

Formalizing the Sense Relation of Opposition from Logical Point of View, a Mathematical Linguistics Approach in Persian¹

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Abstract

The present research intends to elaborate on the possibility of formalizing the sense relation of ‘opposition’ in word pairs. In order to do so, firstly, some fundamental concepts from set theory are introduced; main topics covered in this regard include: ‘membership’, ‘inclusion’, ‘union’, ‘intersection’ and ‘difference’. Then some concepts corresponding to propositional logic, which the authors consider necessary for the purpose of the research, are presented. The concepts include logical connectives (‘negation’, ‘conjunction’, etc.) and quantifiers (universal quantifier and existential quantifier). The present paper also applies the concept of ‘function’ from mathematics to present some of the intended formal expressions corresponding to the introduced sense relations.

To set a suitable framework, the authors go over various technical definitions of ‘opposition’ which are introduced as fundamental concepts in linguistics dictionaries as well as semantics textbooks. Sense relation of ‘opposition’ in word pairs can be classified into several sub-categories, all of which are introduced in this paper and the process of formalizing each of them are explained.

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All in all, the present paper presents six different types of sense relation under semantic opposition category which are as follows; ‘antonymy’, ‘gradable opposition’, ‘complementary opposition’, ‘directional opposition’, ‘symmetrical opposition’, and ‘contrast’. Then, it goes over the process of formalizing each of the mentioned sub-categories and introduces a formal translation for every proposed definition. Finally, the present research examines the efficiency of the introduced formal expressions by providing several examples.

The formal expressions of the listed sub-categories are introduced in the following paragraphs in the same order as they are discussed in the paper.

1. Antonymy; $F(x) = -x$. The logic behind the presented relation is that, based of the definition of antonymy, as it can be observed in the binary pairs (dead/alive), the absence or presence of a semantic feature pertaining to one word results in binary pairs which are antonyms; i.e. the meaning of one word equals the negated meaning of the other. So the absence or presence of the semantic feature [living] in the example in question (–living/+living), causes them to be antonyms; therefore, $F(\text{dead})= F(\text{-living})= -(\text{-living})= \text{alive}$.

2. Gradable Opposition;

$$\forall p, \exists q, \forall x \in M \quad p(x) \rightarrow \neg q(x) \quad [(23)]$$

So;

$$p \approx \neg q$$

Relation [(23)]⁴, means that for every single utterance such as proposition p, that is the word x, and x is a member of the Universal Set of words M, there exists an utterance like q which is in opposition with p. For instance, if the word “woman” is a member of M, then there exists a word, “man” which is in opposition with “woman” It is noteworthy that relation [(23)] is a formal expression which is suitable for all kinds of sub-categories of the sense relation of opposition.

⁴ . The numbers in bracket corresponds to the suggested formal expressions presented in the paper.

3. Complementary Opposition;

$$\neg p \rightarrow q \quad [(29)]$$

Therefore, $p \wedge q$ is never a tautology.

For example, $\neg \text{dead} \rightarrow \text{alive}$, therefore, $\text{dead} \wedge \text{alive}$ is never a tautology.

4. Directional Opposition;

$$\begin{aligned} g: X \rightarrow X & \quad [(31)] \\ \forall x \in X; g(x) = x^{-1} \end{aligned}$$

It is worth mentioning that X is a set of semantic features which concern with the concept of 'direction' and the function g reverses $x \in X$ (x is a directional feature). The set an example, if we take x : to depart, then $g(x) = g(\text{depart}) = (\text{depart})^{-1} = \text{arrive}$, that the function g reverses the semantic feature of direction.

5. Symmetrical Opposition;

$$\begin{aligned} f, g: X \rightarrow X & \quad [(32)] \\ \forall x \in X; x = -y \quad f(x) = -g(y) \end{aligned}$$

As it is seen, the relation of reciprocal opposition is defined as "one element is in contrast with the other"; that is they cannot coexist. Examples include pairs of words 'husband/wife', and 'sell/buy'. So, if Mary is John's wife, then John should be Mary's husband. The relation [(32)], defines two functions that turn the very mutual semantic element of x to $-y$ which is in fact the opposite of x . Considering the example 'sell/buy', it is clarified as follows: buy (+to get sth⁵ by paying money) = -(to give sth by receiving money); so, $f(\text{buy}) = (+\text{to get sth by paying money}) = -g(\text{to give sth by receiving money}) = g(\text{sell})$.

6. Contrast; as this relation is a type of antonymy, the very formal expression of [(23)] works for this relation as well.

The efficiency and correctness of the presented formal expressions are discussed in detail in the paper using various examples from Persian.

⁵ . sth : something

In the end, it is concluded that the sense relation of opposition in word pairs (which includes several sub-categories) can be formalized applying concepts from logic, set theory and mathematics.

Keywords; sense relations, words' opposition, opposition, formalizing, words' sense relations, formalizing sense relations.