

Research Paper: The Analysis of Semantic Field in Persian-Speaking Patients With Wernicke's Aphasia



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ABSTRACT

Objectives: Wernicke's aphasia is one of the most prominent focal brain deficits affecting the comprehension abilities of patients while preserving their production abilities. Although a lot of studies in different languages have been conducted to analyze the nature of this deficit, still some controversies exist in this regard. While some research studies attribute this defect to a performance problem, some research highlight competence deficit and hypothesize qualitative problems. This research, considering the lack of sufficient literature in Persian, tries to reconcile this controversy by investigating the nature of the semantic field in Persian-speaking patients with Wernicke's aphasia and to compare their semantic processing abilities with those of healthy controls.

Methods: In doing so, a semantic judgment task was administered to 10 patients with Wernicke's aphasia and their age- and education-matched controls to recognize different semantic relations between a group of words whose meanings were related to each other in some way or another.

Results: The results showed dissociation in the subjects' performance. While patients with Wernicke's aphasia had severe deficits in semantic judgment tasks, healthy control performed very well. This selective performance was also observed in different semantic pairs. Also, patients with Wernicke's aphasia performed poorly in almost all classes of semantic pairs, but the severity of their problems was more prominent in certain semantic categories.

Discussion: The findings, in line with a competence deficit hypothesis, suggest that linguistic items are processed in the mental lexicon as a semantic unit. Hence, linguistic items are categorized in a brain network correlating with each other based on different semantic relationships.

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Highlights

- Persian-speaking patients with Wernicke's aphasia are incapable of recognizing semantic relationships between words.
- The cause of their deficit is their competence, rather than performance.
- Words are stored in the brain in a bundle of a network rather than separate linguistic units.

Plain Language Summary

One of the most serious problems of Wernicke's aphasia as focal brain damage is that patients cannot understand words and sentences. In this study, we analyzed if these patients are capable of understanding the related words. For example, we investigated if they could understand pairs of words whose meanings are opposite; e.g. short vs. tall. The results showed that patients have severe problems recognizing related words compared to healthy people. As a ramification for this problem, speech therapists, should consider this shortcoming and try to emphasize teaching semantically related words.

1. Introduction

The semantic field or semantic domain describes words based on their similar semantic features [1]. The words in a semantic field encompass a general phenomenon. Being a general layer of meaning, the semantic field coordinates words based on their common conceptual framework [2, 3]. Because of its significant importance in the linguistic processing of healthy individuals, some studies have delved into its internal structure. Among these research studies, some are outstanding [4-7].

It is noteworthy to mention that the studies of semantic processing are not confined to healthy individuals. That is, the analysis of semantic processing in neuropsychological diseases like aphasia has always been taken seriously by researchers. Aphasia is a neuropsychological and neuropathological disease that is the result of focal damage to the temporal or frontal lobes of the brain. In this disease, people's comprehensive and productive abilities are damaged affecting their linguistic capabilities more particularly. In this way, While Broca's aphasia affects the productive abilities of people, Wernicke's aphasia negatively affects the comprehensive abilities of people. The different areas of language which are negatively affected in aphasia include semantic processing, advanced syntactic structure, pragmatic and phonetic abilities, semantic processing, and in particular semantic field analysis. They have been considered in previous literature both in patients with Broca's [8-12] and Wernicke's aphasia [13-16].

Although some papers investigated the internal structure of the semantic field of patients with Wernicke in different languages, few studies have concentrated on this issue in the Persian context. For instance, Mastura et al. have analyzed semantic processing in Persian participants [17]. Although in these studies, semantic abilities in neuropsychological and neurodegenerative diseases have been investigated, the analysis of semantic field structure and more importantly its internal structure has not been taken into account seriously.

As a dynamic semantic phenomenon and also due to its intercultural differences in different languages and its relationship to belief systems [3], the semantic field should be investigated in different languages like Persian and in doing so, a more vivid picture of the nature of its probable deficit could be drawn. In Iran, no specific research has yet studied the structure of the semantic field in aphasia. Hence, because of the lack of enough research on analyzing the nature of semantic processing in pathological diseases in general and Persian-speaking patients with Wernicke's aphasia in particular, this study tried to fill in the aforementioned gap in the Persian setting via scrutinizing an important area of language namely semantics. In doing so, we suggest some possible linguistic strategies which could be used to enhance patients' communicative competence. So, the rehabilitative outcome of the research could be robust.

2. Methods

Initially, 15 monolingual Persian-speaking male patients with Wernicke's aphasia were chosen from Mehr

Table 1. Semantic associative subtypes and their definitions

Superordinate	The Noun "a" is a Member of Noun "b"; Lemon and " Fruit"
Attribute	Adjectives describing a feature of the target picture; juicy and tangerine
Contrast coordinate	Members of the same superordinate category; butter and cheese
Identity	The name of the object itself
Function associate	Verbs depicting nouns' functions; ice cream and eat
Functional context	The specific condition or setting in which the target occurs; milk and breakfast
Antonyms	Words having contrastive relationships; tall and short

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Hospital, of whom 12 were chosen following the order of their admission to the hospital. The specific tool to select these patients was Boston Aphasia Battery Subtests of Auditory Comprehension. In the next stage, 2 patients were eliminated from the test because they were too impaired to understand and perform the test accurately.

Ultimately, 10 patients with severe Wernicke's aphasia and 20 age- and education-matched healthy controls were chosen after consulting with their doctors and reviewed their neuropsychological profile. In the case of both groups, written consent was taken based on which all subjects unanimously accepted to take part in the research. The inclusion criteria for the Wernicke's group included: 1. Lack of addiction to alcohol or other drugs; 2. Lack of any other focal damage or any kind of neuropsychological diseases like severe depression or anxiety; 3. Intact visual or comprehension ability in such a way that the participants could perform satisfactorily on the experiment.

The primary test used to assess subjects' semantic network status was the semantic priming test. The rationale for choosing this test was its viability, easy performance, and manipulation. To choose our test's tokens, first of all, 40 flashcards denoting some frequently used nouns and adjectives were chosen. In the next stage, to select appropriate tokens, the reliability and validity of the words were assessed via asking 50 age- and education-matched individuals to select as many semantic associative types as possible based on the pictures drawn on different flashcards. Having participated in the pilot study, all healthy individuals could choose all semantic associative pictures with high reliability (95%). Hence, all the stimuli were chosen for our main test. Before initiating the test, all subjects were instructed on how to conduct the test. That is, all subjects were explained that they were to judge which picture stimuli corresponds

to which target word(s). The semantic associative subtypes to be chosen for analysis and their definitions were shown in Table 1.

Having enumerated the number of correct associative priming that the participants could count and also their performance pattern, the final data were obtained and subsequently analyzed using inferential statistics, including the independent t-test, Duncan and 2-way ANOVA.

3. Results

In Table 2, the percentage of correct associative pictures of each semantic associative subtype has been shown.

As the Table 2 shows, there were significant differences between patients with Wernicke's aphasia and healthy controls both in the number of correct responses they could produce and also in the optimal performance in each semantic subtype.

In Table 3, the subjects' performance in each associative semantic subtype was compared using the independent t-test, Duncan and 2-way ANOVA. Moreover, to compare healthy controls and healthy patients with Wernicke's aphasia in each subcategory, the Pearson correlation coefficient was used.

As the above Table shows, a systematic difference in the structure of semantic associations in either group could easily be detected. That is, while the first semantic associative subtypes chosen by patients with Wernicke's aphasia were identity and contrast coordinates, the healthy controls' priorities in semantic subtype recognition were function and attribute subtypes.

Table 2. Percentage of associative semantic subtypes in number

Semantic Relation	Patients With Wernicke's Aphasia	Healthy Control
Superordinate	37	87
Attribute	25	90
Contrast coordinate	42	78
Function associate	28	93
Functional context	18	89
Antonyms	26	83
Identity	70	88

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Table 3. The subjects' performance in each semantic associative subtype

Semantic Relation	Patients With Wernicke's Aphasia R=	Healthy Control
Superordinate	0.597	(P=0.00, $\chi^2 < 2.16$)
Attribute	0.467	(P=0.001, $\chi^2 < 2.16$)
Contrast coordinate	0.642	(P=0.00, $\chi^2 < 2.16$)
Function associate	0.743	(P=0.03, $\chi^2 < 2.16$)
Functional context	0.327	(P=0.00, $\chi^2 < 2.16$)
Antonyms	0.312	(P=0.02, $\chi^2 < 2.16$)
Identity	0.448	(P=0.00, $\chi^2 < 2.16$)

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4. Discussion

The purpose of our paper was twofold. First, we were going to see if the structure of the semantic field is damaged in severe Wernicke's aphasia and if so, more specifically, and as our second objective, which component(s) of the semantic field was or were probably more severely damaged.

Our results showed that patients with Wernicke's aphasia compared to their healthy counterparts had problems in enumerating sufficient associative semantic categories. That is, much smaller associative lists they could count compared to those of healthy controls on the one hand and also their tendency to choose some semantically unrelated pictures for the target words, on the other hand, corroborates our hypothesis asserting Wernicke's semantic field deficit. This result, consistent with the related literature, demonstrates Wernicke's patients' deficits in the semantic field [13-16, 18, 19]. Moreover, our

research corroborates with Rose and Douglas's study suggesting that knowledge about object attribute and function are among the most determining parameters in Wernicke's patients' semantic field internal structure [20]. Their results showed that semantic field analysis could be an important tool to recognize lexical-semantic impairment in aphasic patients.

Moreover, patients with Wernicke's aphasia tend to choose an identity as their foremost semantic associative subtype on the one hand, and also their preference to opt functional context semantic associative subtype as their ultimate category on the other hand. All provide reliable evidence justifying the deficit not only in the quantity of semantic network but also in its quality proving more fundamental problems in these patients. As Thompson and his colleagues assert, when functional context subtypes of the semantic field are more severely damaged, it will be a defining factor demonstrating semantic field breakdown [16]. In this circumstance, their major se-

semantic deficit could be attributed to storage rather than retrieval representing a more critical semantic processing deficit in these patients.

5. Conclusion

This research as the first in its type tried to shed some light on the nature of the semantic field in two groups of patients and healthy control. As the findings showed, because of damage to the temporal lobe and prefrontal areas of the brain, individuals' semantic fields were damaged interfering with their linguistic performance. A lot of research studies highlight the importance of semantic network and intact semantic ability in both comprehending and producing linguistic stimuli that have so far been analyzed [4-7]. Because of the critical role of the semantic field, speech therapists and neuropsychologists, being aware of this issue, could analyze the structure of the semantic field in Wernicke's aphasia and in doing so, find the results of such studies useful in employing suitable rehabilitative strategies. The outcome of these measures would be Wernicke's patients' better performance in different linguistic contexts. However, as our ultimate comment, it should also be emphasized that our research was conducted on a highly restricted group of patients with Wernicke's aphasia whose number was also limited. Thus, to achieve more comprehensive and conclusive results, other similar complementary studies with more participants, and also more demographic variables like social class or gender could also be taken into consideration.

Last but not least, it is through all these considerations that a more realistic picture of Wernicke's aphasia could be depicted.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed about the purpose of the research and its implementation stages.

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Conflict of interest

The author declared no conflict of interest.

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