Fuzzy Logic and its Application in Linguistics
المنطق الضبابي وتطبيقاته في علم اللغة

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0. Introduction

The purpose of this paper is to shed light on the concept of fuzzy logic ,its application in linguistics ,especially in language teaching and the fuzziness of some lexical items in English.

Fuzziness means that the semantic boundaries of some lexical items are indefinite and ideterminate.Fuzzy logic provides a very precise approach for dealing with this indeterminacy and uncertainty which grows (among other reasons) out of human behavior and the effect of society.

The concept of fuzzy logic has emerged in the development of the theory of fuzzy set by Lotfi Zadeh(a professor of computer science at the university of California) in 1965.It can be thought of as the application side of the fuzzy set theory. In linguistics, few scholars have dealt with this phenomenon, among them, Lakoff (1972), Labov (1973), and Aitchison (1994). Consequently, very little literature is available on this concept in linguistics. The researcher has to collect bits of information scattered in various fields of knowledge.

The paper is of three sections: section one surveys briefly some of the semantic terms which are closely related to lexical fuzziness, since it is a problem of meaning by nature, like denotation versus connotation and intension versus extension. Section two is of two main parts. The first explores in detail the emergence of fuzzy logic, shedding light on its development and the criticism to it. The second part is devoted to lexical fuzziness, trying to discover its characteristics, the reasons behind its existence in languages, its relation to other similar concepts like vagueness, its application in teaching a second language and some other related titles.

Section three analyzes the difficulties of translating fuzzy lexical items and the causes of such difficulties, supporting the viewpoint by empirical evidence, that is, giving some examples of fuzzy lexical items and their translations. Unfortunately, the researcher could not find even one article on translating fuzzy lexical items. This paper is supposed to be a humble attempt to fill this gap. The paper ends with conclusion and references.

1. Lexical Meaning

1.1 Preliminaries

The problem of fuzziness cannot be studied without exploring the nature of meaning since it is part of the problem of meaning in general. Whether or not lexical items have fixed meaning is a question of a long debate among scholars of various fields of knowledge, i.e., philosophy, psychology, linguistics and mathematics. Thus, each discipline has developed its approaches or tools for the analysis of meaning. Waugh and Herbert (see Aitchison, 1994:39) support the viewpoint that lexical items are precise tools which should be used with care and accuracy. There exists a basic meaning for each lexical item i.e., lexical items have fixed meanings; they are tools of thought, and we should not use the wrong tool. They suppose that educated people will know exactly which lexical item to use when because in the course of their education, they will have learnt precisely what each word means.

The other viewpoint argues that lexical items cannot refer to fixed meanings; lexical items [1] in human language have vague boundaries and fuzzy edges. One of the main advocates of this viewpoint is Lakoff (1972:341) who argues that "words have often been called slippery customers, and many scholars have been distressed by their tendency to shift their meanings, word meanings cannot be pinned down, as if they were dead insects. Instead, they should be likened to fish which slither out of one's grasp" This alternative viewpoint is called "fuzzy meaning assumption".

The notion of a fixed meaning is promoted mainly by lexicographers and schoolmasters since their jobs would be simpler if lexical items have precise meanings. Philosophers, linguists and psychologists are found on both sides of the debate. Aitchison (1994:40-41) adopts a third viewpoint: she sees the meaning of a lexical item as overlapping with its concept (in the external world) to a large extent, though not necessarily totally. People translate the real world into concepts which reflect the external world fairly well, in that there is likely to be considerable agreement over what they are, even between people speaking different languages.

Meaning is a flexible and contingent matter. It is subjected to a wide range of semantic phenomena like the defeasibility of semantic traits, fuzzy boundaries, context dependence, and so on. Meaning for Anolli (2005:3) is a marvelous and dreadful matter. The starting point of this challenge is that meaning is neither

totally intelligible nor totally unintelligible. It is impossible to gain the entirety of meaning hold in a lexical item or in an utterance or in a gesture.

Historically speaking, philosophy, logic, linguistics and semiotics, sociology, anthropology and psychology coped with the challenges of meaning. Furthermore, phonology, syntax, semantics, and pragmatics are areas where each tries to use its own generative capacities in defining the meaning structure. As Jackendoff (1997: 11) underlines, there are correspondences across phonological, syntactic, and semantic representations, but such correspondences may be partial and not one-to-one. In human language, there is an enormous range of ambiguities requiring at least a one-to-many correspondence between the lexical item and its meanings. Ogden and Richards (1923:62) diagramed meaning in a semiotic triangle:

Representation

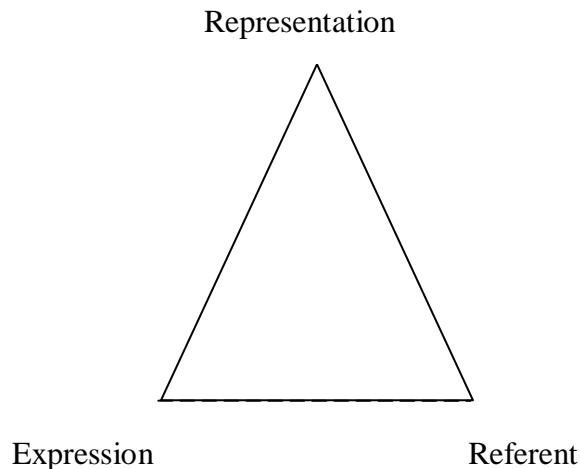Expression   Referent

Figure (1). Semiotic Triangle (after Ogden & Richards)

In this diagram, expression means every sign which is able to generate a meaning between the interlocutors (i.e. an utterance, a word, a gesture, and the like). In turn, representation should be considered as a mental schematic image extracted from all the modes of experience, and indicates the manner (or way) in which an expression designates its referent. It is a mediating term, as individuals understand a referent through the mental representation of a given expression. Last, referent means the object, the event or something else in a (real or possible) world. According to this point of view, meaning may be defined in a threefold manner: (a) the meaning of an expression is the state of things to which the expression refers; (b) meaning is the relation that each linguistic item entails with all the other elements; (c) meaning is the mental image that connects an expression to the correspondent referent.

On this ground, three main theoretical approaches/theories for meaning analysis have been developed: referential/truth-conditional, structural/linguistic, and

cognitive /mental. The next two theories are concerned with the analysis of the meanings of fuzzy lexical items. These fifth theories will be briefly introduced below.

1.2 Theories of Meaning

Several and different theories of meaning have been introduced representing various branches of knowledge. Their diversity indicates the complex nature of meaning and the concern of so many disciplines in it.

1.2.1 The Referential theory

This theory is also named the truth-conditional theory. Of its main advocates Russell, Frege, and Carnap. According to this theory, the meaning of a sentence is essentially given by its truth conditions. More precisely, understanding a sentence about a certain state of things means understanding in what conditions and circumstances such state of things would be true, independently from its reality. As Wittgenstein (1958) states in his Proposition "To understand a proposition means to know what it is the case, if it is true. (One can therefore understand it without knowing whether it is true or not)". Sentences ought to be either 'true' or 'false' or at worst having a third value like 'undetermined'. Like the truth-conditions for predicates, those for natural language sentences are analogously introduced in terms of classical set theory. The meaning of a lexical item is basically identified with a set of points of reference in the universe of discourse, allowing a truth-value to be assigned to any (declarative) natural language sentence.

Frege (1892) the first who introduced the basic distinction between sense (sinn) and reference (Bedeutung). Sense is the way through which we can grasp the reference connected with a certain expression. Sense thus is able to mediate the relation between language and the world. However, he states that sense is not a psychological and subjective process but a "common property of many people and so is not a part or a mode of the individual mind. Reformulating Frege's notion of sense, Carnap (1965) has proposed the idea of intension (see 1.4) to resolve the so-called "opaque or non-truth-conditional contexts". Such contexts are generated by verbs of propositional attitude like to believe that P,to hope that P and so on, in which the truth value of the completive clause following verbs does not depend on referring to an actual state of affairs but on the mental attitude of the speaker. To overtake this difficulty, Carnap has developed the viewpoint of possible world. If I say the king of France is tall, we are able to grasp the sense of this utterance even though everybody knows that nowadays there is not any kingdom in France. Its meaning is not given by what it designates in the actual world but it is an intension,

that is, a function to a possible world in which a kingdom would exist in France and the king would be tall. The extension of a sentence is what it refers to, and gives the truth conditions on whose ground it might be taken as true (or false). The intension of a word or a sentence is a function which fixes its extension in every possible world.

The referential (the truth-conditional) theory of meaning appears to be explicitly abstract and formal, without any attention to subjective aspects. The notion of truth condition has been developed within a totally objective viewpoint, as a sentence turns out to be true or false independently of our recognition of it as such. Meaning is conceived as an objective entity disconnected to the mental processes which makes the linguistic understanding possible. As Lakoff (1972) points out, the truth-conditional theory assumes a ''God's eye'' standpoint to see and grasp the meaning in its absolute and objective nature.

1.2.2 The Structural Theory

de Saussure ,Hjelmslev and other scholars of the structural theory adopt the hypothesis that language may be considered as an autonomous network of mutually interdependent relations within which linguistic items exist by virtue of each other, independently from any outside determination. Thanks to its autonomy, the structural theory conceives meaning as a biunivocal combination of signifiers (the lexical items) and signifieds (the concepts). The inseparable link between signifier and signified assures the autonomy of meaning from any possible adulteration coming from the mental and psychological fields.

The structural theory has been concerned with the question of how the meanings of lexical items— rather than being related to extra-linguistic sets of objects — are intra-lingually related to one another, constituting relational systems which people obviously make use of when communicating.

Accordingly, the meaning (sense) of each lexical item is to some extent depending on the position it occupies in that system. It is argued, that, although the terms may referentially be vague, the position of each term in the system relative to each other, will nevertheless be defined with precision.

What does meaning mean according to, for instance, de Saussure? In his latest writings, meaning is value, that is, the possibility for each lexical item to be compared and contrasted to any other in the linguistic system. The starting point is given by the consideration according to which ''in a language, there are only

differences, and no positive terms" .Thus, the meaning of <u>apple</u> is not given by a set of its semantic features (i.e., what it is, described in positive terms); rather, it is only given by the comparison with the other linguistic items within a certain language. Apple is what it is; insofar as no one other linguistic item takes its own position within a certain natural language. Consequently, meaning is generated by the intra-linguistic negative relations of a given lexical item with one other, and consists of the set of differences which exist between that lexical item (i.e., apple) and all the other lexical items of a given natural language.

For the structural theory, the meaning of a lexical item is defined in a positional differential negative way. Meaning is put totally within the boundaries of a linguistic system, and there is no need to do any reference to an extra-linguistic world and to any conceptual and mental representation. Meaning is designed only by the position of a word in the linguistic system. As a consequence, the autonomy of semantics implies an anti-referential and antipsychological approach. Concerning this, Hjelmslev (1962) formulates the principle of immanence, according to which semantics aims at an immanent understanding of language as a specific self-sufficient system, looking for consistency and regularity inside language rather than outside it.

The structural theory turned out to be invalidated by its intrinsic circularity. If all lexical items are defined on the ground of the relations between them, how can such relations be defined without referring to the items themselves? De Mauro (1965) argues, "we define the terms thanks to the relations, but the relations cannot be defined without having defined the terms. Knowing all the system of linguistic relations existing between a linguistic entry and each other entries does not generate any meaning".

1.2.3 The Cognitive Theory

Around the eighties, a group of scholars – among others, Fillmore, Jackendoff, and Lakoff gave rise to the so-called cognitive theory. Rather than a unitary theory, it is a family of theories which share some common principles and assumptions. Generally speaking, these scholars were unsatisfied with the viewpoint of meaning as an objective, discrete and absolute entity just as it was developed by the traditional semantics in both formal and structural designs. On this ground, they set up a network, although loose by nature, of semantic principles useful to grasp the characteristics of meaning. Thus, they suggest a new design of meaning as the outcome of mental processes and social interactions. It carries the following characteristics:

First, in cognitive semantics, understanding meaning involves understanding the way in which individuals communicate each other. Meanings are neither

abstract entities as in formal and logical semantics, nor intra-linguistic relations as in structural semantics. Rather, they are items of conceptual and mental networks. So, semantics and understanding are two sides of the same coin.

Second, the cognitive theory broadens the notion of meaning. Meaning cannot be designed only by the dictionary knowledge but should take into account the encyclopedic knowledge at disposal to an individual. Dictionary knowledge is the circumscribed set of linguistic features and components of a lexical item which it is possible to find in a dictionary, while encyclopedic knowledge is the general collection of factual knowledge, extracted from the daily experience. In this sense, it is impossible to discern on principle what is intrinsically linguistic and what is not, as well as to distinguish between what is essential in defining the meaning of a lexical item or an utterance and what is not. By nature, meaning is opened up to encompass all our encyclopedic knowledge. As a consequence, meaning, culturally mediated and psychologically situated, cannot be disconnected to our experience.

Third, according to the cognitive theory, linguistic meanings cannot be isolated and detached from their conceptual correspondences. Yet, there are different theoretical positions on this issue and still nowadays there is no agreement among scholars. Fourth, the cognitive theory refuses the externalist position of the truth-conditional standpoint, according to which meanings are externally connected to states of the world through devices that are extrinsic to speakers. At the same time, it rejects the structural approach, according to which meanings are generated only within the linguistic domain. The cognitive theory argues
that language interacts with perception, cognition, reasoning, and emotion.(Anolli,2005:46)

1.2.4 The snapshot theory

This viewpoint is a version of the cognitive theory. The advocates of this theory claim that lexical items are clustered as a series of snapshots (images/pictures) in our minds. There are a number of difficulties with this theory: one major difficulty according to Aitchison (1994:41) is that we see any object we are talking about from a number of angles. Take the lexical item cat, for instance; we need so many snapshots in our minds to represent cats in different colors, sizes and shapes.

1.2.5 The checklist theory

This theory suggests that for each lexical item, we have an internal list of essential characteristics and we label something as cat, or cow only if it possesses these characteristics "criteria attributes" which we subconsciously check off one by

one. This theory is based on an old viewpoint went back to the Greek philosopher Aristotle. A lexical item has a hard core of essential meaning which it is, in principle, possible to extract and specify. Surrounding this core meaning is a number of fairly accidental facts which can be added or omitted without altering the basic meaning in any important way. (ibid)

The major problem of this theory is in deciding which attributes go on to the list and how can one identify the core meaning? It seems extremely difficult to draw a dividing line between essential and nonessential characteristics. Unfortunately, there are few lexical items which can be sorted out in this way. Most lexical items cause considerably more difficulty.

To recapitulate, the theories of meaning discussed above have tried to answer the question, how do lexical items acquire meanings? Each theory has built its assumption on one angle of the triangle; the lexical item has a direct relationship with the external world, the referential theory, or via the image created in the mind, the mental theory. They have not come across the question whether or not lexical items have fixed or fuzzy meaning .This question has been discussed in detail by Aitchison (1994,) who asserts that "for the majority of words, meanings in the mind are fuzzy, not fixed. Language has an inbuilt property of limited sloppiness and only some areas are marked by the setting of firm boundaries".

1.3 Denotation and Connotation

According to the most traditional theories, natural language meaning can be characterized by its denotative and connotative aspects. Denotation is understood to constitute referential meaning as a system of relations between lexical items or sentences of a language and the objects or processes they refer to. Connotation is defined to constitute structural meanings as a system by which lexical items or sentences of a language are conceptually related to one another. Denotation and connotation are terms describing the relationship between the lexical item and its concept. Meaning includes both denotation and connotation. (Chandler, 2004:1)

The denotation of a lexical item is the class of all actual or existent things to which that lexical item correctly applies. A lexical item which names nothing actual has zero-denotation. But it would be a mistake to say that such a lexical item as "unicorn or Apollo" has no denotation since this might suggest that it has no meaning. A lexical item has meaning in the mode of denotation if it is intended to function as a name. The connotation of a lexical item is delimited by any correct definition of it. The connotation of a lexical item and its denotation mutually determine one another. Also, the denotation of a lexical item being determined, the connotation is thereby limited but not fixed. The connotation cannot include any attribute absent from one or more of the things named.

Denotation tends to be described as the definitional, literal, obvious or commonsense meaning of a lexical item. The denotative meaning is what the dictionary attempts to provide. Connotation is used to refer to the socio-cultural and personal associations (ideological, emotional etc.) of the lexical item. These are typically related to the interpreter's class, age, gender, and ethnicity and so on. Lexical items are more polysemic - more open to interpretation - in their connotations than their denotations. Connotation, for Reiger (2005:23) produces the illusion of denotation, the illusion of language as transparent and of the lexical items and the concepts as being identical. Thus, denotation is just another connotation. From such a perspective, denotation can be seen as no more of a 'natural' meaning than is connotation but rather as a process of naturalization. Such a process leads to the powerful illusion that denotation is a purely literal and universal meaning which is not at all ideological.

Denotation simply involves a broader consensus. The denotational meaning of a lexical item would be broadly agreed upon by members of the same culture, whereas connotations are not purely personal meanings; they are determined by the codes to which the interpreter has access. Cultural codes provide a connotational framework since they are 'organized around key oppositions and equations. each lexical item is being 'aligned with a cluster of symbolic attributes'. Certain connotations would be widely recognized within a culture. Most adults in Western cultures, for instance, would know that a car can connote virility or freedom. (ibid)

Denotation is the strict, literal, dictionary definition of a lexical item, devoid of any emotion, attitude, or color. The denotation of the lexical item rose, for instance, is a red rose with green stem. The connotation is that it is a symbol of passion and love-this is what the rose represents. Also, the denotation of the Cross is a brown or golden Cross, but its connotation is a symbol of Christianity. Connotation and denotation are not two separate things/signs. They are two aspects/ elements of a sign, and the connotative meaning of a lexical item exists together with the denotative meaning. Connotation represents the various social overtones, cultural implications, or emotional meanings associated with a sign. Denotation represents the explicit or referential meaning of a sign. Denotation refers to the literal meaning of a word, the dictionary definition. For example, the name Hollywood connotes such things as glitz, glamour, tinsel, celebrity, and dreams of stardom. In the same time, the name Hollywood denotes an area in Los Angeles, worldwide known as the center of the American movie industry. Lexical items that denote a core meaning are those that are generally used and understood by the users and the audience to represent an object or class of objects, an act, a quality, or an idea. (Lewis, 1969:264)

Denotation refers to that type of meaning which shows the relationship between the lexical items and the external world. Denotative meaning is not enough to understand the meaning of lexical items fully, and the process of communication may not occur as well. A lot of lexical items may have similar denotative meanings, but they have different connotative meanings. Connotation refers to those aspects of meaning which a lexical item conveys in addition to its denotative meaning and which reflect our emotional reactions. Connotative meaning indicates the attitude of language users. Certain lexical items are more frequently used than others because of the emotive effect they have on the hearers. Connotative meaning of some lexical items are highly individual, that is, what a lexical item evokes in one person might not do so in others; doctor and injection, for instance, may be quite abhorrent to children.

Connotative meaning differs from denotative meaning in that the latter tends to be stable and determinate and it can be formalized relatively accurately for most lexical items in terms of a limited set of features in contrast with other lexical items of the same semantic field, where as connotative meaning is indeterminate, unstable and tends to be subjective. While denotative meaning is a property of semantics and is said to be invariant, connotative meaning is a property of pragmatics and said to be variant.

1.4 Intension and Extension[(2)]

Intension refers to the set of all possible things a lexical item or phrase could describe; extension refers to the set of all actual things the lexical item describes. For example, the intension of a <u>car</u> is the all-inclusive concept of a car, including, for example, mile-long cars made of chocolate that may not actually exist. But the extension of car is all actual instances of cars (past, present, and future), which will amount to millions or billions of cars, but probably does not include any mile-long cars made of chocolate.

Linguistic expressions and/or their utterances are first associated with an extension. The extension of a sentence is its truth-value: for example, the

extension of 'Plato was a philosopher' is true. The extension of a general lexical item is the class of individuals that fall under that lexical item: for example, the extension of <u>horse</u> is the class of horses. Other expressions work similarly. One can then associate expressions with an intension, which is a function from possible

worlds to extension. The intension of a sentence is a function that is true at a possible world if and only if the sentence is true there.

The extension of a concept, idea, or sign consists of the things to which it applies, in contrast with its intension, which consists very roughly of the ideas, properties, or corresponding signs that are implied or suggested by the concept in question. In semantics, the extension of a concept or expression is the set of things it extends to, or applies to, if it is the sort of concept or expression that a single object by itself can satisfy. (Concepts and expressions of this sort are monadic or one-place concepts and expressions.)The extension of the lexical item dog is the set of all (past, present and future) dogs in the world: the set includes Fido, Rover, Lassie, Rex, and so on. The intension of a singular lexical item maps a possible world to the referent of the lexical item in that possible world. The intension of a general lexical item maps a possible world to the class of individuals that fall under that general lexical item in that world: the intension of camel maps a possible world to the class of camels in that world. (Baldiger, 1980:246)

It can easily happen that two expressions have the same extension but different intensions. For example, Quine's terms 'cordate' (creature with a heart) and 'renate' (creature with a kidney) pick out the same class of individuals in the actual world, so they have the same extension. But there are many possible worlds where they pick out different classes (any possible world in which there are creatures with hearts but no kidneys, for example), so they have different intensions. When two expressions have the same extension and a different intension in this way, the difference in intension usually corresponds to an intuitive difference in meaning. So, it is natural to suggest that an expression's intension is at least an aspect of its meaning.

The meaning of a lexical item can be thought of as the bond between the idea or thing the lexical item refers to and the lexical item itself. de Saussure (1959) contrasts three concepts:

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- "The signified— the concept or idea that a sign evokes.
- The signifier— the "sound image" or string of letters on a page that
-             one recognizes as a sign.
- The referent — the actual thing or set of things a sign refers to".

Intension is analogous to the signified, extension to the referent. The intension thus links the signifier to the sign's extension. Without intension of some sort, words can have no meaning.

Dictionaries deal with the world of intensional meaning, but there is another world which a dictionary by its very nature ignores: the world of extensional meaning. The extensional meaning of an utterance is that which it points to in the extensional (physical) world. That is to say, the extensional meaning cannot be expressed in lexical items because it is that which lexical items stand for. The intensional meaning of a lexical item or expression is that which is suggested inside one's head. Whenever we express the meanings of lexical items by uttering more lexical items, we are giving intensional meanings or connotations. One of the important differences between extension and intension on the utterance level is that when utterances have extensional meanings, discussion can be ended and agreement reached; when utterances have intensional meanings only, arguments may go on indefinitely. Such arguments can result only in conflict; among individuals, they may break up friendships.

2. Fuzzy Logic

2.1 What is Fuzzy Logic?

The origin of this term went back to the time of Plato who laid the foundation for what has become to be known fuzzy logic, indicating that there was a third region beyond true and false. In the early of the 1920s, Lukasiewicz proposed a systematic alternative to the bi-valued logic of Aristotle when he described a three-valued logic. The third value could be described as "possible" and has a numeric value between true and false.
His efforts were followed by Knuth, but none of the efforts gained a wide acceptance. It was not until 1965, when Zadeh published his works on fuzzy sets and mathematics accompanying them. The theory was quickly branded the name fuzzy logic. Zadeh (1965) has found that fuzzy concepts and some fuzzy lexical items that represent fuzzy concepts are often used by people. Then, many scholars have begun to apply this theory in many fields, like philosophy, mathematics, linguistics, social science and so on. The development of fuzzy logic has been motivated in large measures by the need for a conceptual framework which can address the issue of uncertainty and lexical imprecision. (Encyclopedia of Philosophy, 2006)

In the Oxford English Dictionary, we read that fuzzy means either not firm or sound in substance, or fringed into loose fibers. Fuzzy means also covered by fuzz, i.e., with loose volatile matter. Alike any other characteristics, fuzzy can be used to form a predicate of the form: something is fuzzy. For example a bear is fuzzy. It may sound strange to say that bald is fuzzy, or that young is fuzzy. The lexical items (adjectives in this case) bald and young are fuzzy because their meanings are not fixed by sharp boundaries.

Fuzzy logic is a departure from classical two-valued sets and logic. The classical logic relies on something being true or false. A true element is usually assigned a value of 1, while false element has a value of 0.Thus, something either completely belongs to a set or it is completely excluded from it. Fuzzy logic broadens this definition of membership. Considering, for example, a set of tall people in the classical logic, one has to decide where is the border between the tall people and people that are not tall. If the border is set to, for example, 6 feet. Then, if the person is 6 feet and 1 inch tall, it belongs to the set of tall people. If the person is 5 feet 11 inches tall it does not belong to the set. In this case, such a representation of reality leaves much to be desired. On the other hand, using the fuzzy logic, the person being 6,1 tall can still have a full membership of the set of tall people, but the person that is 5,11 tall, can have 90% membership of the set. The 5, 11 people thus can have, what can be described as a quite tall representation in a model. Fuzzy logic is not less precise than other forms of logic: it is an organized and mathematical method of handling inherently imprecise concepts. The concept of coldness, for instance, cannot be expressed in an equation, because although temperature is a quantity, coldness is not. However, people have an idea of what cold is and agree that there is no sharp cut-off between cold and not cold, where something is cold at N degrees but not cold at N+ 1 degrees---a concept classical logic cannot easily handle due to the principle of bivalence. (Wikipedia, 2006.)

In the classical sense, logic referred to as Boolean Logic Consists of three elements: truth values, linguistic connectors, and reasoning types. In Boolean logic, truth values are either 1 or 0, which correspond to true/false duality. In fuzzy logic, truth is a matter of degree, thus, truth values range between 1 and 0 in a continuous manner. This concept of continuum constitutes the most outstanding difference between classical logic and fuzzy logic. Linguistic connectors (or operators) in fuzzy logic function in the same way as in Boolean logic (union, intersection, negation).

The rationale for the development of fuzzy logic, Grunfeld (2006) argues, is somewhat as follows: "informal arguments suffer from vagueness of indeterminacy, so that classical logic is hopelessly inadequate to represent them". He concludes that fuzzy logic results from two stages of fuzzification of classical logic : (i) a move from 2-valued to many – valued logic as a result of treating object language predicates as denoted fuzzily rather than classical sets yielding the base logic, and (ii) a move to many truth values as a result of treating the meta- language predicates true and false as denoting fuzzy subsets of the set of values of the base logic, yielding fuzzy logic proper.

Fuzzy logic, instead of traditional logic which aims at precise reasoning, is about approximate reasoning. A fuzzy proposition induces a possibility distribution over a universe of discourse. One of the interesting facts about fuzzy logic is that fuzzy inferences make it possible to deduce a proposition similar to the consequence from some propositions that is similar to the antecedent. Fuzzy logic deals with the degree of truth of fuzzy propositions, which can be conditional, qualified or both, as well as simple. A simple, unconditional, and unqualified proposition states that a variable element belongs to a fuzzy set. For a particular element, the degree of truth of the proposition is interpreted as the degree of membership of this element to the fuzzy set. Fuzzy logic is derived from fuzzy set theory dealing with reasoning that is approximate rather than precisely deduced from classical predicate logic. It can be thought of as the application side of fuzzy set theory dealing with real world values for a complex problem.

The concept of fuzzy sets may prove to serve as a formally and numerically flexible link to connect satisfactorily the two main, so far seemingly divergent, lines of research in modern semantics: namely, the more theoretically-oriented algebraic model of what logicians feel an 'ideal' speaker should do when he produces meaningful sentences and the more empirically-oriented methods of experimental semanticists who try to find out what real speakers actually do when for communicative purposes they produce texts and/or try to understand them. As fuzzy set theory introduced by Zadeh (1965) has in the meantime been developed into an increasingly successful formal approach of even wider scope than semantics (Zadeh 1975). It seems fit to bridge the gap between an abstract model of, and its application to, vague natural language and the processes it represents (Rieger, 2005).

Basic to the notion of fuzzy sets is that the elements of fuzzy sets show gradual rather than abrupt transition from non- to full membership. Fuzzy sets are defined by characteristic or membership functions which associate with each element a real, non-negative number between 0 and 1;

with 0 equaling 'non-membership' and 1 equaling 'full-membership' in the classical set. One way to understand the relationship between fuzzy sets and fuzzy logic is to examine natural language. Expressions in natural language such as he looks young or he works out a lot are nothing but Phrases describing an event or state of being. When they are put together in a sense-making order, a context is created that leads to reasoning. For example, the combination he looks young, he works out a lot creates a context in which looking young and working out become related. Such Statements are called unconditional statements. One step further is the combination of simple expressions using some linguistic connectors (also called operators) such as in: If he works a lot then he will look young. Here, the connectors if-then modify the context and make it a conditional Statement. When conditions are imposed, reasoning gets more restricted than in a simple relationship (such as that between looking young and working out), which leads to the subject of logical inference. (ibid)

2.2 Characteristics of Fuzzy Logic

Zadeh (1994) refers to some of the essential characteristics of fuzzy logic. They are:
- Fuzzy logic is suitable for uncertain or approximate reasoning, especially for the system with a mathematical model that is difficult to derive.
- Fuzzy logic allows decision making with estimated values under incomplete or uncertain information.
- In fuzzy logic, knowledge is interpreted as a collection of elastic or
- equivalently fuzzy constrains on a collection of variables.
- In fuzzy logic everything is a matter of degree.
- In fuzzy logic, exact reasoning is viewed as a limiting case of approximate reasoning.
- Inference is viewed as a process of propagation of elastic constraints.
- Any logical system can be fuzzified.
- In fuzzy logic, the truth values are fuzzy, local and subjective; and the set of the values is not closed under the usual propositional operations.
- Linguistic approximations have to be introduced to guarantee closure.

- In the second stage of fuzzification, the truth values of the base logic and the set of points in the interval (0, 1)   are replaced by fuzzy subsets of that set referred to as fuzzy truth values.
- Fuzzy logic is conceptually easy to understand. The mathematical concepts behind fuzzy reasoning are very simple. What makes fuzzy easy is the naturalness of its approach and not its far-reaching complexity.
- Fuzzy logic is tolerant of imprecise data. Most things are imprecice; fuzzy logic builds this understanding into the process.
- Fuzzy logic is based on natural language. The basis for fuzzy logic is the basis for human communication.

2.3 Directions in Fuzzy Logic

Two main directions in fuzzy logic can be distinguished (Zadeh, 1978):

a. Fuzzy logic in the broad sense.

It is older, better known, heavily applied but not asking deep logical questions. It serves mainly as apparatus for fuzzy control, analysis of vagueness in natural language and several other application domains. It is one of the techniques of *soft-computing*, i.e. computational methods tolerant to sub optimality and impreciseness (vagueness) and giving quick, simple and sufficiently good solutions. The monographs can serve as recommended sources of information.

b. Fuzzy logic in the narrow sense.

It is symbolic logic with a comparative notion of truth developed fully in the spirit of classical logic (syntax, semantics, axiomatization, truth-preserving deduction, completeness, etc.; both propositional and predicate logic). It is a branch of many- valued logic based on the paradigm of inference under vagueness. This fuzzy logic is a relatively young discipline, both serving as a foundation for the fuzzy logic in a broad sense and of independent logical interest, since it turns out that strictly logical investigation of this kind of logical calculi can go rather far.

2.4 Applications of Fuzzy Logic
As for the application of fuzzy logic, it is recommended for the implementation of a very complex process, where a simple mathematical model cannot be obtained. Fuzzy logic can also be successfully applied to highly nonlinear processes, where it is observed to greatly simplify the modeling.

The most obvious implementation of fuzzy logic is in the field of artificial intelligence. One can easily relate logic to ambiguous linguistic forms as, very, little, sort of, and so on. Such flexibility allows for a rapid advancement and easier implementation of projects in the field of natural language. Fuzzy logic not only brings logic closer to natural language, but also closer to human or natural reasoning. The power of fuzzy logic is to perform reasonable and meaningful

operations on concepts that cannot be easily codified by using a classical approach. It allows an element to belong only partly to a given set. Such modification allows for a much more flexible and wide spread use of reliable and consistent logic in a variety of applications.

In linguistics, it relates logic to semantically ambiguous and vague lexical items as, very, little, hot, large, etc.The linguistic approach, for Zadeh (ibid) is based on two main concepts: the linguistic variable and the linguistic term. A linguistic variable represents a concept that is measurable in some way, either objectively or subjectively, like temperature. Linguistic variables are characteristics of an object or situation. Linguistic terms rate the characteristics denoted by one linguistic variable. A linguistic term is a fuzzy set, and the linguistic variable defines its domain.

Every adequate representation of fuzzy sets involves the basic understanding of five related conceptual symbols:

- the set of elements Q: as in person from a group of friends.
- the linguistic variable $V,$ which is a label for one of the attributes of the elements as in the age of person.
- the linguistic term $A,$ which is an adjective or adverb describing the linguistic variable, which is a subjective measure of $V,$ as in young describing age.
- a referential set X: that is a measurable numerical interval, for the particular attribute $V,$ as in [0,100] years for age, and
- a subjective numeric attribution MA of the membership value, i.e., the membership degree of the element q, labeled by the Linguistic variable V as described by A.
   So, for a linguistic variable V, there will be a measurement process resulting in a measured value MVIA for each element. (Xexeo, 1997)

2.5 Lexical Fuzziness

Fuzziness in language is a pervasive phenomenon. It is part of our daily life. Linguistically speaking, it is a universal phenomenon found almost in every natural language. This stems from the fact that all human languages have the main parts of

speech. Thus; fuzziness is there as there are adjectives. Fuzziness is one of the semantic characteristics of adjectives, especially, gradable adjectives (as modifiers to modify people or things), that is, these lexical items are semantically illusive, loose and indeterminate (fuzzy). However; fuzziness is a neglected area in linguistics and related disciplines, probably due to the misconception that mixes up fuzzy logic with misuse or abuse of language. "Fuzzy language is something we live by; we need it for communication, as we need air to breath. In fact, we need fuzzy language for every aspect of our communication, as much as, if not more, as we need non-fuzzy (Zhang, 2005: 73)

Fuzziness is defined as a linguistic unit (lexical item, phrase, sentence, utterance etc) with no clear-cut meaning boundary. Lexical items like large, big, small, old, etc are examples of what is called fuzzy language. If we push hard enough, there are hardly any lexical items that are not fuzzy. For example, dead or alive appear at first glance clear-cut. However, how would we classify a person who has been in a coma for say six months? Another pair is man and woman, which side would a person who was born with both sex organs? (ibid)

Philosophers, more than linguists, are concerned with lexical items which have "vague boundaries and fuzzy edges and which consequently give neither true nor false to a certain extent" (Lakoff, 1972:183).Big, fore example, is semantically fuzzy since it can be used with so many names which are drastically different in size; it can be used with a big room in one end and a big continent in the other end of the scale. See the figure below.
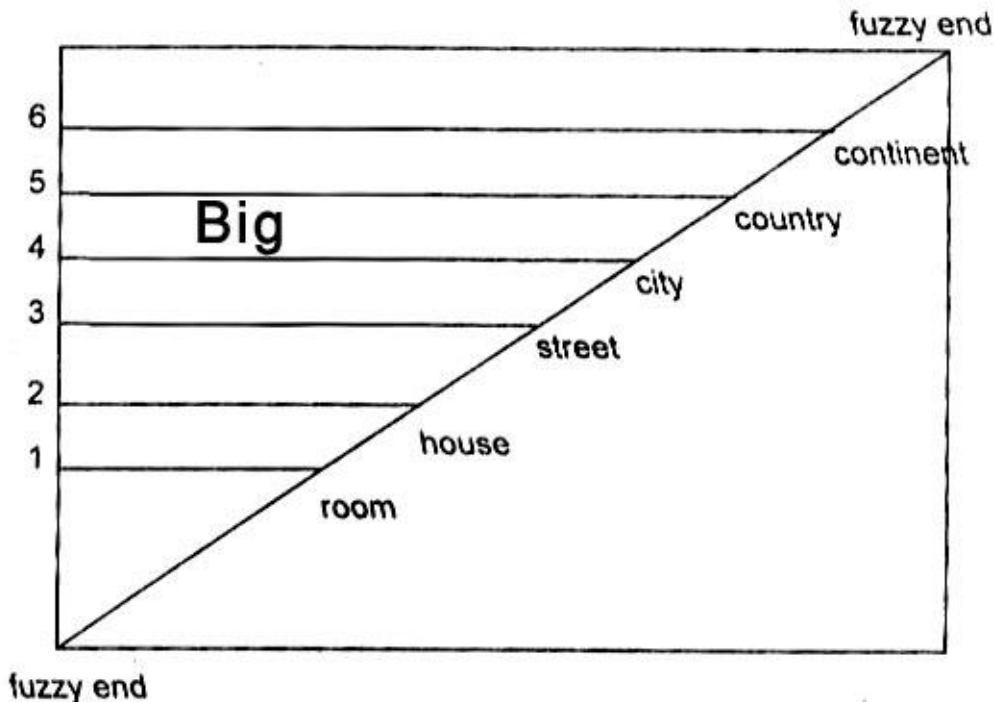

Figure (2) the Fuzzy ends of big

Fuzziness is a way to represent uncertainty, possibility and approximation. If something is fuzzy, it means that we are unable to define precisely its boundaries. In fuzzy logic, constraints become elastic, limits are relaxed and values have distributions instead of being unique. Fuzziness of meaning has been treated formally, though it can be treated quantitatively, at least in principle**.** For Goathly (1997:20) many lexical items in natural language are fuzzy and uncertain in meaning. All lexical items have semantic features which are divided into obligatory/critical or optional/non-critical. For example, a list of features can be included to describe the lexical item <u>bottle</u>(made of glass, narrow at top, of different shapes,colours, etc).If we consider all these features optional, then a sentence such as(some bottles are not made of glass would be marked as contradictory.

Fuzzy language has a number of interesting features. For example, it tends to be relatively clear-cut as far as the core meaning (sense) is concerned, but blurred around peripheral meaning (denotation/reference)
<u>Many</u>, for instance, is fuzzy because its meaning boundary is not clear-cut. How many is many? Its meaning boundary varies from individual to
Individual, from context to context. In the sentence, '<u>John has many girl friends</u>', one individual may think 'five girl friends' is many; another individual may think 'ten girl friends' is 'many'. However, no matter whether it is five or ten they are denotative meanings. In fact, <u>many</u> has a non-fuzzy sense, 'a significant number, no one would dispute it. What we disagree on is the other part of meaning components, reference or denotation (for more information on denotation, see 1.3**).** People normally do not have problems agreeing on the senses of fuzzy expressions. Fuzziness occurs when we try to figure out their reference or denotation.. For example, if John has over 10 girl friends, every one would say that indeed he has 'many' girl friends. Only when it comes to the peripheral part of denotation, would there be less agreement among individuals. For example, we do not know for sure that whether or not 'three girl friends' could be considered by everyone as many.
Fuzziness tends to have invariant sense/core part of denotation and variant peripheral part of denotation; It is, also closely associated with the real world. The reason is that the denotation or reference of an expression relates to the extra linguistic world, things like entities, states of affairs etc. When we try to define the denotation of an expression, we have to consider pragmatic factors that affect the meaning of the expression in one way or another, which leads to what we call pragmatic fuzziness. Fuzzy meaning of expressions is very much a pragmatic matter, as its meaning depends heavily on context (linguistic or non-linguistic) or situation. The interpretation of a fuzzy expression would be influenced by all sorts of pragmatic factors.

There are many more pragmatic factors which affect the interpretation of fuzzy expressions, such as sex, location, occupation etc. For example, how tall is a tall person, depends on all sorts of pragmatic factors. In general, men are taller than women; Europeans are taller than Asians; professional basketball players are taller than ordinary people.(Zhang,2005:78)

The interpretation of fuzzy lexical items can be affected by the scale onto which they are mapped. For example, 'about 5 people' and 'about 1000 people'. Because of space effect (an effect that limits the expansion of a fuzzy expression's extension around the lower end of scale), the meaning of 'about 5 people' would be less fuzzy than 'about 1000 people'. The reason for this is that there is less space in the lower end of scale for 'about 5 people' to expand, while 'about 1000 people' has relatively more space to maneuver. The meaning of fuzzy expressions may also depend on the size and nature of the objects being modified and on the spatial situations surrounding the objects. There are many people in the forest' versus 'there are many elephants in the forest'. Due to the different sizes between 'people' and 'elephant', it is expected that the latter's numerical value would be lower than the former.

Cultural differences dominate how we understand and interpret meaning. For example, in China divorce has always been something disapproved of culturally. So, if we compare 'there are many divorce cases in China' with 'there are many divorce cases in the United States', one would give a lower expectation and give a lower rate for the former but a higher expectation and rate for the latter. Another example, in Korean culture, it is not rare to see married adults with their wives and children still living with their parents. Therefore, 'some' in 'some married adults still live with their parents' would be given a relatively higher expectation and therefore a higher rate if it refers to Korea) (ibid). The above two examples demonstrate that cultural influence plays a big role here and we have to be aware of it in order to fully understand/recognize meanings that tangle with cultural factors.

Scott (1970:17) has developed a method for measuring fuzzy lexical items. If we take two lexical items (see the figure below) on both ends of the scale, a third lexical item can be considered true if it is marked to be true at a point on the scale.
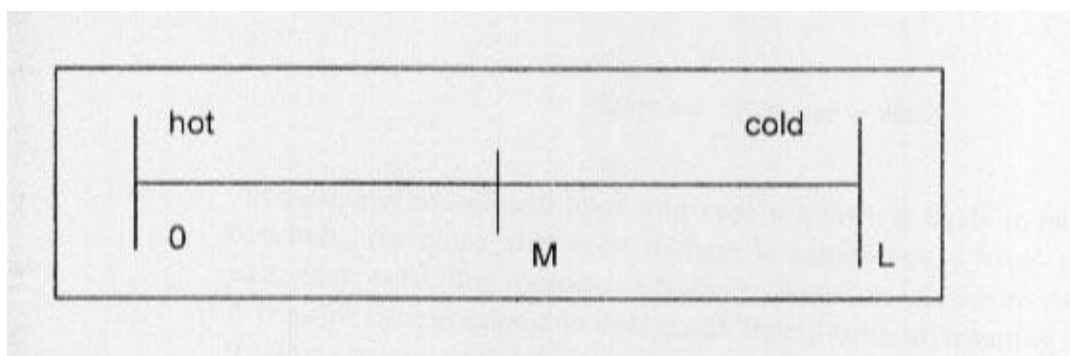

Figure (3) Scott's

method of measuring fuzzy lexical items.

In the figure above, if a lexical item L is true at the point M, then it will be, due to its degree of deviation, true for the entire interval, i.e., from M to L. This means that L deviates from absolute truth at the point L itself to the degree M on the scale, which indicates that the degree of truth of certain lexical items is elastic and does not stick to a strict point.

How are people able to cope with fuzzy lexical items? Aitchison (1994:63) suggests the notion of prototype. It means that for each lexicalized category, human cognition contains a prototypical example(which does not have to be an actual member of the category itself, but which is a kind of mental image) which is used as a yardstick to decide whether a particular object can or cannot be referred to by means of the lexical item in question. People analyze a prototypical exemplar of a lexical item, and then match any new example against the characteristics of the prototype. It does not have to be a perfect match, merely a reasonable fit. This explains how lexical items can be used with slightly different meanings, and how people can recognize new examples of the same category. When people categorize common objects, they do not expect them all to be on an equal footing .A prototype theory is useful, then, for explaining how people deal with untypical examples of a category. Penguins and pelicans are considered birds, as they sufficiently like the prototype, eventhogh they do not share all its features.

2.5.1 Causes of Fuzziness

It is agreed upon among linguists that fuzziness is part of the inherited features in the semantic system of some lexical items "for the majority of words, meanings in the mind are fuzzy, not fixed. Languages have an inbuilt property of limited sloppiness" (ibid: 49).They give some reasons for its existence in languages. Here are some of these reasons.

1. Approximation

The speakers sometime have no choice but to be approximate, because there is no single lexical item or precise expression to refer exactly to its concept. Certain phenomena and thoughts do not always fall neatly into the categories provided by language. Whether a whale, for instance, is to be categorized as a fish or mammal, or an ostrich is a bird or not can be a subject to many questions. Such approximate uses are related to and may be one cause of fuzziness in the semantic concepts themselves.

2. Conceptual Boundaries

Evans&Green (2006:253) state that categories (a term they use instead of concept, set) have definite and distinct boundaries, i.e., an entity either will or will not posses the right properties for category membership. Consider the category, odd number, for example, members of this category are all those numbers that cannot be divided by 2 without leaving a remainder. This category has clearly defined boundaries, because number is either odd or even. Many categories are not so clearly defined, but instead have fuzzy boundaries. Consider the category furniture; while table and chair are clearly instances of this category, it is less clear whether or not carpet should be considered a member of the category. Again with the category bird; birds like robin and sparrow belong to this category, but what about penguins and ostriches, neither of which can fly.

The existence of fuzzy concepts in language provides important insights into the nature of the human conceptual system. It seems that many, if not most, concepts expressed in language are not rigid all-or-nothing notions with precise and clear-cut boundaries. Rather, they are characterized by certain degree of fuzziness. Consider the lexical item rich; how much does one have to be worth to be called rich? Is there any figure that we can give that would be so precise that a person who is short by just five pence would not be called rich? It seems not. This is because the notion of richness does not have clear-cut boundaries, i.e., it is fuzzy.

3. Fuzzy edge phenomenon

Aitchison (1994:46) resorts fuzziness in the meanings of lexical items to two reasons: fuzzy edge phenomenon and family resemblance syndrome.
Lexical items have fuzzy edges in the sense that there is no clear point at which one lexical item ends and another begins. To prove this claim, she refers to an experiment made by Labov.He showed his students pictures of containers and asked them to label each (see the figure below) as either a cup, a vase or abowl.The students were inconsistent in their responses. The picture which is labeled a bowl when it is empty, relabeled a vase if it contained flower and a cup if there was coffee in it. Labov comments that "a goal of some thinkers has been to use words in more precise ways, which is acceptable in technical jargon; it is defeated when applied to ordinary words. Fuzzy edges, then, seem to be an essential feature of word meaning".
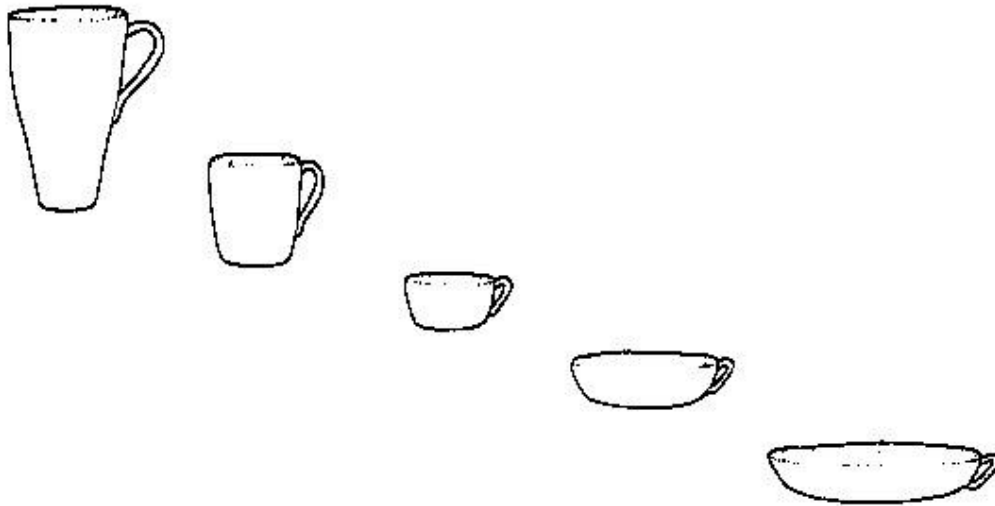
Figure (4) Labov's experiment; Pictures labeled differently, vase, cup, or bowl.

4. Family Resemblance Syndrome

The family resemblance syndrome has been vividly described by the Philosopher Wittgenstein (in Aitchison, ibid: 47) through his example the game: board-games, card-games, ball-games, and so on. If you look at them you will not see something that is common to all, but similarities, relationships, and a whole series of them. Look for example, at board-games, with their multifarious relationships. Now, pass to card-games; here you find many correspondences with the first group, but many features drop out, and others appear. In ball-games, there is winning and losing. We can go through many other groups of games to see how similarities crop up and disappear. Wittgenstein concludes that although every game has some similarity with other games, there is no one factor which links them all. We are faced with a complicated network of similarities overlapping .No better expression to characterize these similarities than family resemblance.

2.5.2 Fuzziness versus Vagueness
Vagueness, which is of French origin, is used for the English lexical item loose. Russell (1923) defines vagueness as "the existence of fluent boundaries, a conception applicable to every kind of representation".
For Peirce (1965) "a proposition is vague when there are possible states of things concerning which it is intrinsically uncertain".Rieger (2005) thinks that vagueness

is one of the basic and obvious characteristics of human language meaning. Vague lexical items occurring in human language sentences do not seem to violate their truth values; the notion of vagueness never attracted any attention as a problem of sentence meaning unless this is founded on pragmatics. Seising (2006) gives this definition: "a term is vague if its use in a context decidable, it will make the context undecidable by virtue of those language rules".

In the literature of fuzzy logic, the lexical item fuzzy often stands for the lexical item vague. Zadeh (1975) states that the meaning of a lexical item may be vague in the sense that it refers to a set of reference-points whose boundary is not sharply defined, thus constituting a fuzzy set in the universe of discourse. It can be argued that most of the lexical items in natural languages are fuzzy. Zhang (2005:74) distinguishes between fuzziness and vagueness. "Fuzziness refers to an intermediate referential boundary and is an inherent Property of language. Because it is inherent, it is not resolvable even when we resort to context, unlike vagueness whose indeterminacy can be eliminated by their incompatibility with a given context".

Logicians like Frege and Russell stress the pervasive vagueness of ordinary language and maintain that logic does not apply to it; yet, they take logic to be more basic (comprehensive) than mathematical reasoning. Russell (1923, 85) states that vagueness and precision characteristics are alike only to a representation, of which language is an example. Vagueness is clearly a matter of degree, depending upon the extent of the possible differences between different systems represented by the same representation. Fuzzy set theory allows vague lexical items to be represented in precise terms. The vagaries of actual lexical item usage by individuals, social groups, in certain pragmatic situations, or otherwise, do not even need to be reduced to strict binary determinateness, but rather become the empirical basis for any structural meaning's representation which depicts the semantic regularities followed and/or established by real communicators. (ibid)

2.5.3 Fuzziness and Language Teaching
Fuzziness is a very important feature of language. Since the use of fuzzy language is a kind of communicative skill, it is quite necessary for language learners, especially for the second language learners to grasp it.
One application of the study of fuzzy language is to provide information that can be used in the construction of materials for the teaching of fuzzy expressions and their appropriate use.

Second language learning is a process which is full of uncertainty or ambiguity. During the process, learners often show intolerance of ambiguity, this seriously impedes L2 learning. These problems are the negative effect that fuzziness in language brings to EFL learning. If learners can utilize it in L2 learning, they will benefit from it. If they ignore it, their L2 learning will be impeded. L2 learners often cannot tolerate the fact that they are not able to express their ideas with clarity and exactness when speaking and writing. For example, we often hear students complain that "when I am writing in English, I do not like it when I cannot express my ideas exactly" or "when I am reading something in English, I feel impatient when I do not totally understand the meaning." If the students do not realize the existence of fuzziness in language, and do not tolerate the uncertainties and ambiguities involved in language learning, their language learning will be seriously affected (Miao, 2005).

In second language teaching, if the teachers can guide the students and help them to take some measures to utilize the fuzziness in language, the students will benefit from that. Through introducing more Social-cultural knowledge and structural knowledge of the target language, the teachers can help the students to enlarge their possible varieties, and then the students can make appropriate choices among these varieties freely and flexibly. Facing the fuzziness or uncertainty in language, second language learners often feel that it is an extremely difficult task to learn a language. First, English provides its speaker with a great variety of ways of being fuzzy, so learners have to deal with the fuzziness in language itself. Second, learners have to deal with the uncertainties stemming from the lack of total correspondence between any two languages.

Although fuzziness is so prevalent phenomenon in native English speakers' conversations and in the process of second language learning, it is rarely, if ever, formally taught to learners of English .Very few textbooks incorporate the context of teaching and practice of fuzziness in order to meet the real life demands of communication. In order to help students to utilize the fuzziness in L2 learning, there are a few principles relating to the teaching and learning of fuzzy language use that need to be borne in mind. The teacher should avoid asking students to speak at inappropriate levels of fuzziness, and the students should know that in communication, there are some factors that influence the degree of explicitness and fuzziness, such as the audience, sensitivity of information being shared, and of topic being discussed. In one word, context is the most important factor. So in order to raise the awareness of utilizing the fuzziness in language, the teachers should try to introduce the social-cultural knowledge of the target language. Facing the uncertainty in language learning, teachers should develop students' cognitive

learning style of inferring and guessing the meaning of utterances from the context. In developing the cognitive learning style of inferring and guessing, Twaddell (1980:439) recommends that students practice while guided. It is the teacher's task to organize the teaching process so as to facilitate this development .Teachers should keep in mind that certain amount of fuzziness in guessing the meaning of lexical items must be accepted. The teacher should not expect the students to come up with exact meanings while guessing in this manner. Teachers should also help students to realize that through successive encounters with a lexical item and successive guessing in context after context, we sooner or later learn more and more precisely the meanings of the unfamiliar lexical items.

2.5.4 Hedges

The use of hedge as a linguistic term goes back to the early 1970s, when Lakoff (1973) published his article Hedges. His main concern is the logical properties of lexical items and phrases like rather, largely, very, in their ability to make things either fuzzier or less fuzzy. Thus, he defines hedges as those phrases or larger syntactic structures whose meaning implicitly involves fuzziness. In other words, whose meaning indicates non-central membership of a logical or referential category (ibid: 454)

Linguistic hedges, or simply hedges, modify linguistic lexical items. They are the fuzzy model counterparts of adverbs. After a linguistic term is defined, for example old, it is expected that one is able to understand
concepts such as very old and almost old .Since linguistic hedges modify linguistic terms; we use fuzzy operations from [0] into [1]. The most common linguistic hedges and their corresponding operators are very, almost and somewhat. Hedges like about, almost behave in the same way as around. Also in the attributive clauses such as John is clever, Mary is tall, the hedges very and somewhat modify the degree of fuzziness. In particular, very in John is very clever pushes the degree of meaning upwards; while somewhat, in John is somewhat clever pushes the semantic value of clever downwards.

Since the early 1970s the concept of hedge has moved far from its origins, particularly since it has been adopted by pragmatists and discourse analysts. The term is no longer used only for expressions that modify the category membership of a predicate or noun phrase. Lakoff (ibid) observes that certain verbs and syntactic constructions convey hedged performatives (I suppose/I think that Harry is coming; won't you open the door? The idea of hedged performatives has become then one way of widening the concept of hedges.

In addition to the idea of hedged performatives, the concept was also widened in another way when hedges are taken to be modifiers of the speaker's commitment to the truth-value of a whole proposition, not just the category membership of a part of it. The use of hedges is considered as showing a lack of full commitment to the propositional content of an utterance. In other words, hedges (e.g. perhaps, seem, might) are seen as modifying the truth-value of the whole proposition, not as making individual elements inside it more imprecise.

A linguistic hedge or modifier is an operation that modifies the meaning of a lexical item or a fuzzy set. For example, if <u>hot</u> is a fuzzy set, then very hot, more or less hot, and extremely hot are examples of hedges that are applied to that fuzzy set. Hedges can be viewed as operators that act upon a fuzzy set's membership function to modify it. Hedges play the same role in fuzzy production rules that adjectives and adverbs play in English sentences. There are hedges that intensify the characteristics of a fuzzy set (very, extremely), that dilute the membership curve (somewhat, rather, quite), that form the complement (not), and that approximate a scalar to a fuzzy set (about, close to, approximately). The mechanics underlying the hedge operation is generally heuristic in nature. Zadeh's original definition of the hedge <u>very</u> intensifies the fuzzy region by squaring the membership function at each point in the set. On the other hand, the hedge somewhat dilutes the fuzzy region by taking the square root of the membership function at each point along the set. The contrast hedges change the nature of fuzzy regions by making the region either less fuzzy (intensification) or more fuzzy (diffusion). Hedges such as <u>positively, absolutely,</u> and <u>definitely</u> are contrast hedges, changing a fuzzy set by raising the truth values above and decreasing all the truth values below, thus reducing the overall fuzziness of the region.

Since a hedge is linguistic in nature, multiple hedges can be applied to a single fuzzy set. The approximation hedges are an important class of transformers. They not only broaden or restrict existing bell-shaped fuzzy regions, but also convert scalar values into bell-shaped fuzzy regions. The most often used approximate hedge is the about hedge, which creates a space that is proportional to the height and width of the generated fuzzy space.

It is necessary to distinguish between two types of hedges. Prince and Bosk (1982:85) in their discussion of hedging in physician-physician discourse, they start from Lakoff's definition of hedges as devices that make things fuzzy, but add that there are at least two kinds of fuzziness. One is fuzziness within the propositional content; the other fuzziness is in the relationship between the propositional content and the speaker, that is, the speaker's commitment to the truth of the proposition conveyed. Accordingly, there are two types of hedges: those that

affect the truth-conditions of propositions, which they call approximators (e.g. His feet were sort of blue), and shields, which do not affect the truth-conditions but reflect the degree of the speaker's commitment to the truth-value of the whole proposition (e.g. I think his feet were blue).

2.6 Criticism to fuzzy logic

The first and most common criticism to fuzzy logic is that fuzziness is just another name of probability. This claim has been refuted by many scholars, among them Kosko, 1992 and Xexeo (1997) who argue that this claim can be contradicted by the following two arguments: a philosophical and a mathematical.

The philosophical argument starts from the fact the fuzziness describes a current situation, while probability describes a future event.
Linguistic lexical items subjectively describe linguistic variables, while
Probability can only describe the odds that a fact will happen in the
future. Suppose you know that Jack is 30 years old. The probability of
the sentence "Jack is 29" being true is zero. While it is very close to the
true age, so the degree of truth is certainly different than zero. Although
this is a very appealing argument and it is very effective in the classroom, it has not achieved good results in academic debates.
The mathematical argument, meanwhile, is stronger. Kosko (1992) proved that probability measures are a proper subset of fuzzy measures. This proof can be easily followed and stand until now. It is possible that the proof is only valid in certain contexts.

The second criticism is that fuzzy logic is misleading and everything that is done with it can be done with some traditional technique. No one can deny that there is a lot of publicity around fuzzy systems nowadays, and the name which originally was perceived as a sign of sloppiness is now used to project and image of high-tech solution. But the main reason to use fuzzy logic is not the uniqueness of the solutions, but the fact that they usually are easier and cheaper. Fuzzy logic can provide a faster route to an economic solution, especially for highly nonlinear systems. Although it is difficult to imagine that all critics will cease, the current widespread use of fuzzy logic, both in academy and industry, is a clear sign that fuzzy logic has gain a place for itself. Experience shows that fuzzy sets are very useful in giving machines human- like ability to process complex problems. Another great strength of fuzzy logic is the generality of its basic premises. It is very difficult to find a science that has not been fuzzified in some way.

After explaining how fuzzy logic departs not only from classical logic, but also from classical conception of what logic is and does, Haack (1996,   ) criticizes fuzzy logic for its methodological extravagances and its linguistic inconsistencies.

She argues that fuzzy logic does not avoid but actually requires the imposition of artificial precision. She points out that the linguistic evidence does not support the contention motivating fuzzy logic that, true and false, like bald and tall, are predicates of degree.

3. Conclusion

Fuzzy logic is a departure from the classical logic which is a two-valued system. It relies on something whether true or false. Fuzzy Logic broadens this concept into a many valued system. Fuzzy logic was developed by a professor of computer science but it can be applied to many fields of knowledge like Engineering, mathematics and linguistics. Philosophers, more than linguists, are concerned with lexical items which have vague boundaries and fuzzy edges. In Linguistics, though it has not been given its due attention, it is used as an approach for the semantic analysis of lexical items. It is applicable to those lexical items whose meanings are fuzzy, that is, they are semantically illusive, loose and indeterminate.

Fuzziness is almost a universal phenomenon found in every natural language. It is one of the problems of the study of meaning in general. Fuzzy lexical items are mostly adjectives, especially those adjectives which are gradable, like hot, tall, rich, etc.Cultural differences and time(among other factors) dominate how we understand and interpret meaning.
In second language learning, the teachers should guide their students to understand and utilize fuzziness in language. Students can broaden their varieties and then make appropriate choices among these varieties freely and flexibly.

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الخلاصة

يسلط هذا البحث الضوء على موضوع غموض الحدود الدلالية لبعض الكلمات في اللغة
الانكليزية وإمكانية تطبيقها في مجالات علم اللغة ومنها استخدامها في تدريس اللغة
الانكليزية.نعنى بغموض الحدود الدلالية للمفردات إن هذه المفردات لايمكن تحديد أو تعين
سماتها الدلالية. لم يجرى التعامل مع هذه الظاهرة اللغوية قبل الخمسينات من القرن الماضي
والتي اعتبر وجودها في اللغات لأسباب عده من بينها السلوك الانسانى وتأثير المجتمع.
أول من انتبه لهذه الظاهرة اللغوية هو عالم الحاسبات الايرانى الجنسية لطفي زادة الأستاذ في
جامعة كاليفورنيا الامريكيه وذلك من خلال تطويره لنظريةالمجموعه الضبابية   fuzzy set
theory) عام 1965 .وقد اعتبرا لمنطق الضبابي Fuzzy) على أنه الجانب التطبيقي للنظرية
المذكورة.كما لم يجرى التعامل معها بعمق في علم المنطق التقليدي.
لم بهتم بها في علم اللغة وهو العلم المتخصص في دراسة اللغات إلا عدد قليل من علماء اللغة
منهم .Labov,Lakoff and Aitchison
يتألف البحث من قسمين. يستعرض القسم الأول بإيجاز بعض المصطلحات الدلالية ذات
الصلة المباشرة مع فكرة غموض الحدود لدلالية للمفردات لأنها ظاهره دلالية أصلا. من هذه

المصطلحات التي استعرضها هذا القسم هي المصطلحات الخاصة بأنواع المعنى كالمعنى المعجمي والمعنى العاطفي........ الخ.

ينقسم القسم الثاني إلى جزأين تتناول الجزء الأول ظهور هذا النوع من المنطق والذي يسمى بالمنطق الضبابي ومواصفاته واهم الملاحظات النقدية التي وجهت له.تخصص الجزء الثاني في تناول ظاهرة غموض الحدود الدلالية للمفردات محاولاً الوقوف على مواصفاتها بشكل مفصل والأسباب التي تقف وراء وجودها في اللغات الانسانيه.كما ناقش هذا لجزء بعض التطبيقات المعروفة لهذه النظرية وخاصة في مجال تدريس اللغات الاجنبيه وبعض العناوين الأخرى ذات العلاقة.

واختتم البحث بالاستنتاجات وقائمة المراجع.