meaning of a word in terms of its relationship with other similar or opposite words or in terms of a word as kind of something or part of something etc.

Word meaning has received less concern in linguistic semantics than sentence meaning especially after the Chomskian revolution of the 1950/60s. The modern movement known as lexical semantics has shifted the focus from the sentence level to the word level and the representation of the word in the lexicon. That is to say word meaning became the centre of interest to linguists "without, however, reviving the theoretical perspective, i.e., reasoning about the nature of meaning, or methods, e.g., lexical fields, componential analysis of word meaning etc., of their predecessors" (Nirenburg & Raskin, 2001). Lexical semantics assumes that words in isolation do have meaning. This is due to the fact that a sentence acquires

its meaning by virtue of the words that compose it and the manner of their combination.

Lexical semantics is currently playing a crucial role in computational linguistics due to the fact that lexical entries in any representation must contain a considerable amount of information related to the word-sense. "Knowing a word is generally considered to be a matter of knowing the word's meaning, and meaning is one of those concepts of great importance for understanding the nature and limits of psychology" (Miller 1999: 19).

Psycholinguistic notions of interest to lexical semantics provide us with a good idea of how concepts are organized in the human memory and how desired information is accessed in the *mental lexicon* i.e. a language user's knowledge of words. "Psycholinguistics unifies principles of Linguistics, Psychology and Cognitive Science, and can be defined as "the study of the psychological processes by which human beings learn and put into practice a natural language system" (Di Felippo & Dias-da-Silva, 2004). In our mental lexicon, the inventory of lexemes stored in our brain is drawn up to enable us name things, recognize words and convey thoughts in a way intelligible to others. Psycholinguistics studies the psychological processes by which the natural language system is learnt and practiced by humans. The leading role played by psycholinguists is apparent in number of models of knowledge representation designed. "The importance of ideas in psycholinguistics may be illustrated by its influence on artificial intelligence, in particular in knowledge representation." (Saint-Dizier & Vigas, 1995:1).

Knowledge representation is about how to store and manipulate knowledge in an information system in order to perform certain tasks using various mechanisms. "Knowledge representation developed as a branch of *artificial intelligence* – the science of designing the computer systems to perform tasks that would normally require human intelligence." (Sowa,

2000: xi) Representing knowledge poses a central problem for many artificial intellegence applications including machine translation, speech recognition and information retrieval systems. Knowledge representation is a central issue in arranging knowledge and processing concepts in an information system. It poses certain difficulties in the way knowledge is stored, manipulated and used by mechanisms to accomplish a given task. These difficulties lie in knowing how is knowledge represented in the human mind and how human language is manipulated in the human mind in order to match the way it works.

Knowledge representation is a multidisciplinary subject, which according to Sowa (2000), employs and applies techniques from three other areas namely logic, ontology and computation. *Logic* provides the formal structure and rules of inference without which knowledge representation is vague as there must be criteria to determine whether a statement is redundant or contradictory. "*Ontology* defines the kinds of things that exist in the application domain" (ibid 2000:xi). Ontologies form a vast domain in artificial intelligence in general and lexical semantics in particular. For lexical semantics "ontology is a formal system that aims at representing for a given domain by means of basic elements, different concepts and their related linguistic realization." (Saint-Dizier & Vigas, 1995:19). It provides well defined terms and symbols to avoid confusion. *Computation* supports the applications that implement logic and ontology in computer programs to perform certain tasks for certain domains. Thus, "Knowledge representation is the application of logic and ontology to the task of constructing computable models for some domain" (Sowa, 2000: xii).

The process of lexical knowledge representation begins by determining the type of knowledge which has to be modelled in order to develop formalisms for the representation of any given domain or subject matter accordingly.

5. Lexical Semantic Relations:

Lexical semantic relations refer to connections between senses of the same word as well as connections that occur between senses of different words. Sense relations within the same word are of two types: polysemy and homonymy. Polysemy ocurrs where words carry a number of different associated meanings whereas in homonymy the different meanings of a word are unrelated. There are two types of lexical semantic relations that occur between senses of different words namely, hierarchical and non-hierarchical. Hierarchical relations include taxonomies such as the subordinate/ superordinate relation (X is subtype of Y) in the hierarchy of hyperonyms/hyponyms or (X is a part of Y) in meronymies. Non-hierarchical relations are mainly of two types: synonymy and antonymy. Synonymy refers to the relation between words of different form and similar meaning where a word can be replaced by another (synonym) in a given context without affecting the contextual meaning as in '*car*' and '*automobile*'. Antonymy is the semantic relation that holds between two words that can, in a given context, express opposite meanings as in '*far*' and '*near*'. Our main discussion here is directed towards sense relations within the same word: such as polysemies and homonymies.

One of the most striking problems in semantics, lexicography and natural language processing is the problem of polysemy where many words can carry multiple meanings or senses. The term 'polysemy' is used both in semantic and lexical analysis where it implies a word with multiple meanings or senses. Although such words generate little difficulty in everyday communication among people, they do seem to pose serious problems of understanding of actual sense for linguists and lexicographers.

The fundamental problem posed by polysemy for computation is that "particular words can take on an almost indefinite number of subtle

meaning variations. These variations can stem from regular sense extension processes, be induced by contextual factors, or result from metaphorical or metonymic extensions" **(**Verspoor, 1997)**.** Before proceeding any further let us examine the words in Table1, which lists some English common words with the greatest number of senses in the Merriam-Webster Pocket Dictionary (Data from Hirst, 1987). The fourth column shows the number of senses we counted in the WordNet 1.7 lexical database, Princeton University.

Table1. English common words with the greatest number of senses

Word	Category	Senses in Merriam Webster	Senses in WordNet
go	verb	63	30
fall	verb	35	32
run	verb	35	42
way	noun	31	12
work	verb	31	18
do	verb	30	13
draw	verb	30	33
play	verb	29	29
get	verb	26	37
form	noun	24	15
make	verb	24	48
strike	verb	24	18
turn	verb	19	12
take	verb	24	41
dead	adj	21	21
good	adj	21	25
have	verb	21	21

Word	Category	Senses in Merriam Webster	Senses in WordNet
line	noun	21	29
pass	verb	21	25
touch	verb	21	15
dry	adj	20	16
wing	noun	20	8
draft	noun	19	11
give	verb	19	
turn	noun	19	12

A word with several related senses is said to be polysemous as in '*door', 'body', 'tube'* etc. while words or forms with several semantically unrelated senses are said to be homonymous as in '*bank'* (a financial institution or river side). "A case of homonymy is one of an ambiguous word, whose different senses are far apart from each other and not obviously related to each other in any way. Cases of homonymy seem very definitely to be matters of mere accident or coincidence (Hurford & Heasley, 1983:123).

The field of lexical semantics deals with the phenomenon of ambiguity and lexical selection and interpretation processes. Much research has been devoted to the study of the dimensions of lexical ambiguity, anticipating the construction of a lexical model that is able to account for these dimensions. This important issue has led lexicographers and computational linguists to become more concerned with the theoretical issues, such as polysemy, than linguists. Linguists deal with polysemy as a phenomenon that may be linked with both homonymy and metaphor. The main concern here is how a given item can be interpreted in more than one way and how related these meanings are. Weinreich (1994) and

Pustejovsky (1995) identify two types of lexical ambiguity, namely contrastive ambiguity and complementary polysemy.

5.1. Contrastive Ambiguity:

A lexical item may carry two distinct and unrelated meanings, i.e. homonymy. A homonym can be defined as a word with no relationship between its senses, as in the word *bank* where the first sense refers to a river side and the second to a financial institution. Ambiguity and polysemy of nominal forms represent an important concern which affects the organization of word meaning. The basic distinction between what Weinreich (1994) termed contrastive and complementary ambiguity should involve different solutions for the representation of lexical knowledge. Contrastive ambiguity, as manifested by words such as *bank* (financial institution or river side) is handled by multiple representations for the clarity of senses. However it is claimed that this type does not form a significant problem in the language since contrastive ambiguity between two unrelated senses of a word, tends to be a historically accidental and idiosyncratic property of individual words. Hence "we don't expect to find instances of the same contrastive ambiguity replicated by other words in the language or by words in other languages" (Dyvik, 2003).

5.2. Complementary Polysemy:

This type of lexical ambiguity occurs in cases where a single word has multiple senses which are related to one another in some predictable way. It is claimed that ambiguity can result from senses which are manifestations of the same basic meaning of the word depending on the context it occurs in. The manner in which senses are related in complementary polysemy is the factor that distinguishes it from contrastive ambiguity where senses have no contextual relation. Accordingly, a word

like '*door'* has two related senses being (physical object or aperture). So, knocking on the '*door'* (physical object) is different from going through the same '*door'* (aperture). Let us first examine the senses of the Arabic word for '*door'* in order to figure out how words behave in different languges and how sense extensions vary from one language to another:

bab (door/chapter)
sense$_1$ = *physical object*, e.g. I painted the front door.
sense$_2$ = *aperture*, e.g. Adam went through the door.
sense$_3$ = *written communication (book chapter)*, e.g. I started a new chapter of my thesis.

The third sense in Arabic refers to opening/entering (or going through writing/reading) a written text. This sense might be extended from the notion of '*opening'* as in '*open the book'* or '*open a new chapter'* compared to '*open the door'*. Therefore, it is an instance of complementary polysemy not contrastive ambiguity because of the shared collocate with the verb to open.

It is claimed that complementary polysemy poses a serious problem not only in one language but also would normally be projected into other languages. The English word '*lamb'*, for example, is said to denote two different senses: a count noun *animal* and a mass noun *meat* whereas in Arabic the word '*haml'* (lamb) and its synonyms '*kharu:f*' (*lamb/sheep*) refer only to the count noun '*animal'*. It seems that it is only accidentally, in English, that this noun is classified as polysymous because it refers to both *animal* and *meat*. This may be because it is linked with small masses like '*chicken, eggs, snails'* where complementary polysemy is of less occurrences. More interestingly, the polysemy in the case of *lamb* is only temporary and will disappear as the lamb gets old and becomes a sheep. The second sense for '*lamb'* as mass noun '*meat'* can only appear in Arabic

if the word *lamb* occurs in a compound as in '*lahm kharu:f*' (*sheep meat/ mutton*) where the complementary polysemy is completely absent. However, Arabic and English interpret other masses the same way whether large or small, like '*fish', 'chicken', 'eggs', 'potatoes' etc.,* where complementary polysemy may occur equally in both languages:

1. I did not like the fish we had for lunch.
2. I went to see the dead fish at lunch time.

An example showing complementary polysemy for the noun fish as count/mass relation:

1. 'John likes <u>fish</u> for lunch.'
2. 'John swims like a <u>fish</u>.'

fish$_1$

CAT = *mass_noun*

GENUS = *flesh*

fish$_2$

CAT = *count_noun*

GENUS = *animal*

Although these two representations of the noun '*fish*' lack the necessary logical relation between them, they are distinguished by type, as an important factor for compositionality, which mainly depends on what the basic lexical categories of the language denote. A modification to this representation introduced by Pustejovsky (1995) stores complementary senses in a single entry, distinguished by sense identification number. This approach, adopted by many theoretical and computational researchers, is structured to differentiate between contrastive and complementary senses when representing a lexical item.

Fish

SENSE$_1$

CAT = *count_noun*

GENUS = *animal*

SENSE$_2$

CAT = *mass_noun*

GENUS = *meat*

Before moving any further let us examine this representation through applying it to Arabic. The Arabic word '***?ain*** عين ' can refer to several morphologically and semantically related senses as well as to morphologically but semantically unrelated senses.

a. Complementary senses for the Arabic word '*?ain* عين ':

?ainعين

SENSE$_1$

CAT = *noun*

GENUS = *organ_of_sight*

SENSE$_2$

CAT = *noun*

GENUS = *watcher*

SENSE$_3$

 CAT = *noun*

GENUS = *aperture_ hole (as in a needle)*

The above, modified structure provides the distinction between different polysemies and shows that they are semantically related. The above senses can also be compared to contrastive senses related to the same word form '*?ain* عين '.

b. Contrastive sense for the Arabic word (*?ain*):

?ain عين

CAT = *noun*

GENUS = *ground_water_source* عين الماء

One important characteristic of this representation is the ability to include with each sense more significant information about the form, meaning, pronunciation, etymology, part of speech etc. that distinguishes it from other senses. Such information provides more clarity for word sense disambiguation WSD and participates in creating links between and among similar or different words and concepts that enable encoding various semantic relations like synonymy, antonymy, hyponymy etc.

There are cases in Arabic where a word may carry multiple but related senses as in the noun '*sawt/aswat* صوت/أصوات ' where it can be classified as complementary polysemy according to its interpretation in Arabic:

$sense_1$ = vote: an *indication* of a choice or opinion that is made by voting.

$sense_2$ = voice: sound produced by *speaking* or singing.

The common morphological derivation of a pair of nouns in Arabic provides evidence for their relatedness as polysemes. The Arabic word '*sawt*' (*vote*) and '*swat*' (voice) are apparently derived from the same un-augmented tri-literal root '*s w t*' (sound). In addition, the '*indication*' of vote in $sense_1$ one refers to verbal consent '*speaking*' in $sense_2$.

1. *hada fariq ?add al aswat* هذا فريق عد الأصوات (This is a vote counting team).

2. *hada fariq tasji:l al aswat* هذا فريق تسجيل الأصوات (This is a voice recording team).

The two senses can be classified as complementary polysemy rather

than contrastive senses i.e., to '*vote*' is to primarily '*say*' who or what you are in favour of. Example 2 above also shows that the word '*aswat*' denotes two senses: '*votes*' and '*voices*' as unrelated to one another when modified by '*tasji:l*' (recording) which denotes the recording of voice as well as writing down (in a record) the names of the voters (votes). Therefore example 2 can be interpreted as having these two contrastive senses:

hada fariq tasji:l al aswat هذا فريق تسجيل الأصوات :

a. This is a voice recording team. (audio recording)
b. This is a vote recording team. (writing)

This word gets even more ambiguous in its proper context than on its own or in a lexicon as in the following example:

hadihi aswat alnakhibi:n هذه اصوات الناخبين .

The word '*aswat*' in this context refers to two different senses:

a. These are the voices of the electors.
b. These are the votes of the electors.

Ambiguity varies between two languages when one borrows a word from the other. In this case, polysemy projects into the borrowing language from the source language but not the opposite. The term '*alqaida*' borrowed from Arabic to refer to a group of extremists in Afghanistan known by this name and classified as a terrorist organization. This proper name of this entity is derived from the meaning of '*the base*'. Since proper names are not translated, as illustrated in the example below, the polysemy in this case occurs only in Arabic but not in English. In other words, the sentence '*The Americans attacked Alqaida*' carries one sense in English whereas in Arabic is interpreted as having two senses:

alamrica:n yuha:jimu:n alqaida الأمريكان يهاجمون القاعدة .

a. The Americans attacked Alqaida. (terrorist group based in

Afghanistan)

b. The Americans attacked the base. (a military base)

6. Conclusion:

No one would argue about the importance of a reliable semantic lexicon to handle such different and/or related senses of words and concepts. However, there should be an agreement on how to represent lexical data to be easily manipulated by computers in order to encode any semantic relations between senses and to carry out various applications of a conceptual lexicon such as word sense disambiguation (WSD), lexical chains etc.

It seems, therefore, a fundamental task to us, to figure out similarities and differences among a variety of computational linguistic lexicons in terms of the similarities and differences of the approaches that underlie those lexicons. For any lexicon to cover and represent adequately the semantics of the lexicon is to take into account the following points:

o To focus on establishing relations between the senses of lexical items not by merely listing them;

o To build up a consistent criterion for sense selection and coverage;

o To be able to cover the complete range of usages for a lexical item.

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