An Explanatory Model for the Visual Factors in Semantic Diversification:
A Case Study of a Metaphor-Metonymy Complex

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Abstract: The phenomenon of semantic diversification concerning three-dimensional periphery has been discussed by Schuchardt (1921), mainly in terms of the opposition of concavity/convexity and interior/exterior. The analysis of semantic diversification in the case of multiple languages has revealed an explicit metonymic linkage. However, there is no reason to assume that metonymy is the only basis for such a pattern. In this paper, I attempt to build an explanatory model of this type by utilizing Necker's cube, Glass pattern, and affordance theory, which are a theoretical framework related to perceptual recognition. The results of the discussion indicate the possible projection of a metaphorical element as well as that of a metonymical one.

Keywords: metonymy, Necker Cube, Glass pattern, Affordance

1. Introduction

In the analysis of semantic diversification[1], it is important to elucidate its factors as well as its aspects. The factors of semantic diversification have been examined from a variety of perspectives, i.e. linguistic, social and cultural perspectives. As well as these perspectives, it is also important to consider the physical mediation. This is because we receive stimuli from the outside world that correspond to a certain semantic diversification.

In this paper, in order to explore the bodily factors of semantic diversification, I will refer to the cases of several languages in which both of outer convexity and inner concavity of a certain 3D object can be expressed in the same word. After reviewing the examples, I will propose possible explanatory models that may correspond to the diversification of the meanings. Through the above process of discussion, I aim to highlight the physical aspect, mainly the visual aspect, of the factors that cause semantic diversification.

[1] The “semantic diversification” in this paper denotes the semantic phenomenon of multiplicity defined in Zalizniak (2012), which includes both semantic change as diachronic phenomenon and polysemy as synchronic phenomenon.

The definition of metaphor and metonymy in this paper conforms with that of polysemy established by Seto (2007) as mentioned in the following sections.

2. Previous Studies Revisited: Possibility of Exploring Physical Factors

To begin with, this paper localizes the phenomenon of semantic diversification in words in which two meanings can be expressed in the related previous studies: convex protuberance on the outer side of the three-dimensional periphery and concave depression on the inner side of the three-dimensional periphery. A pivotal study on this topic may be Schuchardt (1921). This study covered cases of words denoting both of outer convexity and inner concavity of a certain 3D object in various languages. The main points of the discussion converge on the opposition of inside/outside and concavity/convexity, the opposition between konvex (convex), a convex protuberance from the viewpoint of outside, and konkav (concave), a concave indentation from the viewpoint of inside. The phenomenon of the opposition between these meanings in the same word is a metonymy based on the physical contiguity of space in the real world defined by Seto (1999), since these meanings are inextricably linked and have a continuous relation between the inside and the outside.[2]

However, is it really possible that the factors that cause the semantic diversification converge only on the oppositional criteria of inside/outside or concavity/convexity? For example, when we see a concave depression on the inside, do we at the same time recall a convex protuberance on the outside? If we do not perceive them at the same time, we rely on our empirical knowledge that an inner concave indentation is likely to be a convex protuberance observed from the outside. Is this a diversification of meaning based solely on metonymical elements?

In order to consider these arguments, I will commence with analyzing examples of words in several languages, which denote either outer convexity or inner concavity of a certain 3D object.

3. Review of Examples

The English word ‘edge’[3] mainly denotes a convex protuberance on the outer side of the three-dimensional periphery:

“Cut out a polygon of any shape. Make a tracing of this on paper; then turn the polygon half-way around

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[2] Seto (2007: 215).

[3] "edge, n.". OED Online. September 2022. Oxford University Press. https://www.oed.com/view/Entry/59504?rskey=cU89xE&result=1&isAdvanced=false (accessed November 20, 2022).

so that one edge may be in a straight line with its former position, and make another tracing."[4]

Unlike edge, the English word corner[5] means both a convex protuberance on the outside of the three-dimensional periphery and a concave indentation on the inside of the three-dimensional periphery in the same word:

"If the kitchen be in the northeast corner of the house, as already recommended, this will bring the dining room into proper relation with it."[6]

"And his name stood as a fixture at the corner of the street, and was often in folks' mouths, being the name of a street—and that was certainly something."[7]

In English, in addition to corner, nook[8], cant[9], and quoin[10] also mean (meant) both senses of concavity and convexity. The following are examples of the two senses indicated by nook:

"On each side of vestibule is a cozy nook, fitted with seat 'and fretwork grilles, and lighted by oval art-glass windows."[11]

"By this faint illumination I saw something in a nook of the street commanded by the windows"[12]

German Ecke is the etymological cognate of the English word edge. Unlike the English edge, which

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4 Campbell (1899: 76).
5 "corner, n.1". OED Online. September 2022. Oxford University Press. https://www.oed.com/view/Entry/41635?rskey=WLbuFa&result=1&isAdvanced=false (accessed November 20, 2022).
6 Osborne (1910: 105).
7 Andersen (1860: 157).
8 "nook, n.". OED Online. September 2022. Oxford University Press. https://www.oed.com/view/Entry/128184?rskey=r4UZRX&result=1&isAdvanced=false (accessed November 20, 2022).
9 "cant, n.1". OED Online. September 2022. Oxford University Press. https://www.oed.com/view/Entry/27196?rskey=C39C55&result=2&isAdvanced=false (accessed November 20, 2022).
10 "quoin, n.". OED Online. September 2022. Oxford University Press. https://www.oed.com/view/Entry/156875?rskey=9e0fRy&result=1&isAdvanced=false (accessed November 20, 2022).
11 Lambert (1894: 10).
12 Chamber's Journal (1850: 229).

mainly indicates the meaning of a convex protuberance on the outer side of a three-dimensional periphery, the German Ecke expresses the meaning of both a convex protuberance on the outer side of a three-dimensional periphery and a concave indentation on the inner side of a three-dimensional periphery. This diversification of both senses in Ecke is a mechanism conforming purely to geometric processes. And precisely because of its geometric nature, it can reflect the human visual structure in which what is projected on the surface of the retina is transformed and interpreted via intermediate representations in the neural pathways.[13] The mechanism of semantic diversification in Ecke can in this sense be regarded as a true reflection of the bodily mechanism. Therefore, this elucidation will contribute to elucidating the somatic factors of semantic diversification primarily in the visual function structure of the human body. A detailed semantic description of Ecke can be found in Paul (2002):

> „Es bedeutet im eigentl. Sinn den Punkt, wo mehrere Kanten zusammentreffen (ahd. mhd. die scharfe Kante selbst), weiterhin aber auch den der eigentl. Ecke zunächst liegenden, von den zusammentreffenden Kanten und Flächen begrenzten Raum."
>
> (Paul 2002: 243)

This description notes that the original meaning of Ecke was point, but then the meaning was extended to the finite space formed by the lines forming that point. Refer to the examples of Ecke below[14]:

> "In dem Ofen, der in einer Ecke des Zimmers stand, brannte noch das Feuer weiter."[15]

> „Ich versprach ihm alles mögliche Stillschweigen, und sah schon im Geist den Titel meiner Piece an den Ecken der Straßen und Plätze mit großen Buchstaben angeschlagen."[16]

Ecke has both of the meanings of a convex protuberance on the outside of a three-dimensional periphery (see the latter example) and a concave indentation on the inside of a three-dimensional periphery (see the former example). Next, we refer to semantic description of the German word Winkel:

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[13] Walter et al. (1987).
[14] The following German examples dealt with in this paper are retrieved from Deutsches Textarchiv(DTA). URL: https://www.deutschestextarchiv.de/
[15] Reichspost. Nr. 6, Wien, 08.01.1895. S.5.
[16] Goethe, Johann Wolfgang von: Aus meinem Leben. Dichtung und Wahrheit. Bd. 1. Tübingen, 1811. S.262.

Winkel

1 geom. >zwei in einer Ebene liegende Geraden, die sich in einem Punkt schneiden<

2 ahd. >Ecke<

daraus abgel. 3 >schmaler Zwischenraum, enger Raum<

(Paul 2002: 1174)

According to this description, the meaning of Winkel has been extended from two straight lines in the same plane that intersect at a point to edge or corner formed by these straight lines, to a finite space composed of outer convexity and inner concavity of a certain 3D object. In other words, Winkel, like Ecke, also encompasses both of these meanings. Refer to the examples of Winkel below:

"Eine kenntliche Stelle des Spielplatzes, z. Exemp. eine kleine Grube, ein Maulwurfshügel, oder der Winkel eines geräumigen Saals -- denn das Spiel lässt sich auch im Hause spielen, wenn Lerm und Staub nicht gescheut werden -- ist seine Wohnung oder eingebildete Höle."[17]

"Wie der Zank im vollsten Gange gewesen, hab' er sich fortgeschlichen, und draussen in einem Winkel der Straße aufgepaßt."[18]

However, it should also be pointed out that there is a difference between the meanings of the two words, Winkel and Ecke. Ecke has the original meaning of angularity, which may have originally indicated the meaning of convex projection on the outer side of the three-dimensional periphery. On the other hand, Winkel indicates both the inner and the outer, convex and concave surfaces which are indicated by its original meaning "curvature". Next, we refer to the semantic description of the Spanish word esquina, which indicates similar meanings:

esquina

s. f.

1 Ángulo formado por dos paredes de un edificio: *Al torcer la esquina se encontró con su amiga Carmen. Su casa hace esquina.*

2 Lugar donde se unen dos lados o caras de una cosa: *la esquina de la mesa.*

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[17] Guts Muths, Johann Christoph Friedrich: Spiele zur Übung und Erholung des Körpers und Geistes. Schnepfenthal, 1796. S.299.

[18] Meißner, August Gottlieb: Kriminal Geschichten. Wien, 1796. S.79.

(Gutiérrez Cuadrado & Bargalló et al. 1996: 667)

In other words, esquina has the meaning of a convex protuberance on the outer side of a three-dimensional periphery. Next, we refer to the description of the meaning of the Spanish word rincón:

rincón

s. m.

1 Ángulo entrante que forman dos superficies, especialmente dos paredes: *el rincón de una habitación. Deja las cosas en un rincón. La encontré llorando en ese rincón.*

2 Lugar oculto o difícil de encontrar: *He mirado por todos los rincones del parque y no lo encuentro. Esta ciudad tiene rincones muy bonitos.*

3 COLOQUIAL. Lugar, generalmente apartado, donde una persona vive o pasa gran parte de su tiempo: *Suelo trabajar en este rincón.*

4 Espacio pequeño: *Te he dejado un rincón para poner tus cosas.*

(Gutiérrez Cuadrado & Bargalló et al. 1996: 1401)

According to Corominas & Pascual's (1991) Etymological Dictionary of Spanish, rincón is derived from the Arabic rukun, which means a concave indentation on the inside of a 3D periphery, contrary to esquina:

RINCÓN, ... procede del árabe vulgar rukún

(Corominas & Pascual 1991: 23)

The semantic description of 'rukn', which etymologically corresponds to the vulgar form of the Arabic word rukun, indicates the meaning 'corner':

ركن rukn pl. اركان arkān

support, prop; corner; nook; basis, basic element, first principle

(Wehr 1976: 359)

[19] انه يحطوك في غرفة مدورة ويقولوا لك دور على ركن

(They put you in a round room and tell you to turn on a corner.)

[19] URL:http://corpus.leeds.ac.uk/cgi-bin/showcontext-cqp.pl?cpos=I-AR-LEMMA.2053524.2053524

This word means inner concavity. Then, refer to the semantic description of the Spanish word ángulo:

ángulo

s. m.

1 GEOM. Figura geométrica formada por dos radios que salen de un punto común o por dos planos que salen de una línea común: *un ángulo de 90°(grados), un ángulo de 180°, medir la abertura de un ángulo.*

2 Saliente formado en la unión de dos planos o superficies: *La pared del pasillo forma un ángulo al llegar a la habitación.* SIN. esquina.

3 Entrante formado en la unión de dos planos o superficies: *el ángulo del pasillo, el ángulo de la habitación.* SIN. rincón.

4 Punto de vista: *Hay que considerar este asunto desde otros ángulos menos estrechos.*

(Gutiérrez Cuadrado & Bargalló et al. 1996: 93)

In this meaning of ángulo, word sense 2 and word sense 3 are opposed as an outward protuberance and an inward indentation. In other words, ángulo indicates both of outer convexity and inner concavity of a certain 3D object. Next, we refer to the Arabic طرف ṭaraf, although only supplementarily:

طرف ṭaraf pl. اطراف aṭrāf

utmost part, outermost point, extremity, end, tip, point, edge, fringe, limit, border; side; region, area, section

(Wehr 1976: 558)

This Arabic word طرف ṭaraf means edge:

بسبب عناية الله استطاع السائق السيطرة على الحافلة وتفادي انقلابها وتدهورها ولكنه اصطدم بالسياج الحديدي الموجود على طرف الشارع [20]

(Because of the providence of Allah, the driver could control the bus and avoid overturn and smashup, but it crashed against the iron fence on the edge of the street.)

This word also has the meanings of region, area, and section, all of which denote space:

[20] Khaleej-2004 Corpus Dataset URL: https://sourceforge.net/projects/arabiccorpus/

لا تعني أن المنّ انقطع عن بني إسرائيل بمجرد وصولهم إلى الأرض العامرة في طرف أرض كنعان ، فإننا نفهم من يشوع 5 : 10 – 12[21]

(It does not mean that the manna was cut off from the Israelites as soon as they reached the fertile land, the marginal region of the land of Canaan, for we understand it from Joshua 5: 10-12.)

The above are examples of words in several languages in which either of outer convexity and inner concavity of a certain 3D object can be expressed. There are several cases in which the same word can be used to express both of these meanings, such as English corner, nook, cant, quoin, German Ecke, Winkel, Spanish ángulo, and so on. Through the examination of these cases, the question arises as to why both of these senses are expressed in the same word while they are expressed in separate words in some cases.

As pointed out in the previous study by Schuchardt (1921), outer convexity and inner concavity of a certain 3D object form an opposition in several words. In addition to the above criteria of opposition, concavity / convexity or inside / outside, the meaning of concave indentation inside the periphery of the 3D, unlike the meaning of convex protuberance outside the 3D periphery, can also denote the concave space formed by its components, which is observed in several examples, including German Ecke, and Arabic طرف ṭaraf. From this point of view, the realm of meaning may be extended in the sense of concave indentation inside the three-dimensional periphery, compared to that of convex protuberance outside the three-dimensional periphery, and it is not simply the case that the two sides of the same object are equally inverted in a somewhat metonymical way. Even if there are potential common elements between the two meanings, can we say that they are limited to the mere metonymical relationship of the two sides of the same object?

In Schuchardt's (1921) previous study, it is assumed that the visual angle of the visual object is consciously changed between the inside and the outside of the same object. However, is such diversification of meaning really due to a conscious change of the visual angle?

The reason why the same word can be used to describe both cases of outer convexity and inner concavity of a certain 3D object may be the elements that they have in common.

4. Development of an Explanatory Model

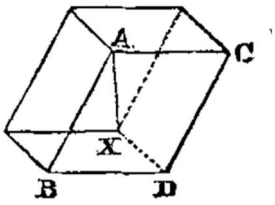
In the following section, three theoretical frameworks on physical functions, (1) Necker cube, (2) Glass patterns, and (3) Affordance theory, will be used as explanatory models to discuss the issues highlighted by the case study above. Using these theoretical frameworks as an explanatory model, I will

[21] URL:http://corpus.leeds.ac.uk/cgi-bin/showcontext-cqp.pl?cpos=I-AR-LEMMA.948951.948951

attempt to explain the physical factors that cause the same word to have diverse meanings: convex protuberance on the outside of the three-dimensional periphery and concave indentation on the inside of the three-dimensional periphery.

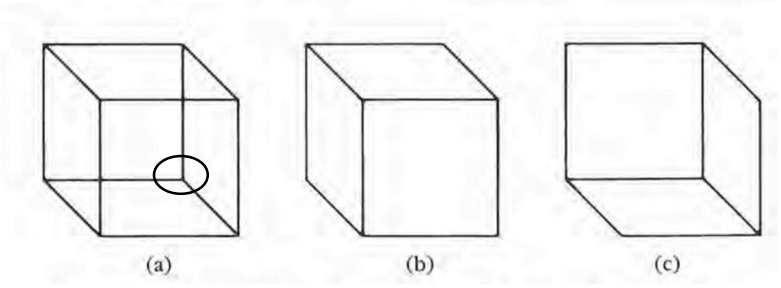
4.1. Necker cube

First, I hypothesize a physical factor for semantic diversification, utilizing Necker's cube as an explanatory model. Necker's cube is a kind of inverted figure discovered by Louis Albert Necker from Switzerland. An inverted figure is an illusionary figure that can be viewed or interpreted in multiple ways at the same time. Necker's cube is a typical example of perspective inversion. A figure of the perspective inversion is a three-dimensional inverted figure that reflects the depth perception in human vision. Other examples of this perspective inversion include "Mach's Book" and "Schröder's Stair". The following is a diagram by Necker (1832):



(Necker 1832: 336)

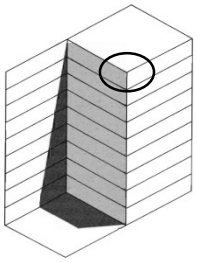
Marr (1982) made this figure plain:



(Marr 1982: 26; I added a circle to this figure.)

When focusing on a certain vertex of the transparent cube shown in the figure (a), two different ways of viewing can occur: one is the figure (b) and the other is the figure (c). If we consider the circled vertex as the center, it appears to protrude outward in the case (c), while it appears to be depressed inward in the case (b). In Necker's cube figure, the visual perception of the object can take several forms without a conscious change of the visual angle between inside and outside. In other words, when the object has a

structure like Necker's cube, the view of the object is not consciously changed between the inside and outside viewpoints, but the object is visually inverted. If we focus on the circled area, the object can be visually inverted without a conscious change of the visual angle of the object. Applying Necker's cube, Marr (1982) also created the figure below:



(Marr 1982: 294; I added a circle to this figure.)

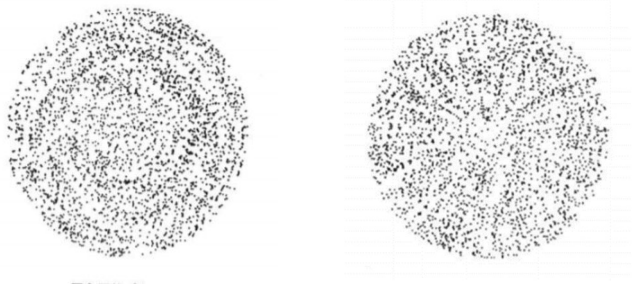
In this figure, the bright and dark areas appear clearly, which can shape the identification more than in the previous figure. According to normal astrophysical laws, sunlight often shines above the field of view, so relatively bright areas located relatively high up and illuminated by light are more likely to be recognized as convex. Thus, the two meanings are different enough to be identified by differences in brightness and darkness. However, it can also be said that the two meanings are so similar that they can only be distinguished by such differences.

In the Necker cube, both outer convexity and inner concavity can be perceived as the same visual object in a somewhat illusional way. They make a perceptual ensemble because of a certain perceptual and geometric similarity in a horizontal level of visual perception. Therefore, it can be deduced that they form metaphor as polysemy based on morphological similarity defined by Seto (2007: 5f.).

4.2. Glass patterns

Next, I will hypothetically explain the physical factor of the semantic diversification by adopting the Glass patterns as an explanatory model, which are also theoretical frameworks of visual structure like Necker's cube. Glass patterns are assemblage of random dots, i.e., random dot patterns, in which various global structures are perceived. This is a typical manifestation of Gestalt perception.[22] The following figures are concentric and radial Glass patterns:

[22] IEICE (2012: 140).



concentric radial

(Wilson & Wilkinson 1998: 2934)

Wilson & Wilkinson (1998) psychophysically measured human detection sensitivity to Glass patterns and found that detection sensitivity became higher in the following order: concentric = > radial = > hyperbolic = > parallel patterns. In other words, it can be derived that humans tend to perceive visual objects in accordance with the pattern of horizontal projection structures on the retina, which may be concentric circles or radial shapes. Advancing this hypothesis may lead to another hypothesis that the area of visual perception tends to expand in accordance with the pattern of horizontal projection structures on the retina, such as concentric circles or radial structures. One of the eye movements closely related to the expansion of the visual recognition area is the convergence-divergence movement. This convergence-divergence motion works in conjunction with the two-way visual system in the brain to expand the recognition space.[23]

And in this viewpoint of the spatial extension of the perceptual world, both outer convexity and inner concavity may be perceived in the same way, for they have in common the extensional potential in the human visual system. Therefore, it can be deduced that they form metaphor as polysemy based on characteristic similarity defined by Seto (2007: 5f.).

4.3. Affordance theory

Finally, I will hypothetically explain the physical causes of the semantic diversification, using affordance theory, a theoretical framework of human behavioral principles, as an explanatory model. Affordance theory, originally developed by James Gibson, a British perceptual psychologist, reconfigures the interrelationship between human beings and their environment based on the dynamic aspect of human beings. The framework of affordance theory has extracted invariant characteristics of the environment and vividly portrayed the principles of human behavior toward their environment that receive these invariant

[23] Goodale & Milner (2004), Goodale et al. (1994), Ungerleider & Mishkin (1982).

characteristics as stimuli.

In “Reasons for Realism”, Gibson, the originator of the affordance theory, describes the invariant properties as follows[24]: When visual components of the external world are projected as stimuli onto the plane of the retina, they maintain their arrangement structure. In this regard, is the three-dimensional array structure of external visual components projected onto the retina as a flat array structure, such as Necker's cube or the Glass patterns? This point of view is expected to be clarified in the future.

Gibson also describes the affordance of surfaces in the environment as follows. [25] The materials in the environment and the surfaces they possess can afford benefits and injuries when they encounter animals with the ability to move around. And the following is a summary of the various kinds of affords with regard to the relationship between the meaning of the convex part and the concave part. A vertical rigid surface stops human moving, affords “mechanical contact”, and becomes a “barrier”. The “sharp” edge, which is formed by two hard surfaces forming an acute angle, affords contact injury. And both of the protrusion and indentation may cause a possible trip. In other words, both convex surfaces that protrude outward (imagine a curb) and concave surfaces that form an inward dent (imagine a dent) can injure people or cause them to stumble, and both have in common what obstacles human movement and their action.

And in this viewpoint of risk management, both outer convexity and inner concavity may be pregnant with equal value or function, for both of them can be a hazard to human life. Therefore, it can be deduced that they form metaphor as polysemy based on functional similarity defined by Seto (2007: 5f.).

5. Conclusion

Based on the above, I will attempt to explain the physical factors of the semantic diversification composed of both of outer convexity and inner concavity of a certain 3D object, utilizing the following body-related theoretical frameworks that I have examined as an explanatory model:

1. Necker cube 2. Glass patterns 3. Affordance theory

Besides the opposition between concavity and convexity or between inside and outside as pointed out in the previous study of Schuchardt (1921), the following factors may be considered as some possibilities:

The visual objects, convex protuberances on the outside of the three-dimensional periphery or concave indentations on the inside of the three-dimensional periphery, have in common the same visual planar structure as Necker's cube. Therefore, it is highly probable that the visual objects are visually

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[24] Reed & Jones (1982: 50).

[25] Reed & Jones (1982: 293). Note that ‘afford’ here approximately means the function or action for humans in the interrelationship between the environment and humans (as a result of the output of environmental variables).

inverted and perceived as visually equivalent objects without any conscious changes of the visual angle to the objects between the inside and outside, i.e., the two sides of the same object. This common basis between the meanings may be equivalent to metaphor as polysemy based on morphological similarity defined by Seto (2007).

It is also likely that the area of visual perception is extended from the convex protuberances outside the three-dimensional periphery to the concave space formed by them in accordance with the pattern of planar projection structure on the retina, which is concentric or radial, similar to the Glass patterns. This common basis between the meanings may be equivalent to metaphor as polysemy based on characteristic similarity defined by Seto (2007).

As pointed out in the “affords” of the environment in the affordance theory, both of outer convexity and inner concavity of a certain 3D object may induce injury or stumbling in everyday life and be obstacles to human movement and behavior. Therefore, there is a possibility that the two are considered to be equivalent in terms of their value for human behavior. This common basis between the meanings may be equivalent to metaphor as polysemy based on functional similarity defined by Seto (2007).

The semantic diversification between a convex protuberance on the outside of the three-dimensional periphery and a concave indentation on the inside of the three-dimensional periphery must on one hand be a metonymy based on the physical contiguity of the spatiotemporal reality of the real world. At the same time, however, it is undeniable that this diversification of meanings includes some metaphorical elements, such as horizontal visual conformity observed in the case of Necker's cube or empirical equivalence in affordance theory, which are recognized as factors for the diversification of meanings. Thus, the foundation of metaphor may be the virtual establishment of simultaneous awareness of perceptual presence and recollection in thought. This foundation can definitely be clarified in the elucidation of the bodily basis through a comparative analysis with metonymy as the phenomenon of semantic diversification, in which a wide variety of factors are intertwined with one another.

The similarities between the two meanings and their respective bodily mechanisms have been highlighted to an explainable level. As a future perspective, it is expected that the similarities between the mechanisms observed in this paper will be analyzed in other cases to elucidate the importance of the physical factors in the whole mechanism of semantic diversification in language.

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意味の多様化現象の視覚的要因の説明モデル

―メタファーとメトニミーの複合体の事例研究―

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立体周縁部に関する意味の多様化現象は、Schuchardt(1921)などにおいて、専ら凹凸・内外という対立軸に限定されて論じられてきた。複数言語の実例を通して、当該の意味の多様化の類型を分析した結果、明示的なメトニミー的連関が観察された。しかし、メトニミーのみが当該類型の基盤であると断定されるべき理由はない。本稿では、ネッカーの立方体・グラスパターン・アフォーダンス理論という知覚的認識に関する理論枠組みを援用しつつ、当該類型の説明モデルを構築することを試みる。考察の結果、従来考えられてきたメトニミーだけでなく、意義間の重層性を基盤とするメタファー的要素をも含むという可能性が示された。