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Source-Target Mappings and Sensory Modality Distribution in Persian Synesthetic Metaphors: A Cognitive Corpus-Based Study

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Abstract

Addressing synesthesia as a neurological, perceptual and linguistic phenomenon is a rather new research domain. It is important to be aware of the difference between synesthesia as a special neurological phenomenon, in which the stimulation of one sensory modality triggers stimulation in one or more other modalities on one hand; and sensory integration issues prevalent in developmental disorders in general on the other hand, however both affect cognitive development. Synesthesia may provide a window into perception, thought and language as Ramachandran and Hubbard (2001) explained. Within the realm of Iranian cognitive linguistics, the works of Afrashi (2018), Afrashi & Joulaei (2021) and Joulaei & Afrashi (2021) are the first corpus based cognitive researches on linguistic representations of synesthesia in Persian Language, which used vast linguistic data corpuses, mainly focused on Persian Language Data Base (PLDB). This paper aimed at reaching several objectives: First giving a report on the research domain of linguistic synesthesia status que. Second, discussing synesthesia as a multidisciplinary research domain. Third, providing a linguistic corpus-driven model for linguistic synesthesia in Persian. Forth, presenting synesthesia as a scientific problematic that needs to be researched within neurological developmental research domain.

Keywords: Cognitive Linguistics, Synesthesia, Conceptual Metaphor, Corpus Linguistics, Sense Transfer

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1. Introduction

Synesthesia is a cognitive, neurological and linguistic phenomenon in which the stimulation of one sensory modality triggers stimulation in one or more other modalities. The perception of synesthesia is an inner, complex and personal experience, that is difficult to be conveyed, articulated and communicated. What renders synesthesia a communicable experience is its expression through conceptual metaphors and adjective phrases, which is mentioned by Williams (1976) as synesthetic adjectives. Preminger (1974, p. 839) defines synesthesia as follows: "The perception or description of the perception of one sensory modality in terms of another." Ramachandran & Hubbard (2001) view synesthesia "as a genuine perceptual phenomenon, not an effect based on memory associations or on vague metaphorical speech. The authors identify different subtypes of number-color synesthesia and propose that they are caused by hyperconnectivity between color and number areas at different stages in processing: lower synesthetes may have cross-activation within the fusiform gyrus, whereas higher synesthetes may have cross-activation in the angular gyrus. This hyperconnectivity might be caused by a genetic mutation that causes defective pruning of connections between brain maps". Thus, synesthesia may provide a window into perception, thought and language as Ramachandran and Hubbard (2001) explained. It is important to be aware of the difference between synesthesia as a special neurological phenomenon and sensory integration issues prevalent in developmental disorders in general. This intricate perceptual phenomenon was discovered relatively late in psychology and neuroscience. Perhaps this delay was because reports from synesthetes about this inner, individual, and complex experience closely resembled the speech of individuals with psychosis. Consider, for example, the following real instances of a synesthete's speech (Cytowic, 1989, p. 51):

1. "[…] Paul's name has such an ugly color. It is a gray and ugly color […]."

Or, in another case:

2. "[…] The colors of people's voices draw my attention. Julia's voice is yellow. Like a flame of fire flickering. Sometimes, I become so absorbed in these colors that I cannot comprehend what is being said […]."

Examining such evidence from the speech of synesthetes partly justifies why the analysis of such data has received less attention in linguistics.

The first documented report of synesthesia appeared in a Latin medical treatise by a physician named Sachs in 1812 (Dann, 1998). This report describes the cases of the author and his sister, both of whom experienced intense synesthesia involving colors, sounds, digits, and other numerical data (Ione& Tyler, 2004, p. 59). However, addressing synesthesia as a neurological, perceptual and linguistic phenomenon is a rather new research domain.

Key research questions of the present paper are as follows:

1. Based on a methodological search performed on the Persian Language Database (PLDB), how mappings among source- target domains in the synesthetic metaphors are shaped in Persian Language?
2. What is the most frequent sense in Persian synesthetic metaphors' target domain?

3. What is the most frequent sense in Persian synesthetic metaphors' source domain?

2. Types of Synesthesia

Perceptual synesthesia is most commonly of the graphemic-chromatic type; in this condition, seeing certain letters and numbers elicits the perception of certain colors. In other types of synesthesia, hearing certain phones may lead to the perception of specific colors, or hearing nonlinguistic sounds and musical notes may be associated with the perception of colors. Even in rare types of synesthesia, tasting certain flavors can result in the perception of tactile sensations or geometric shapes. Sometimes, the perception of certain phones can also activate the sense of taste (Davis, 2007, p. 2). As Hubbard & Ramachandran (2003) report, one very common type of synesthesia, originally noted by Francis Galton[1] (1822-1911) but still very little studied, involves what is called the "number line", which runs in families. If asked to visualize numbers, the subject finds that they are arranged in a continuous line extending from one point in the visual field to another remote point- say from the top left corner to bottom right. The line does not have to be straight- it is sometimes curved or convoluted or even doubles back on itself.

The first extensive study of synesthesia was conducted by a psychiatrist named Eugen Bleuler(1857-1939). It was guided by one of his students named Lehmann, who was himself a synesthete. He found that approximately 12% of the 600 synesthetes in the studied sample had vowel-color synesthesia (Bleuler & Lehmann, 1881). In the 21stcentury, the study of synesthesia has gained significant importance and pursued specific objectives, including the genetic basis of synesthesia, sense transfer, synesthesia and memory, and ultimately, the relationship between synesthesia and

3. The Linguistic Representation of Synesthesia

The works of Jakobson (1995), Shen (1997), Ullmann (1951; 1959; 1964), Williams (1976), and Yu (1992; 2000) represent the most significant contributions examining the linguistic representations of synesthesia.

Within the realm of Iranian cognitive linguistics, the works of Afrashi (2018), Afrashi & Joulaei (2021) and Joulaei & Afrashi (2021) are the first corpus based cognitive researches on linguistic representations of synesthesia in Persian Language, which used vast linguistic data corpuses, mainly focused on Persian Language Data Base (PLDB). The Persian Language Database (PLDB), sometimes referred to as the Farsi Language Database (FLDB), established by the Iranian computational linguist and lexicographer, S. M. Assi and his team, contains various corpora in Modern Persian (Farsi), including a selection of samples of contemporary Modern Persian literature, formal and informal spoken varieties of the language, and a series of dictionary entries and word lists producing a corpus of several million words. The process of data entry and text

[1] English polymath and the originator of eugenics.

analysis will be continued to cover the most important samples of all varieties of Modern Persian. Texts are annotated for Part-of-Speech and pronunciation. The aim of PLDB was to establish a linguistic database for the Persian language serving as a main source of information for those who conduct research on any aspect of this language. It is based in the Institute for Humanities and Cultural Studies (Assi, 1997).

Conceptual metaphors are one of the most important linguistic representations of synesthesia (Afrashi, 2018, p, 29-38). The nature of the link between synesthesia and metaphor is obscure, given that synesthesia involves arbitrarily connecting two unrelated things, whereas there is a non-arbitrary conceptual connection between the source and the target domain in metaphor. Basis of metaphor exists in all of us but it is larger and stronger in synesthesia as a result of the cross-activation gene. In this formulation synesthesia is not synonymous with metaphor but the gene that produces synesthesia confers a propensity towards metaphor (Ramachandran & Hubbard, 2001). Such effects may be mediated by a class of neurons in the premotor cortex and parietal lobes called “mirror neurons” (Rizzolatti, Fadiga, Gallese, Fogassi, 1996).

Conceptual metaphors and compound adjectives are two primary means for expressing synesthesia in language. Although synesthesia is a specific perceptual experience that occurs for some individuals, traces of it exist in all languages, particularly in literature. Synesthetic representations in language can even serve as a criterion for language typology, as Ullmann (1959) demonstrated by studying English, French, and Hungarian poetry and examining cross-sense transfers in these languages.

To lay the groundwork for discussing synesthetic metaphors, it is useful to examine several examples:

3. His harsh voice over the phone drew my attention.

4. The sweet scent of her perfume lingered in the air.

5. I like the sharp taste of Southern cuisine.

6. I jumped at the neighbor girl’s purple scream.

In Example 3, synesthesia occurs between the auditory and tactile domains. In Example 4, between the gustatory and olfactory domains; in Example 5, between the gustatory and tactile domains; and in Example 6, between the auditory and visual domains. Examples 3 through 6 represent synesthesia in the form of adjective phrases. The focus of the present paper, however, is the possibility of representing synesthesia through conceptual metaphors. Consider the following examples in this regard:

7. The music sounded transparent and bright.

8. The room was filled with a warm, sweet fragrance.

9. I could feel the weight of his gaze.

Examples 7 through 9 demonstrate the representation of synesthesia through conceptual metaphors. In Example 7, a mapping is established between the target domain of hearing and the source domain of vision. In Example 8, a mapping is created between the target domain of

smell and the source domains of touch and taste. In Example 9, a mapping occurs between the target domain of vision and the source domain of touch.

Even this limited set of examples raises at least three theoretically significant issues. First, it is worthwhile to ask: in sentences containing synesthetic metaphorical expressions, does the verb, which denotes the event, agree with concepts from the source domain or the target domain? As evident from Example 7, the verb "sounded" agrees with the target domain of hearing, whereas in Example 9, the verb "feel" agrees with the source domain of touch. Although a definitive pattern for verb agreement in synesthetic metaphorical expressions cannot be proposed without sufficient evidence at this point, it still seems that this issue can be analyzed in terms of salience. It appears that verb agreement with either the source or target domain in synesthetic metaphors may be related to the cognitive factor of salience. Cognitive salience involves the activation of concepts or aspects of concepts in speech. The flow of speech requires that we can access concepts when needed and employ them in speech processing. The activation of a concept may follow conscious mechanisms whereby a concept becomes the focus of an individual's attention and is processed in their working memory (Anderson, 1983, pp. 118–120; Dean, 1992, p. 35). On the other hand, the activation of a concept can occur through spreading activation, whereby the activation of one concept leads to the activation of another (Anderson, 1983, pp. 86–125). It seems that in synesthetic metaphors, verb agreement with the source or target domain follows the principle of spreading activation. In some cases, the concept in the source domain agrees with and activates the verb; in other cases, the concept in the target domain agrees with and activates it.

Another point that can be raised regarding synesthetic metaphorical expressions is that in such expressions, concepts from the source domain can establish mapping relations with more than one target domain. For instance, in Example 8, the target domain of smell is placed in a mapping relationship with both the source domain of touch and the source domain of taste.

A further important issue, constituting a theoretical problem for synesthetic conceptual metaphors, is that in synesthetic metaphors, both the source and target domains are concrete and experientially accessible, belonging to the domain of senses. The theoretical challenge posed by these metaphors is whether such constructions can be considered metaphors within the framework of conceptual metaphor theory.

The third issue addressed here relates to another concept known as sense transfer. This topic will be discussed in the following section.

4. Sense Transfer

Sense transfer in synesthetic metaphors is a subject that can be assessed as a semantic typological criterion across different languages. Ullmann (1964, p. 86) contends that sense transfer in synesthetic metaphors is not random; rather, it follows a pattern. He examined source and target domains in nineteenth-century French and English poetry and identified three dominant patterns: a) Transfer from lower senses to differentiated senses is more common than the reverse: over 80% of the 2000 examples that he analyzed exhibited this trend; b) The tactile

domain is the most prevalent source domain; and c) In synesthetic metaphors, the auditory domain is the most prevalent target domain. In Ullmann's view, the senses of smell and taste are considered lower, whereas hearing and sight are considered differentiated. Research by Day (1996) confirmed findings (b) and (c) from Ullmann's (1964) study but presented a result contrary to finding (a) from the same research.

What Ullmann introduced as the hierarchy from lower to differentiated senses can be represented as follows:

Touch → Taste → Smell → Hearing → Seeing

Figure 1. *The Hierarchy of Sense Transfer*
(Ullmann 1964)

Based on this hierarchy, it becomes clear that touch is the lowest sense and simultaneously the most prevalent source domain in synesthetic metaphorical mappings across languages, whereas seeing is considered the most differentiated sense. Nevertheless, in Ullmann's research, hearing is considered the most prevalent target domain in synesthetic metaphors. Although this analysis is related to language typology but it could be used as a criterion to evaluate language speakers' synesthetic competence and performance.

Williams (1976) studied synesthetic adjective phrases in everyday English, some other Indo-European languages, and Japanese, also considering historical semantic changes. His findings are presented in Figure 2:

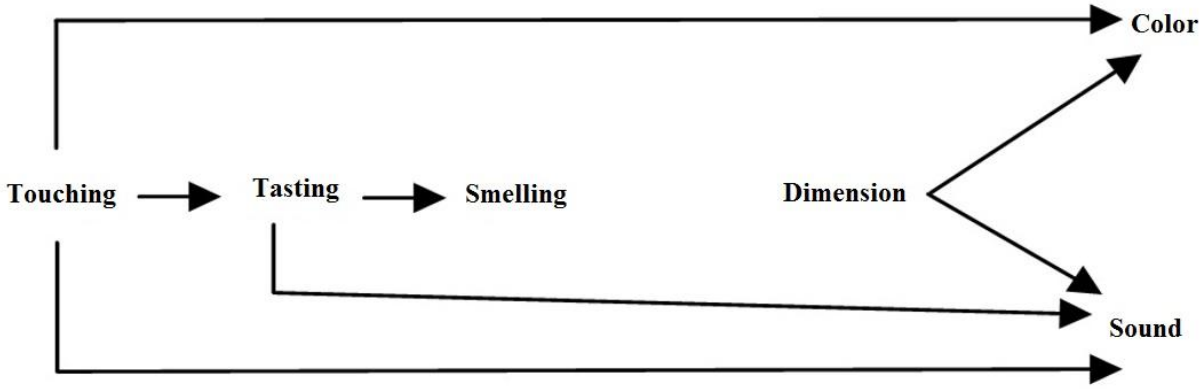

Figure 2. *Sense transfer*
(Williams 1976)

A notable point in Williams' Figure 2 is his division of the sense of seeing into the two classes

of color and dimension. He also notes that in synesthetic metaphors, transfer occurs from the tactile domain to the gustatory, color, and auditory domains. Transfer takes place from the gustatory domain to the olfactory and auditory domains. Transfer occurs from the dimension domain to the color and auditory domains. According to Williams (ibid.), sense transfers that deviate from these patterns are eliminated from the automatized language. In general, based on the findings of Williams' research, the patterns of inter-sense transfer in automatized language align with the results of Ullmann's (1964) research on poetic language. Accordingly, we understand that these two studies have addressed universal principles for sense transfers in the linguistic representation of synesthesia.

Shen (1997, p. 51) addressed the fact that the directionality of sense transfers in synesthesia is governed by a cognitive constraint, according to which mapping proceeds from an accessible, basic cognitive and conceptual domain to a less accessible, less basic domain. In an experimental study based on participant judgments, he found that transfer from a lower sense to a differentiated sense is more natural than the reverse direction. This is why Examples 10 and 11 in Persian are considered unacceptable, whereas Examples 12 and 13 are acceptable:

10. *transparent taste
11. *low-pitched smell
12. grating voice
13. cold color

Examples 10 and 11 are unacceptable because the differentiated senses of seeing and hearing are used as descriptors for the lower senses of taste and smell. In contrast, Examples 12 and 13 are acceptable because the lower sense of touch is used as a descriptor for the differentiated senses of hearing and see

Classen (1993) conducted an ethnographic and cross-cultural study on the ranking of sensory systems. Accordingly, the hierarchy of synesthetic metaphors in English is as follows:

Hearing → Seeing → Smell → Taste → Touch

Figure 3. *Hierarchy of Synesthetic Metaphors*
(Classen1993)

An observation arising from considering the hierarchy of sense transfer (figure1) based on Ullmann (1964), the diagram of sense transfer (figure 2) based on Williams (1976), and the hierarchy of synesthetic metaphors (figure3) based on Classen (1993) is that in all these sensory rankings, touch, taste, and smell are considered the lower senses in that order. However, linguistic and cultural evidence shows slight variation regarding which of vision or hearing holds

a more basic position in metaphorical constructions. This provides a suitable ground for further research.

Yu (2009, pp. 65–81) examined synesthetic metaphors in Chinese. The data for this research were extracted from Chinese novels and short stories. The results of this study also corresponded with the hierarchy of sense transfer presented by Ullmann (1964). Yu identified 11 types of sense transfer in synesthetic metaphors in Chinese, which were: touch to smell, touch to hearing, touch to seeing, taste to hearing, dimension to hearing, dimension to color, color to hearing, hearing to color, dimension to smell, color to smell, and hearing to touch. Moreover, in studies conducted on synesthetic metaphors, elements such as dimension, color, and temperature have been distinctly considered in addition to the five main senses.

5. Synesthetic Metaphors in Persian Language and Concluding Remarks

In the present research the Persian Language Database (PLDB) was searched to find synesthetic metaphors. For this purpose, the search was conducted based on keywords from the lexical domains of each of the five senses. As a result, 50 contemporary texts comprising 2000 sentences were retrieved, selected and analyzed. Finally, 500 sentences containing synesthetic metaphors were identified. The results of this research revealed the following mapping patterns; Therefore, the first research question of the paper: “Based on a methodological search performed on the Persian Language Database (PLDB), how mappings among source- target domains in the synesthetic metaphors are shaped in Persian Language?” was answered as follows:

Smell → Hearing
14. I could *hear* a smell in the air that irritated my nose.

Hearing → Taste
15. I *tasted* a lot of insults and harsh words.

Hearing → Touch
16. She sang *softly*.

Smell → Taste
17. A smell lingered in the air that *bittered* my mouth.

Smell → Touch

18. The air had grown *heavy* with an unpleasant smell.

Seeing → Touch

19. His gaze *weighed* heavily on my body.
20. His gaze *pierced* my heart.

Seeing → Hearing

21. The silence of his gaze bothered me.

Examining the naming patterns of synesthetic metaphors in Persian shows that the senses of taste and touch can serve as source domains for the sense of hearing. The senses of taste, touch, and hearing can serve as source domains for the sense of smell. The senses of touch and hearing are used as source domains for the sense of vision. Analysis of the above naming patterns showed that, with one exception, synesthetic metaphors in Persian follow Ullmann's (1964) hierarchy.

The second question of the research:" What is the most frequent sense in Persian synesthetic metaphors' target domain? ", was addressed as follows:

Among the two senses of seeing and hearing, hearing is used with the highest frequency as the target domain in Persian synesthetic metaphors. "Finally, the third question of the research: "What is the most frequent sense in Persian synesthetic metaphors' source domain? ", was answered as follows: Among the senses that can serve as the source domain in Persian synesthetic metaphors, the sense of touch has the highest frequency.

Synesthesia and synesthetic metaphors are considered relatively new topics in cognitive science and cognitive semantics, with a limited body of research literature. Synesthesia is a specific sensory-perceptual condition experienced by some individuals. Interestingly, however, traces of synesthesia are found in all languages and in the literature of all nations. One criterion for investigating synesthesia in language is the study of patterns of transfer between the senses. Inter-sense transfer can be studied in terms of a hierarchy with the sense of touch at one end and the sense of seeing at the other. This hierarchy has now become a criterion for the semantic typology of languages based on the representation of synesthetic patterns within them. As discussed previously in most languages, including Persian, the sense, most frequently occupying the target domain position in metaphorical mappings is hearing, and the sense most frequently occupying the source domain position in metaphorical mappings is touch. Synesthesia has various neurological, genetic, and linguistic dimensions which are among the significant topics of research during the present decades. Since synesthesia affects both communication and learning, performing research in this field on children and identifying synesthete children in general and synesthete children with special needs would be a valuable achievement. The different forms of synesthesia span the whole spectrum from sensation to cognition and, indeed, this is precisely why synesthesia is so interesting to study.

References

Afrashi, A. (2018). Conceptual metaphor and synesthesia. In *Metaphor and cognition* (pp. 29–38). Institute for Humanities and Cultural Studies.

Afrashi, A., & Joulaei, K. (2021). Synesthesia in Persian: A cognitive and corpus-based approach. *Advances in Cognitive Sciences, 22*(4), 114–123.

Anderson, J. R. (1983). A spreading activation theory of memory. *Journal of Verbal Learning and Verbal Behavior, 22*, 261–295.

Assi, S. M. (1997). Farsi linguistic database (FLDB). *International Journal of Lexicography, 10*(3), 5.

Bleuler, E., & Lehmann, K. (1881). *Zwangsmässige Lichtempfindungen durch Schall und verwandte Erscheinungen auf dem Gebiete der anderen Sinnesempfindungen*. Fues's Verlag.

Classen, C. (1993). *Worlds of sense*. Routledge.

Cytowic, R. E. (1989). *Synesthesia: A union of the senses*. Springer-Verlag.

Dann, K. T. (1998). *Bright colors falsely seen: Synesthesia and the search for transcendental knowledge*. Yale University Press.

Davis, M. (2007). Eighteen rules for writing a code of professional ethics. *Science and Engineering Ethics, 13*(2), 171–189.

Day, S. (1996). Synesthesia and synesthetic metaphors. *Psyche, 2*(32).

Deane, P. D. (1992). *Grammar in mind and brain*. Mouton de Gruyter.

Hubbard, E. M., & Ramachandran, V. S. (2003). The phenomenology of synaesthesia. *Journal of Consciousness Studies, 10*(8), 49–57.

Ione, A., & Tyler, C. (2004). Synesthesia: Is F-sharp colored violet? *Journal of the History of the Neurosciences, 13*, 58–65.

Jakobson, R. (1995). *On language*. Harvard University Press.

Joulaei, K., & Afrashi, A. (2021). *Synesthesia in Persian language*. Neveeseh Parsi.

Preminger, A. (Ed.). (1974). *Princeton encyclopedia of poetics*. Princeton University Press.

Ramachandran, V. S., & Hubbard, E. M. (2001). Synaesthesia—A window into perception, thought and language. *Journal of Consciousness Studies, 8*(12), 3–34.

Rizzolatti, G., Fadiga, L., Gallese, V., & Fogassi, L. (1996). Premotor cortex and the recognition of motor actions. *Cognitive Brain Research, 3*, 131–141.

Shen, Y. (1997). Cognitive constraints on poetic figures. *Cognitive Linguistics, 8*(1), 33–71.

Ullmann, S. (1951). *The principles of semantics*. Jackson, Son & Co.

Ullmann, S. (1959). *The principles of semantics* (2nd ed.). Blackwell.

Ullmann, S. (1964). *Language and style*. Blackwell.

Williams, J. (1976). Synaesthetic adjectives: A possible law of semantic change. *Language, 52*(2), 461–478.

Yu, N. (1992). A possible semantic law in synesthetic transfer: Evidence from Chinese. *The SECOL Review, 16*(1), 20–40.

Yu, N. (2000). Figurative uses of finger and palm in Chinese and English. *Metaphor and Symbol, 15*, 159–175.